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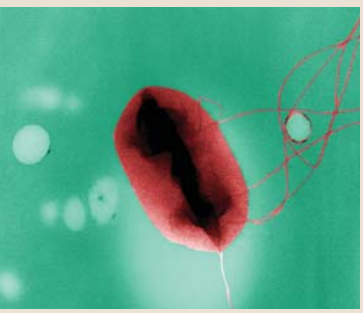

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Update: Accidental Drownings, Active Component, U.S. Armed Forces, 2005–2014

Service members are at risk for unintentional drownings during training, occupational activities, and off-duty recreation. During 2005–2014, there were 1,193 incident episodes of accidental drowning with a rate of 8.4 per 100,000 person-years. Approximately one in six (n=162; 13.6%) of drowning episodes resulted in death. The overall incidence rate of accidental drowning decreased during the surveillance period; however, the death rate remained relatively stable. Incidence rates overall and death rates were relatively high among service members who were male, young, and in either the Navy or Marine Corps. The percentage of cases that were fatal was greatest among black, non-Hispanic service members. The results of this report may be useful to increase awareness regarding the ongoing risks and effects of drowning-related episodes among U.S. service members.

TABLE 1. ICD-9 diagnosis/external cause of injury codes and STANAG[a] injury codes used to define drowning-related episodes

ICD-9	Description
994.1	Drowning and nonfatal submersion
E830	Accident to watercraft causing submersion
E832	Other accidental submersion/drowning in water transport accident
E910	Accidental drowning and submersion
E984	Submersion (drowning), undetermined whether accidentally or purposely inflicted
STANAG[a]	**Description**
150	Water transport accident, involving submersion in boarding and alighting
151	Water transport accident, involving submersion of occupant of small boat
159	Water transport accident, involving submersion, other
860–869	Drowning or submersion, not elsewhere classified

[a]NATO standardization agreement cause of injury code

In the United States, unintentional drowning is the fifth leading cause of unintentional injury death and accounted for an average 3,533 deaths per year during 2005–2009.[1,2] Males and members of racial-ethnic minorities were overrepresented among fatal drowning victims. Among adolescents and adults, alcohol use was involved in approximately 70% of water recreation-related fatalities, and nearly 25% of emergency room visits for drowning.[2] Inability to swim and failure to wear life jackets were also risk factors for drowning among adults.

Many military occupational activities—particularly of the Navy, Coast Guard, and Marine Corps—occur on or near water. Recent accidental drowning deaths of two Navy SEALs at the Combat Swimmer Training Facility at Joint Expeditionary Base Little Creek as well as the 2013 deaths of two Navy divers during a predeployment training exercise at Aberdeen Proving Ground, MD, illustrate that that even the most highly trained and fit personnel can be at risk of accidental fatal drowning during training and diving operations.[3]

Water-related recreational activities in or near water can also be potentially dangerous—particularly for non-swimmers and weak swimmers—in hazardous conditions and settings (e.g., storms, currents, riptides), and when safety measures are not observed.

In 2001, Bell and colleagues reviewed 352 fatal drownings of male U.S. Army soldiers from 1980–1997.[4] The analysis revealed increased risk among soldiers who were relatively young, black, and unmarried. Most deaths occurred during off-duty activities; alcohol use was involved in approximately one-third of the cases. A June 2009 *MSMR* article documented an average of 140 accidental drowning episodes and 20 deaths per year among active component service members during 2004–2008.[5] The findings showed that accidental drownings affected service members who were young, male, unmarried, in the Coast Guard, Navy, or Marine Corps, and in combat-specific occupations. Incidence rates of accidental drowning episodes were lowest among black, non-Hispanic service members compared to respective counterparts; however, the case fatality percentage (i.e., the percentage of drownings that were fatal) was highest among black, non-Hispanics.

This analysis updates and expands on the findings of the June 2009 *MSMR* article. Specifically, the report summarizes counts, rates, and correlates of risk of medical encounters and deaths related to accidental drownings among U.S. military members during 2005–2014.

METHODS

The surveillance period was 1 January 2005 through 31 December 2014. The surveillance population included all individuals who served in an active component of the Army, Navy, Air Force, Marine Corps, and Coast Guard any time during the surveillance period.

For surveillance purposes, the term "drowning-related episode" refers to both fatal and non-fatal drownings, and was defined by a record of a hospitalization or outpatient encounter that included an ICD-9 discharge diagnosis code (in any

diagnostic position), an ICD-9 external cause of injury code, or a NATO standardization agreement (STANAG) cause of injury code that indicated a drowning or submersion injury that was not intentionally inflicted **(Table 1)**; or by a death record with an underlying cause of death of "accidental drowning and submersion." Deaths of service members were ascertained from records maintained in the DoD Medical Registry of the Armed Forces Medical Examiner System (AFMES) and routinely provided to the Armed Forces Health Surveillance Center for integration into the Defense Medical Surveillance System (DMSS). Coast Guard deaths are not included in AFMES, so they are not included in this report.

Cause of injury codes that excluded medical encounters from consideration as cases were ICD-9: E964 "assault by submersion (drowning)"; ICD-9: E954 "suicide and self-inflicted injury by submersion (drowning)"; and NATO STANAG "general class of trauma" codes 3: "assault, or intentionally inflicted by another person" and 4: "intentionally self-inflicted."

If an individual had case-defining medical encounters in both inpatient and outpatient settings, information on the inpatient record was used for the analysis. Individuals could be counted as cases once per calendar year. Incidence rates, including death rates, were calculated using person-time in the denominator. Case fatality percentages were calculated by dividing the number of deaths by the total number of accidental drowning episodes (both those who survived and those who died).

TABLE 2. Incident counts and rates of accidental drownings, active component, U.S. Armed Forces, 2005–2014

	Total		Deaths		
	No.	Rate[a]	No.	Rate[a]	Case fatality %
Total	1,193	8.4	162	1.1	13.6
Sex					
Male	1,086	8.9	153	1.3	14.1
Female	107	5.2	9	0.4	8.4
Age group					
<20	88	9.8	10	1.1	11.4
20-24	495	10.7	69	1.5	13.9
25-29	301	9.0	45	1.3	15.0
30-34	141	6.6	16	0.7	11.3
35-39	88	5.2	12	0.7	13.6
40+	80	5.3	10	0.7	12.5
Marital status					
Married	546	6.9	64	0.8	11.7
Not married	609	10.7	92	1.6	15.1
Other/unknown	38	6.1	6	1.0	15.8
Race/ethnicity					
White, non-Hispanic	849	9.6	91	1.0	10.7
Black, non-Hispanic	112	4.9	28	1.2	25.0
Hispanic	110	7.0	23	1.5	20.9
Asian/Pacific Islander	40	7.0	8	1.4	20.0
American Indian/Alaskan Native	9	5.4	0	0.0	0.0
Others/unknown	73	9.9	12	1.6	16.4
Rank					
Recruit	8	2.9	0	0.0	0.0
Enlisted	1,009	8.7	147	1.3	14.6
Officer	176	7.4	15	0.6	8.5
Service					
Army	359	6.8	62	1.2	17.3
Navy	342	10.4	46	1.4	13.5
Air Force	239	7.2	29	0.9	12.1
Marine Corps	186	9.7	25	1.3	13.4
Coast Guard	67	16.4	n/a	n/a	n/a
Military occupation					
Combat-specific	208	10.9	39	2.1	18.8
Armor/motor transport	80	13.7	7	1.2	8.8
Pilot/aircrew	47	9.0	2	0.4	4.3
Repair/engineer	340	8.2	55	1.3	16.2
Communications/intelligence	203	6.5	26	0.8	12.8
Health care	67	5.6	10	0.8	14.9
Other/unknown	248	9.0	23	0.8	9.3

[a]Rate per 100,000 person-years

RESULTS

During the 10-year surveillance period, there were 1,193 incident episodes of "accidental drowning" (overall incidence rate: 8.4 per 100,000 person-years [p-yrs]); approximately one of six drowning episodes resulted in deaths (n=162, case fatality: 13.6%) **(Table 2, Figure 1)**. In the past 10 years, the fewest cases were in 2012 (n=90) and 2014 (n=92). Overall, incidence rates decreased during the surveillance period; however, death rates remained relatively stable.

Incidence rates (unadjusted) were relatively high among males, service members younger than 25, white non-Hispanics, members of the Coast Guard, Navy, or Marine Corps, and in armor/motor transport or combat-specific military occupations **(Table 2)**.

The overall death rate was 1.1 per 100,000 p-yrs. The death rates were highest among males, service members aged 20–24 years, and those who were unmarried, Hispanic, enlisted, in the Navy or Marine Corps, and in combat-specific occupations. The death rate among black, non-Hispanic service members was lower than the rates of most other race/ethnicity groups, but the case fatality percentage was the highest (i.e., case fatality, overall: 13.6%; black, non-Hispanic: 25.0%; Hispanic: 20.9%).

More accidental drownings occurred in July (n=196) than any other month; slightly more than one-half (54%) of all accidental drownings occurred from May through August **(Figure 2)**.

FIGURE 1. Incidence counts and incidence rates of accidental drownings, by clinical outcome, active component, U.S. Armed Forces, 2005–2014

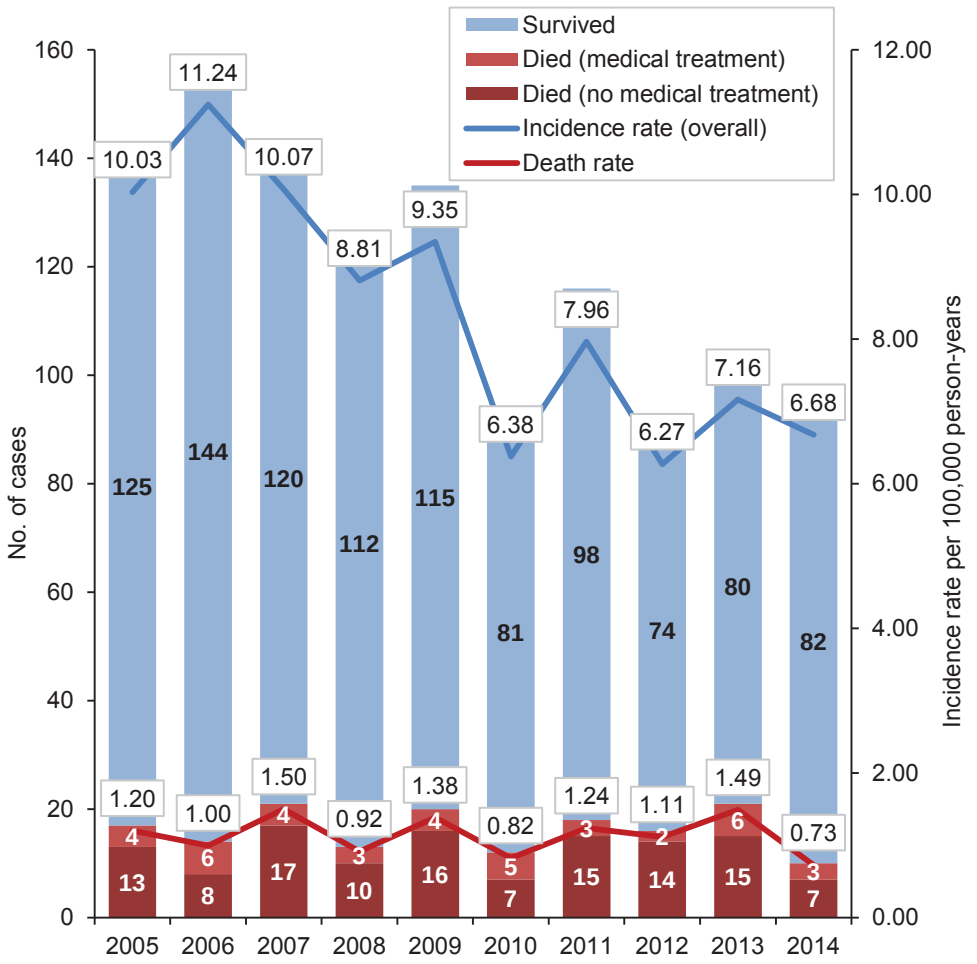
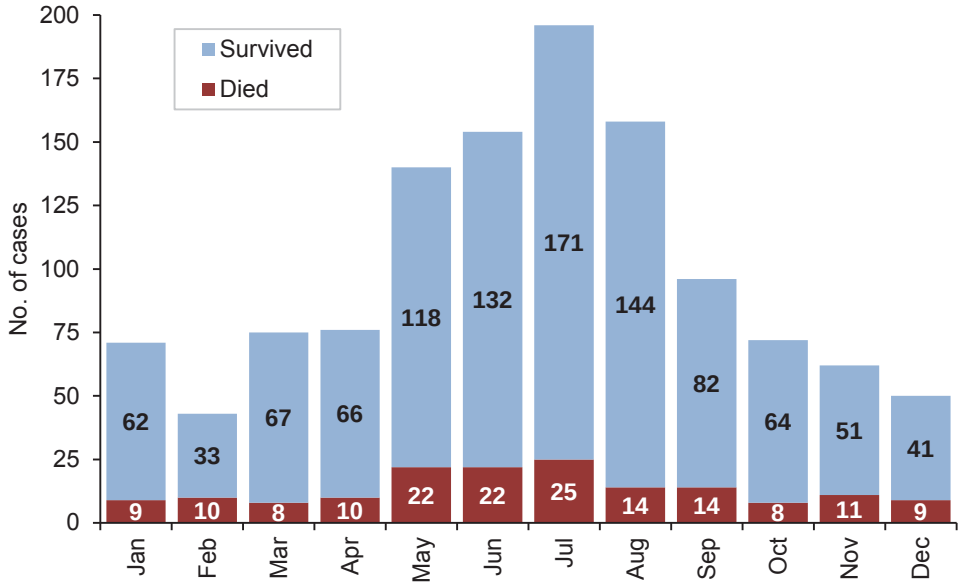


FIGURE 2. Accidental drownings by calendar month and clinical outcome, active component, U.S. Armed Forces, 2005–2014



EDITORIAL COMMENT

This report documents an average of 119 accidental drowning episodes and 16 deaths per year among active component members of the U.S. Armed Forces. In this analysis, the highest rates of drowning-related episodes affected members of the Coast Guard, Navy, and Marine Corps—perhaps due to geographic proximity to, and more frequent, or more prolonged exposures to, potentially dangerous water environments (on and off duty). Of interest, in the Navy, Marine Corps, and Coast Guard, swimming and water survival proficiencies are required for graduation from recruit training. In Army and Air Force recruit training, swimming proficiency is not required and water survival training is not routinely conducted.

Consistent with the findings of an earlier study of fatal drownings among U.S. soldiers, this analysis found relatively high rates (unadjusted) of drowning-related episodes among service members who were young, unmarried, male, and in combat occupations.[4] In contrast to the findings of the earlier study, in which the fatal drowning rate was more than 50% higher among black, non-Hispanic solders than among white soldiers, this analysis documented relatively low rates of drowning-related episodes (fatal and non-fatal) among black, non-Hispanic service members. However, this analysis did demonstrate a higher proportion (25.0%) of fatalities among drowning episodes for black, non-Hispanic service members, particularly for black Marines and soldiers, for whom case fatality percentages were 33.3% and 32.6%, respectively **(data not shown)**.

This analysis has limitations that should be considered when interpreting the results. For example, drowning-related medical encounters were identified from drowning-specific diagnosis and cause-of-injury codes that were reported on standardized electronic medical records. The completeness and accuracy of case ascertainment by these methods are not known; it is possible that many medical encounters for conditions related to water submersion ("near drowning") were not documented with the case indicator codes used for this report. In addition, it is possible that

the data received from the Armed Forces Medical Examiner's office lag in assigning a drowning-related code for some service members' deaths. This would mean that the capture of fatal drownings in this analysis was incomplete—particularly in more recent years.

This analysis summarized drowning-related episodes in relation to demographic and military characteristics. As such, the findings do not account for factors such as swimming proficiency, nature and setting of the drowning episode, frequency and duration of exposure to drowning risk, adherence to routine safety measures, alcohol use, and so on. Absent information related to these factors, novel specific recommendations aimed at prevention are not appropriate. However, the results of this report may be useful to increase awareness regarding the ongoing risks and effects of drowning-related episodes among U.S. service members.

More information about water safety is available from these online resources:
American Red Cross: http://www2.redcross.org/services/hss/tips/healthtips/safetywater.html
Army: https://safety.army.mil/safetycity/pages/water/watersafety.aspx
Navy: http://www.public.navy.mil/comnavsafecen/Pages/ashore/off-duty_rec/WaterSafety.aspx
Air Force: http://www.afsec.af.mil/information/factsheets/factsheet_print.asp?fsID=18526&page=1

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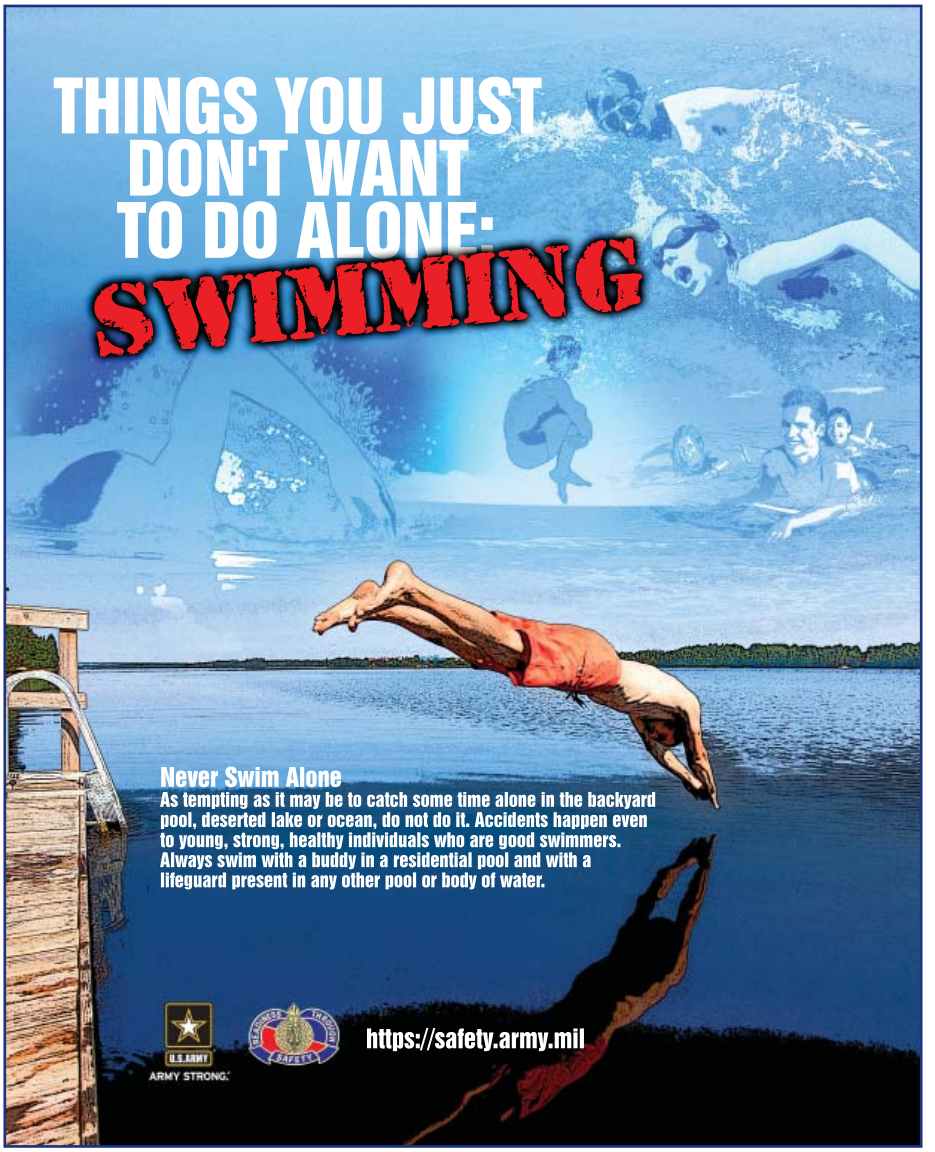

Risk of Mental Health Disorders Following an Initial Diagnosis of Postpartum Depression, Active Component, U.S. Armed Forces, 1998–2010

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Postpartum depression (PPD) is one of the most common psychiatric conditions of the postpartum period. Several studies have found an association between PPD and other mental health disorders. The Defense Medical Surveillance System (DMSS) was used to identify a cohort of primiparous service women with PPD between 1998 and 2010 and match them by month of delivery to a cohort of women without PPD. During the surveillance period, there were 5,203 incident cases of PPD with a crude rate of 44.9 per 1,000 person-years. Individuals in the PPD cohort, when compared to their matched controls, were at higher risk for subsequent depressive disorders (adjusted hazard ratio [HR]: 7.3 [95% CI: 5.2–10.3]), anxiety disorders (adjusted HR: 3.2 [95% CI: 2.5–4.0]), and bipolar disorders (adjusted HR: 4.7 [95% CI: 1.9–11.9]). There were higher rates of these mental health diagnoses among individuals who eventually left service. Early screening, support, and treatment are essential during this vulnerable postpartum time frame to preserve the female fighting force.

Postpartum depression (PPD) is a common psychiatric condition of the postpartum period.[1–4] It is a clinical diagnosis made among women with a history of persistently depressed maternal mood or anhedonia (inability to experience pleasure from activities usually found enjoyable) accompanied by additional supporting symptoms (e.g., change in appetite or body weight, persistent insomnia or hypersomnia, changes in psychomotor activity, persisting fatigue or energy loss, feelings of worthlessness or excessive guilt, persistent concentration or decision-making difficulties, recurring thoughts of death or suicide), which are experienced for at least 2 weeks during the peripartum period.[5] Despite the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V) guidance of a peripartum time specifier (pregnancy through the fourth postpartum week), clinicians and researchers have considered depression arising in the first 12 months after delivery to be postpartum depression.[1,3] When this extended postpartum period has been used, studies have indicated the peak time of PPD onset to be 2–6 months postpartum,[1] with many cases resolving 3–6 months thereafter.[6] Risk factors for PPD include a history of depression, anxiety and depression during pregnancy, stressful life events during pregnancy or the early postpartum period, as well as poor social support.[7]

Prevalence estimates vary with population studied, diagnostic criteria, and time frame considered. The Centers for Disease Control and Prevention (CDC) has reported an 8%–19% self-reported postpartum depression prevalence among U.S. women.[8] This prevalence estimate approximates the combined point prevalence estimates reported by Gavin et al. in a systematic review (7.1%–19.2%).[2] In studies evaluating this condition in military women, published estimates of prevalence have ranged from 9.9% to 20% among active component female members.[9–13]

The public health impact of PPD is substantial, with both mother and infant being adversely affected. Maternal negative affect, marital discord, and suicidality have been linked to infants' impaired social, language, and behavioral development.[3] PPD is also associated with subsequent maternal major depression diagnosis, bipolar disorder, and obsessive compulsive disorder.[14–19]

Few military studies have examined the association between postpartum depression and other mental health disorders. Those active component females who do experience PPD have a 42.2-fold increased adjusted odds of having suicidality in the postpartum period when compared to service women without PPD.[13] Furthermore, deployment less than 6 months after delivery confers a 37% increased risk of mental health issues within 6 months of redeployment when compared to postpartum active component military mothers who were deployed much later, suggesting that the peripartum period may confer additional risk for mental health issues.[20] This analysis evaluates the association between PPD and subsequent incident mental health disorders and investigates differences in lengths of military service ("military retention") among women with and without PPD.

METHODS

The surveillance period was 1 January 1998 through 31 December 2013. The surveillance population included women who had served at any time in the active component of the Army, Navy, Air Force, Marine Corps, or Coast Guard during the surveillance period and who also gave birth for

the first time between 1 January 1998 and 31 December 2010. Service women with any documented mental health diagnoses prior to delivery were excluded.

First-time births, diagnoses of incident PPD, and subsequent mental health diagnoses were derived from records routinely maintained in the Defense Medical Surveillance System (DMSS). These records document both ambulatory encounters and hospitalizations of active component members of the U.S. Armed Forces in fixed military and civilian (if reimbursed through the Military Health System) treatment facilities.

All deliveries occurring during the period from 1 January 1998 through 31 December 2010 were identified by ICD-9: V27.x or ICD-9: 640.xx–679.xx, if they had a fifth digit of 1, 2, or 4, indicating that the service women had delivered or were in the postpartum period. The following delivery types were excluded: ICD-9: 644.0 (threatened premature labor), ICD-9: 644.1 (other threatened labor), and ICD-9: 677 (late effect of complication of pregnancy). If a service woman had multiple deliveries during this period, the "first birth" was considered the earliest delivery (i.e., occurring first by date). If a service woman had only one delivery during this period, for the purposes of this analysis, this was designated a "first birth." It is possible that some women had delivered prior to entering the service.

For this analysis, an incident case of PPD was defined by the presence of any of the codes in **Table 1** in any diagnostic position of the record of a single inpatient encounter, two outpatient encounters, or in a single outpatient visit in a psychiatric or mental healthcare specialty setting (defined by Medical Expense and Performance Reporting System [MEPRS] code: BF). In addition, the diagnosis had to have occurred within the first 12 months after the date of delivery to qualify as an incident case of PPD. A service woman could qualify as an incident case of PPD only once during the surveillance period.

To evaluate the impact of PPD on subsequent mental health diagnosis, all primiparous women were designated as part of either a PPD-exposed cohort or a PPD-unexposed cohort. The exposed cohort comprised primiparous women who had been designated as a PPD case as previously defined. The unexposed cohort (subsequently called the control cohort) comprised primiparous women who had not been designated as a PPD case according to the previously specified criteria. Service women with any previous diagnoses of mental health disorders prior to their delivery were excluded from either cohort.

One non-PPD control was selected for each PPD case. Each control was matched on date of delivery (±1 month). The follow-up period for subsequent mental health disorders for women in the PPD cohort did not begin until 6 months after their qualifying PPD diagnosis so as to allow the PPD episode to resolve before allowing a subsequent mental health diagnosis. For matched controls, follow-up began on the same date. The follow-up period continued until 31 December 2013 or until the occurrence of one of the following censoring events: the service woman left active service, died, or received one of the mental health diagnoses of interest.

An incident case of depressive, anxiety, or bipolar disorder was defined by the presence of any of the codes in **Table 1** in the first or second diagnostic position of the record of a single inpatient encounter (hospitalization), two outpatient encounters, or a single outpatient visit in a psychiatric or mental healthcare specialty setting (defined by MEPRS code: BF). Because the ICD-9 diagnostic codes for PPD and depression are so similar, it was challenging to make a clear distinction between incident PPD and depression, so individuals with a PPD diagnosis who were later diagnosed with depression during the 6-month resolution period were not counted in the subsequent analyses for the incidence of depression.

Members of either cohort who were diagnosed with one of the other mental health diagnoses of interest (anxiety or bipolar disorder) during the 6-month resolution period were excluded from the analysis that examined the incidence of the same mental health outcome after the resolution period. Such exclusions were specific for the mental health condition of interest. Accordingly, a diagnosis of one mental health condition during the resolution period did not result in exclusion of that service member from the

TABLE 1. ICD-9 diagnostic codes for postpartum depression and for subsequent cases of depressive, anxiety, and bipolar disorders

ICD-9 code	Description
Postpartum depression	
296.20–296.25	Major depressive disorder, single episode
311	Depressive disorder, not elsewhere classified
648.44	Mental disorders, postpartum condition or complication
Depressive disorders	
296.2x (x=0–5 only)	Major depressive disorder, single episode
296.3x (x=0–5 only)	Major depressive disorder, recurrent episode
296.5x (x=0–5 only)	Bipolar I disorder, most recent episode (or current) depressed
296.9x	Other and unspecified episodic mood disorder
300.4	Dysthymic disorder
311	Depressive disorder, not elsewhere classified
Anxiety disorders	
300.00–300.09	Anxiety states
300.20–300.29	Phobic disorders
300.3	Obsessive-compulsive disorders
Bipolar disorders	
296.0x (x=0–5 only)	Bipolar I disorder, single manic episode
296.1x (x=0–5 only)	Manic disorder, recurrent episode
296.4x (x=0–5 only)	Bipolar I disorder, most recent episode (or current) manic
296.5x (x=0–5 only)	Bipolar I disorder, most recent episode (or current) depressed
296.6x (x=0–5 only)	Bipolar I disorder, most recent episode (or current) mixed
296.7x (x=0–5 only)	Bipolar I disorder, most recent episode (or current) unspecified
296.80	Bipolar disorder, unspecified
296.89	Other bipolar disorders (Bipolar II, manic-depressive psychosis, mixed type)

examination of the incidence of other mental health conditions.

For example, if a service woman received one of the aforementioned anxiety-related diagnoses in the 6-month resolution period, she was excluded as a case of subsequent anxiety. However, she could still be counted as a case of depression or bipolar disorder if she received one of those diagnoses after the 6-month resolution period.

Crude incidence rates were calculated by dividing the number of cases by the number of person-years of follow-up for each cohort. Cox proportional hazards regression models were developed to assess the influence of PPD on the risk of developing subsequent depressive, anxiety, and bipolar disorders. Hazard ratios (HRs) were adjusted for age, race, marital status, education, rank, and occupation.

Military retention (i.e., time in service after diagnosis) was measured beginning the day after PPD diagnosis for each member of the PPD cohort and her matched control. The length of stay in service was computed by summing the number of months between the time of PPD diagnosis and the end date of the service woman's military service as contained in her demographic record from DMSS or 31 December 2013 (whichever came first). All analyses were performed using SAS System for Windows, version 9.4.

RESULTS

There were 5,203 incident cases of postpartum depression among primiparous active component service members with an overall crude incidence rate of 44.9 cases per 1,000 person-years (p-yrs). Of the 126,006 primiparous service women without histories of previous mental health diagnoses before their deliveries, 4.1% met the criteria for PPD during the 12-month follow-up period. The annual rates of PPD showed a steady trend of increase during the surveillance period **(Figure 1)**. The highest annual overall rate was in 2010 with 61.7 cases per 1,000 p-yrs.

Compared to their respective counterparts, incidence rates of PPD were higher among younger, married, and less educated women and among those who were not deployed within the first postpartum year **(Table 2)**. The overall incidence rate of PPD was higher among active component service women who worked in a healthcare–related field (48.9 cases per 1,000 p-yrs) when compared to combat-related (39.9 cases per 1,000 p-yrs) and all other fields (44.4 cases per 1,000 p-yrs) **(data not shown)**. For each occupational group, annual PPD rates generally increased from 1998 through 2005 and then plateaued (with marked year-to-year variability) through 2010 **(Figure 2)**.

FIGURE 1. Annual incident cases and incidence rates of diagnoses of postpartum depression (PPD), active component, U.S. Armed Forces, 1998–2010

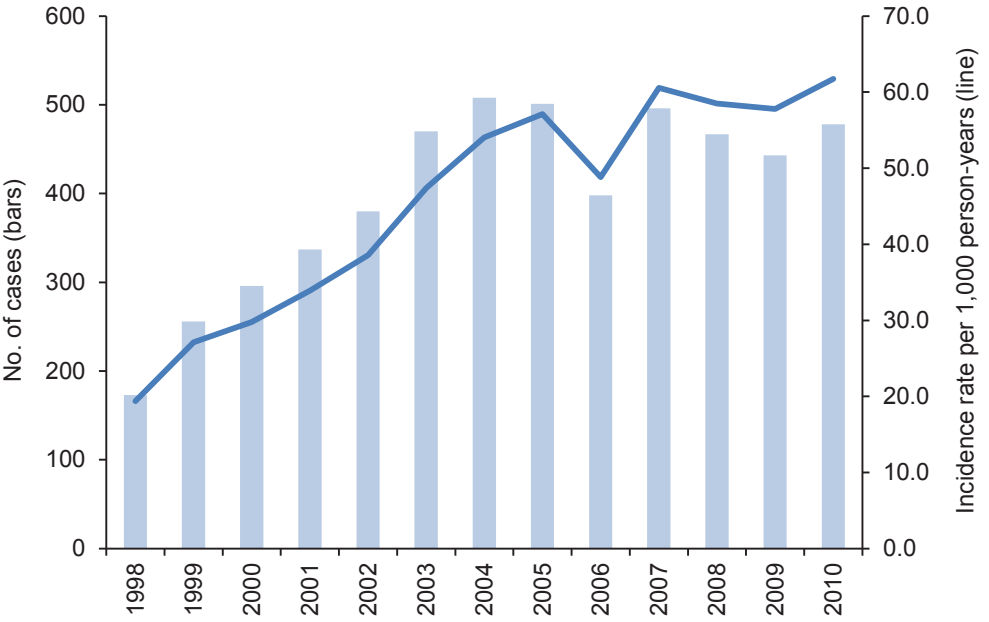


TABLE 2. Incidence rates of postpartum depression (PPD) by demographic characteristics, active component, U.S. Armed Forces, 1998–2012

	Total deliveries	(%)	PPD	(%)	PPD rate[a]	Rate ratio
Total	126,006	100.0	5,203	100.0	44.9	.
Age						
<30 years	107,020	84.9	4,692	90.2	47.0	1.7
≥30 years	18,986	15.1	511	9.8	28.1	Ref
Marital status						
Married	80,665	64.0	3,385	65.0	45.8	1.1
Not married	45,341	36.0	1,818	35.0	43.3	Ref
Rank						
Enlisted	111,307	88.3	4,887	94.0	47.7	3.7
Officer	14,458	11.5	312	5.9	23.4	1.8
Warrant	241	0.2	4	0.07	13.0	Ref
Education						
≤High school	94,144	74.7	4,303	82.7	49.6	1.6
>High school	31,862	25.3	900	17.3	30.8	Ref
Deployment within first year						
No	120,467	95.6	4,978	95.7	45.0	1.0
Yes	5,539	4.4	225	4.3	43.1	Ref

[a]Rate per 1,000 person-years

Analysis evaluating the development of depressive disorders

The study cohorts for this analysis included 2,264 primiparous female active component service members (1,132 in the PPD cohort and their 1,132 matched controls). Excluded were 4,071 PPD cases who were diagnosed with depressive disorders during the 6-month PPD resolution period and their 4,071 matched controls. The average follow-up times were 40.3 months and 53.8 months for the PPD cohort and control cohort, respectively **(data not shown)**. The crude incidence rate of depressive disorders after the 6-month resolution period was 125.5 cases per 1,000 p-yrs in the PPD cohort and 22.3 cases per 1,000 p-yrs in the control cohort, with an overall adjusted HR of 7.3 (95% CI: 5.2–10.3) **(Table 3)**. The trend of higher incidence rates of depressive disorder cases among the PPD cohort when compared to the control cohort continued across time **(Figure 3)**.

Analysis evaluating the development of anxiety disorders

The study cohorts for this analysis included 7,538 primiparous female active component service members (3,769 in the PPD cohort and 3,769 controls). Excluded were 1,434 PPD cases who were diagnosed with anxiety disorders during the 6-month PPD resolution period and their 1,434 matched controls. The average follow-up times were 44.2 months and 57.1 months for the PPD cohort and control cohort, respectively **(data not shown)**. The crude incidence rate of anxiety disorders was 39.8 cases per 1,000 p-yrs in the PPD cohort and 13.6 cases per 1,000 p-yrs in the control cohort, with an overall adjusted HR of 3.2 (95% CI: 2.5–4.0) **(Table 3)**. The trend of higher incidence rates of anxiety disorder cases among the PPD cohort when compared to the control cohort continued across time **(Figure 4)**.

Analysis evaluating the development of bipolar disorders

The study cohorts for this analysis included 8,104 primiparous female active component service members (4,052 PPD cases and 4,052 matched controls). Excluded were 1,151 PPD cases who were diagnosed with bipolar disorders during the 6-month PPD resolution period and their 1,151 matched controls. The average follow-up times were 47.7 months and 58.4 months for the PPD cohort and control cohort, respectively **(data not shown)**. The crude incidence rate of bipolar disorders was 6.3 cases per 1,000 p-yrs in the PPD cohort and 1.2 cases per 1,000 p-yrs in the control cohort, with an overall adjusted HR of 4.7 (95% CI: 1.9–11.9) **(Table 3)**. The trend of higher incidence rates of cases among the PPD cohort when compared to the control cohort continued across time **(Figure 5)**.

FIGURE 2. Annual incidence rates of diagnoses of postpartum depression by occupation, active component, U.S. Armed Forces, 1998–2010

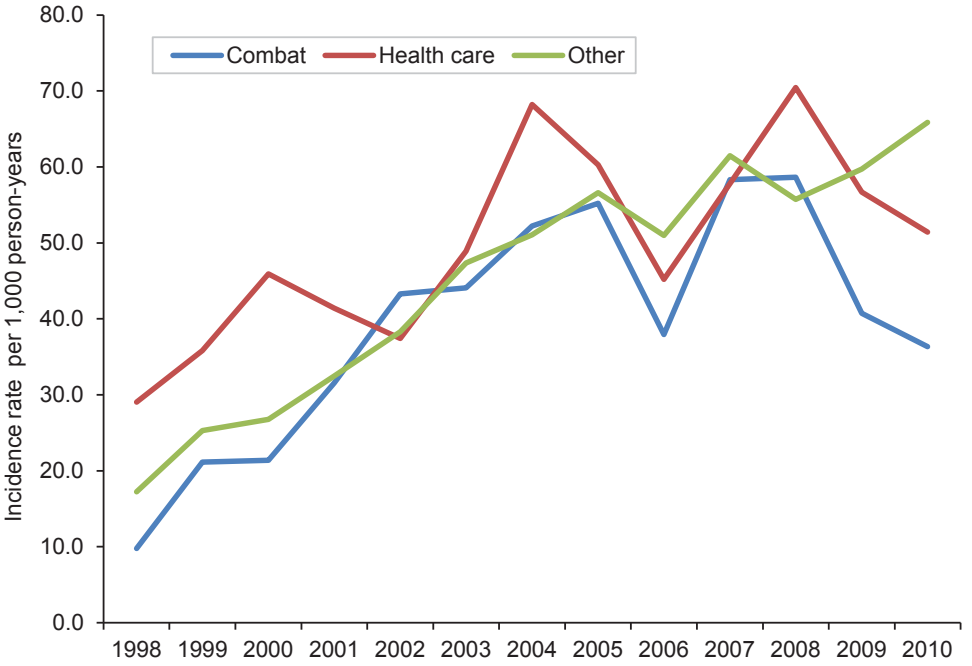


TABLE 3. Mental health disorders associated with postpartum depression (PPD), active component, U.S. Armed Forces, 1998–2012

	Rate[a]	Crude HR	95% CI	Adjusted HR[b,c]	95% CI
Depressive disorders		6.9	5.1–9.4	7.3	5.2–10.3
PPD cohort	125.5				
Control cohort	22.3				
Anxiety disorders		3.3	2.7–4.1	3.2	2.5–4.0
PPD cohort	39.8				
Control cohort	13.6				
Bipolar disorders		4.6	2.5–8.4	4.7	1.9–11.9
PPD cohort	6.3				
Control cohort	1.2				

HR=hazard ratio

[a]Rate per 1,000 person-years

[b]Adjusted for age, race/ethnicity, marital status, education, rank, occupation

[c]Reference is control cohort.

FIGURE 3. Annual incidence rates of depressive disorders by cohort, by year, active component, U.S. Armed Forces, 1998–2010

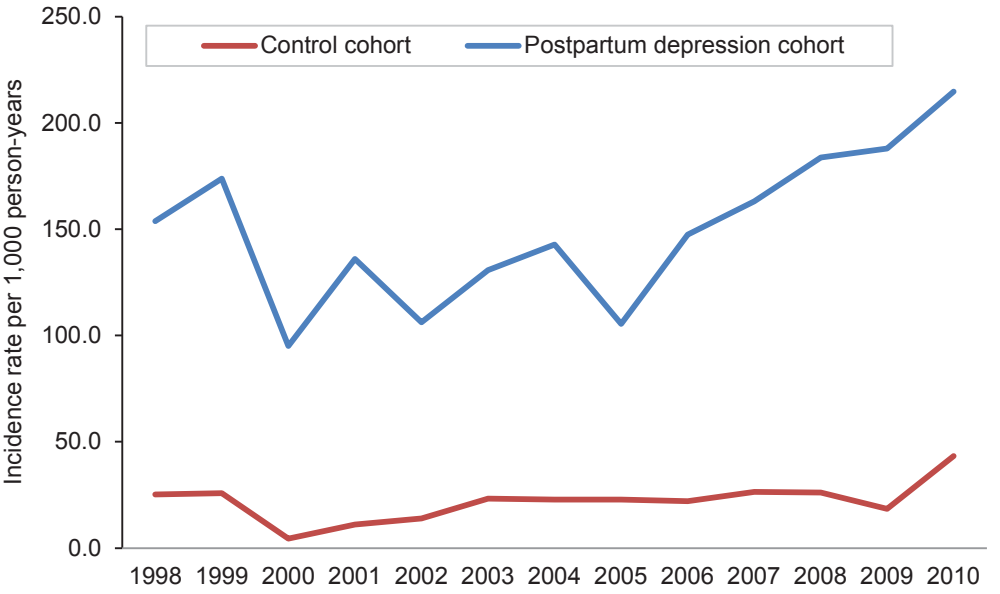
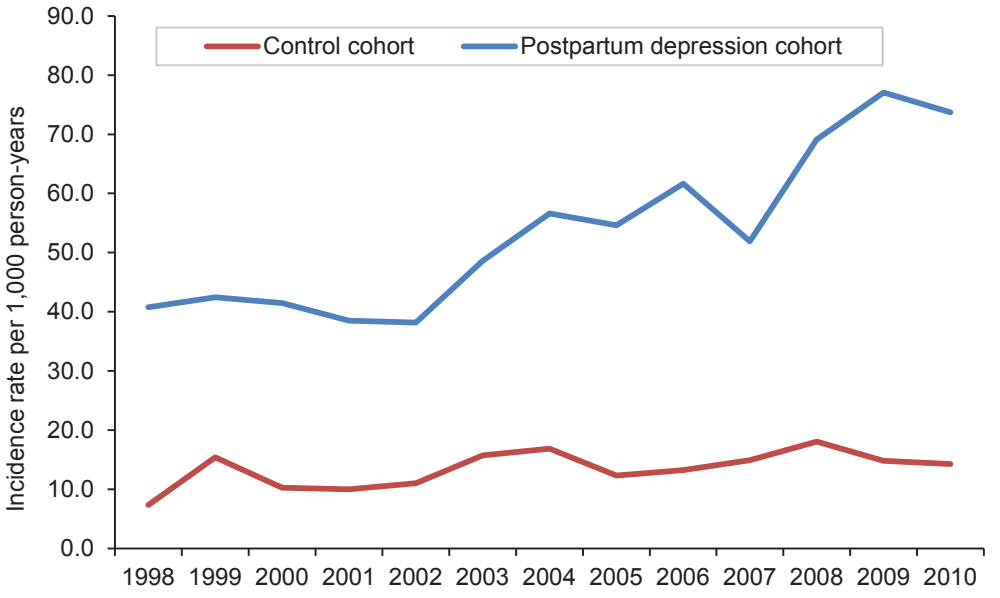


FIGURE 4. Annual incidence rates of anxiety disorders by cohort, by year, active component, U.S. Armed Forces, 1998–2010



Analysis evaluating the duration of military service

For each mental health outcome, the PPD cohort had shorter mean and median durations of subsequent military service than the control cohort **(Table 4)**. Furthermore, the incidence rates of mental disorders were higher among PPD cases than their matched controls and higher among PPD cases and controls who left service compared to those who remained in active service **(Tables 3, 5)**.

EDITORIAL COMMENT

This study defined cases of PPD based on diagnoses of depression among primiparous service women that were recorded during healthcare encounters in the first 12 months after delivery. Using that definition, the analysis identified 5,203 cases of PPD (4.1%) among the 126,006 women who delivered during the 13-year surveillance period. The overall incidence rate was 44.9 per 1,000 p-yrs, but the annual incidence rates rose throughout the surveillance period. Service women who were diagnosed with PPD were found to be much more likely to be subsequently diagnosed with depression, anxiety disorder, or bipolar disorder than women who were not diagnosed with PPD. In addition, women who were diagnosed with PPD, as a group, had shorter periods of subsequent military service when compared to other primiparous service women who were not diagnosed with PPD. The distribution of the incidence of PPD by demographic characteristics was similar to civilian data, suggesting that both populations are affected in a similar way.[7] However, other comparisons with studies of civilian populations should be undertaken cautiously because of unique aspects of this study's methods. In particular, it is noteworthy that, in identifying members of both the PPD cohort and the matched sample (primiparous service women not diagnosed with PPD), women who had been diagnosed with a mental health disorder prior to their delivery were excluded. Because women with prior mental health disorders have a higher risk of developing PPD, the exclusion of such service women from this study likely resulted in a lower overall incidence rate of PPD than if all primiparous service women had been included.

Several limitations to this report should be considered when interpreting results. First, the PPD case definition used may have captured more than what was intended. Inclusion of depressive disorders anytime within the first 12 postpartum months, as is precedent, yielded a higher number of cases (n=5,203) than restriction to just the first 4 weeks postpartum specified by the DSM-V (n=122) or through use of the ICD-9: "mental disease postpartum complication" (n=344). Second, the increasing incidence rate trend of PPD over time may reflect a more general increase in military provider sensitization to mental health issues and diagnoses as years of wartime conflict progressed rather

FIGURE 5. Annual incidence rates of bipolar disorders by cohort, by year, active component, U.S. Armed Forces, 1998–2010

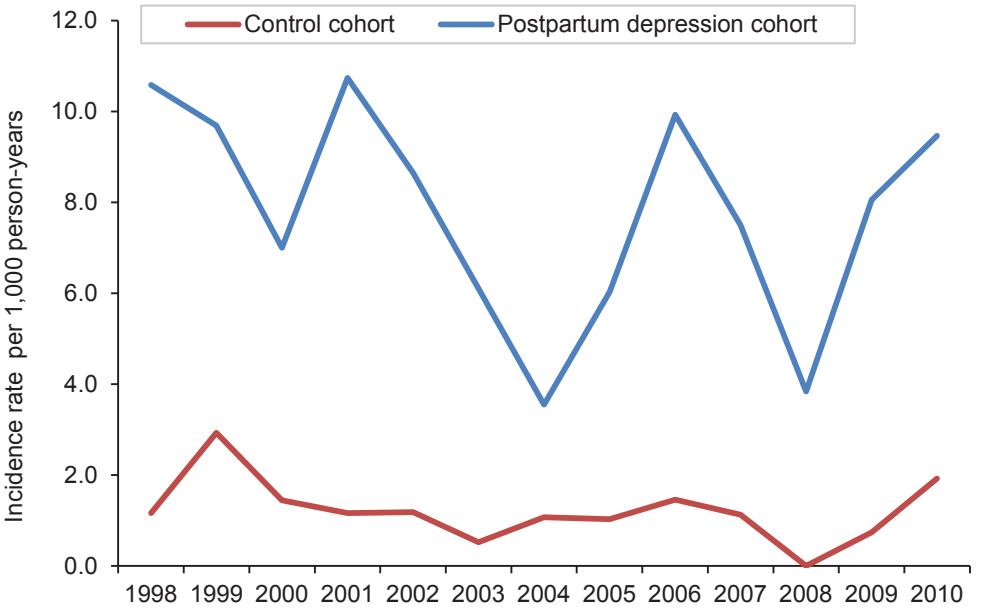


TABLE 4. Mean and median durations of military service for each cohort, by mental health outcomes group

	Total	Mean no. months	Median no. months
Depressive disorders			
PPD	1,132	59.9	51.7
No PPD	1,132	63.5	57.2
Anxiety disorders			
PPD	3,769	54.0	44.0
No PPD	3,769	64.9	56.3
Bipolar disorders			
PPD	4,052	53.7	43.6
No PPD	4,052	64.8	55.6

PPD=postpartum depression

TABLE 5. Subsequent mental health disorders and service retention in service women with and without diagnoses of postpartum depression (PPD), active component, U.S. Armed Forces, 1998–2010

	PPD cohort			Control cohort (no PPD)		
Outcome	No. of cases of outcome	%	Rate[a]	No. of cases of outcome	%	Rate[a]
Depressive disorders[b]						
Still in service	191	40.0	97.1	57	50.4	17.5
Not in service	287	60.0	156.0	56	49.6	30.9
Total	478	.	125.6	113	.	22.3
Anxiety disorders[b]						
Still in service	241	43.7	37.6	134	54.9	12.4
Not in service	311	56.3	41.7	110	45.1	15.5
Total	552	.	39.8	244	.	13.6
Bipolar disorders[b]						
Still in service	19	18.8	2.5	4	17.4	0.3
Not in service	82	81.2	9.7	19	82.6	2.5
Total	101	.	6.3	23	.	1.2

[a]Rate per 1,000 person years
[b]p-value=0.0001

than an actual increase in PPD cases. Third, primiparous women were included regardless of delivery outcomes (live, stillborn), so the accompanying disparate emotional sequelae (depression versus grief) were not distinguished. Fourth, the 6-month resolution period selectively precluded a subgroup of affected women who may go on to have a more chronic form of PPD.[6] In addition, the use of ICD-9 diagnostic codes always carries the potential for misclassification of both exposure (PPD) and outcome (mental health diagnoses). Finally, it is possible that there was ascertainment bias in that the PPD cohort may have contained a disproportionate number of women with better access to providers who were more aware of, sensitive to, and more apt to diagnose, not only PPD but also the other disorders examined in this study.

Despite these cautions, this study has definite strengths. First, it employed a large population-based cohort drawn from the active component of all Department of Defense (DoD) Services and with the capacity for longer-term follow-up. Second, a substantial comprehensive surveillance database was used to characterize this cohort and a sophisticated epidemiologic (dynamic cohort) design allowed for a more nuanced analysis of it. Most importantly, this study fills a void by adding to the understanding of PPD incidence and its association with subsequent incident mental health and work retention issues.

Women who are diagnosed with PPD should be considered to be at higher risk of subsequent development of depressive, anxiety, or bipolar disorders than women not diagnosed with PPD. The association between PPD diagnosis and eventual military attrition emphasizes the need for early identification, treatment, and support for affected individuals to minimize mission

impact. This support should include primary, secondary, and tertiary preventive measures. Ancillary individual and family resilience programs should continue to be developed and encouraged throughout an individual's military career.

Women in the DoD healthcare occupational category appeared to be more often diagnosed with PPD than members of the other categories examined. This observation may be associated with healthcare workers' increased awareness of PPD, willingness to seek treatment, easier access to supportive services, or differential vulnerability to hypothesized cognitive-behavioral or interpersonal precipitating factors.[3,21,22]

In the peripartum period, vigilant depression screening through validated tools (such as the Edinburgh Postnatal Depression Scale of women in the postpartum period) should be used.[23] Individuals who are identified through such screening could then be supported through multidisciplinary teams and further expansion and availability of DoD career intermission programs (DoD authorized temporary break from active duty work), the main goals of which would be to facilitate transition through this vulnerable time.

Disclaimer: The views expressed are those of the author(s) and do not necessarily reflect the official views of the Uniformed Services University of the Health Sciences, the United States Air Force, or the Department of Defense.

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Urinary Tract Infections in Active Component U.S. Armed Forces Women Before and After Routine Screening Pap Examination

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It has been suggested that Pap tests, when used as surrogate markers for routine pelvic examinations in asymptomatic women, may be associated with an increased short-term risk of urinary tract infections (UTIs). This retrospective cohort study used Defense Medical Surveillance System (DMSS) data from 2007 through 2013 to compare the incidence of UTIs in active component women before and after receiving a routine screening Pap examination. The pre-Pap (baseline) UTI incidence rate in this cohort was 105.9 per 1,000 person-years (p-yrs) compared to 129.8 per 1,000 p-yrs post-Pap; the rate ratio was 1.23 (95% CI: 1.18–1.27). The adjusted relative risk of UTI post-Pap was 1.14 (95% CI: 1.10–1.18) and the adjusted percentage of UTIs attributable to a Pap test in the post-exposure period was 12.2% (95% CI: 9.1–15.2). Routine Pap tests, when used as a surrogate marker for pelvic examination, may be a modifiable risk factor for UTI in active component U.S. military women.

In the U.S., routine preventive care visits for women often include a complete pelvic examination that consists of an external inspection, a speculum examination, and a bimanual examination.[1] There is disagreement as to whether the benefits of these screening pelvic examinations outweigh their potential risks. For example, the American College of Obstetrics and Gynecology notes that, although the balance of evidence neither supports nor refutes the value of performing annual complete pelvic examinations in low-risk asymptomatic patients, such annual exams are reasonable for women over the age of 21.[2] However, the American College of Physicians believes that the potential harms associated with screening pelvic examination exceed the available benefits and recommends against them.[3] It is important to note that this difference in perspective does not extend to cervical cancer screening, a well-established intervention that remains very strongly supported by both organizations.

Some of the potential harms cited for routine screening pelvic examinations include a delay in treatment due to a false negative exam, the harms of overdiagnosis and/or overtreatment (of pathology that would be clinically insignificant), and the harms of false positives and the potential risks associated with unnecessary additional diagnostic testing.[4] There are also potential harms associated with the procedure itself, including patient anxiety over the exam, pain related to the instrumentation, and a potential opportunity cost for other preventive medicine engagements (clinical time spent on a pelvic exam cannot be spent on other initiatives).[2,3] A recent pelvic examination has also been proposed as an independent risk factor for symptomatic UTI in women.[3,5,6]

An association between pelvic examination and UTI development is biologically plausible. Speculum examination/instrumentation and associated microtrauma may increase the risk of UTIs in a manner similar to sexual intercourse, a well-established independent risk factor for UTIs in women.[7] In the one available retrospective cohort study that examined this association, one additional UTI was diagnosed for every seven speculum examinations performed.[6] In that study, a routine Pap screening was used as a surrogate exposure for routine pelvic examination in an asymptomatic woman.

In 2008, a total of 9.8 million primary diagnoses of UTI were made in the U.S. with more than half of all the associated clinical encounters occurring in the outpatient/non-hospital-based ambulatory care setting.[8] A potential association between pelvic examination and UTIs in women is of public health significance. Specific to women, UTIs and associated symptoms represent about 2% of all family physician encounters and most of this burden occurs in otherwise healthy, premenopausal, sexually active individuals.[9] A cross-sectional telephone survey revealed that approximately one of nine adult female respondents endorsed UTI symptoms during the prior year and reported that the lifetime prevalence of physician-diagnosed UTIs exceeds 50%.[10]

UTIs also represent a significant burden for women in the U.S. military. During a 14-year surveillance period, 30.4% of women had at least one UTI diagnosed through a medical encounter resulting in a mean annual loss of 4,981 work days.[11] In women who deployed, the incidence of UTI increases from 70.3 per 1,000 person-years (p-yrs) (non-deployed, active component, all service) to 86.7 per 1,000 p-yrs (deployed, active component, female, all services).[11,12] As in the civilian population, rates of UTI in the U.S. military are highest among young and presumed sexually active women.[11]

With the exception of frequency of sexual activity, the major risk factors for UTIs in women tend not to be modifiable (younger age, history of recurrent infections, anatomic abnormalities, and immune deficiency/suppression).[5] From a public health perspective, routine pelvic examination in asymptomatic women may represent a potential target for primary prevention of UTIs and warrants further investigation.

METHODS

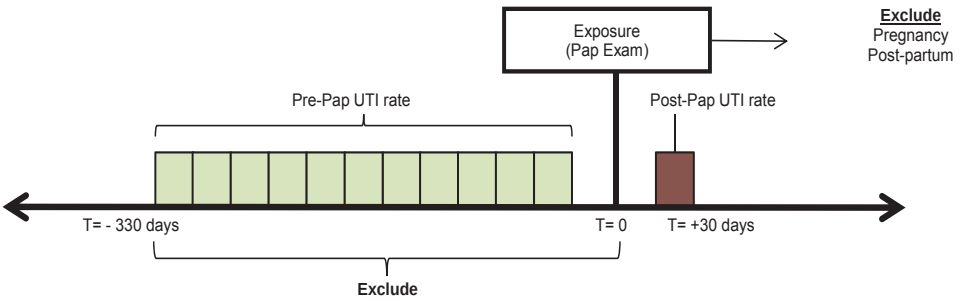
The surveillance population included all active component women in the Army, Navy, Air Force, Marine Corps, and Coast Guard. The surveillance period was 1 January 2007 through 31 December 2013. All data used to determine incident cases were derived from records of both ambulatory encounters and hospitalizations routinely maintained in the Defense Medical Surveillance System (DMSS).

This study used a retrospective cohort before-and-after design **(Figure 1)**. Screening Pap examination was used as a surrogate exposure for a routine pelvic examination in an asymptomatic woman. Rates of UTI in the 11 months pre-Pap were compared to rates of UTI in the 30 days following the exam. The exposure was defined by the presence of an ICD-9 code for a routine Pap screening examination (ICD-9: V76.2, V76.47, V15.89) in any diagnostic position of a service woman's health record. Women who were pregnant (V22.x, V23.x, 630.x–679.x), or who gave birth (V24.x or V27.x) in the 11 months before the identified exposure were excluded. Also excluded were women who did not have at least 11 months of documented military service, who had more than one encounter meeting exposure criteria in 11 months, and those who were diagnosed with UTI on the same day as Pap screening (presumed symptomatic UTI at time of exposure). For the cohort of women who were identified as having undergone a Pap test, health records were searched for the outcome variables of interest during the 11 month pre-Pap, and 1 month post-Pap periods.

The primary outcome measure was UTI defined by the recording of ICD-9 code: 599.0, 595.0, 597.80, or 595.9 (UTI unspecified, acute cystitis, non-sexually transmitted urethritis unspecified, and cystitis unspecified) in the primary or secondary diagnostic position of an inpatient or outpatient encounter. Individuals could have multiple incident UTI episodes recorded during the baseline period; however, each incident episode had to occur at least 30 days after any prior episode (i.e., 30 days of person-time were censored after each UTI encounter during which time women were considered not to be at risk of a new incident UTI). Sexually transmitted infections (STIs) were defined by the recording of either an inpatient or outpatient encounter for chlamydia (099.41 or 099.5), gonorrhea (098.0x, 098.1x, 098.4x, or 0.98.8x), or syphilis (091.x–097.x), in any diagnostic position, or a confirmed reportable medical event for these same conditions.

Incidence rates were calculated for UTI and STI in the time periods before and after Pap smears by dividing the number of cases of UTI or STI by the corresponding calculated person-time. Rate ratios with 95% confidence intervals (CIs) allowed comparisons of relative frequency. Poisson regressions (unadjusted, fully adjusted, and parsimonious models) were used to determine relative risk. All analyses were performed using SPSS version 22.0.

FIGURE 1. Retrospective cohort, before and after exposure (Pap screening examination) study design



RESULTS

During the surveillance period, a total of 322,862 screening Pap encounters were identified among service women eligible for inclusion in this analysis. Consistent with the general age distribution of active component female service members, 86.9% of all exams were performed on women aged 20–39 years **(Table 1)**. There were 30,357 incident diagnoses of UTI identified in the pre-exposure period resulting in a baseline UTI incidence rate of 105.9 per 1,000 p-yrs aggregated over the surveillance period. UTI incidence declined with increasing patient age from 208.2 per 1,000 p-yrs among

FIGURE 2. Annual numbers of care encounters for screening Pap tests, active component service women, U.S. Armed Forces, 2007–2013

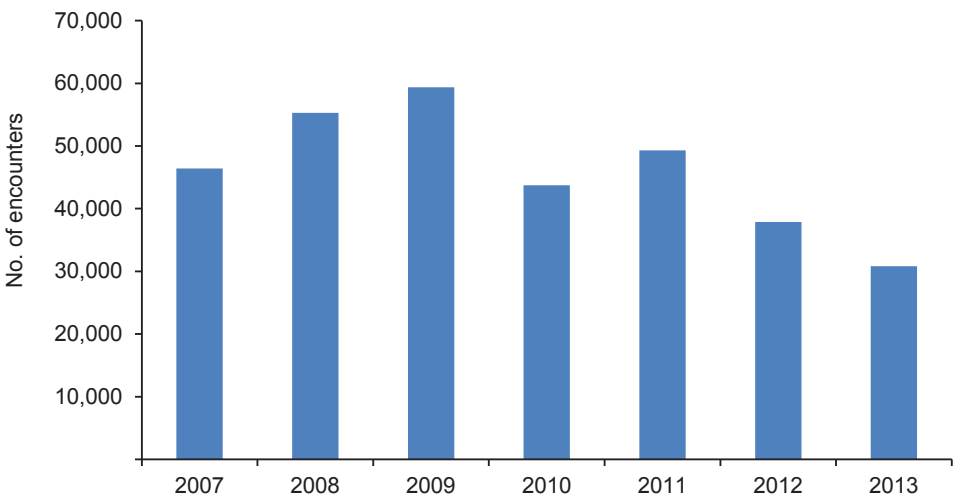


TABLE 1. Frequency counts of screening Pap examinations (exposures), active component, U.S. Armed Forces, 2007–2013

	Year of Pap examination							Total
	2007	2008	2009	2010	2011	2012	2013	
Total	46,397	55,278	59,353	43,712	49,287	37,849	30,806	322,682
Age group								
<20	1,239	1,466	1,561	828	595	191	73	5,953
20–24	14,563	16,934	18,040	12,210	14,743	11,637	9,150	97,277
25–29	12,796	15,454	16,959	12,716	14,926	11,486	8,675	93,012
30–34	7,053	8,703	9,408	7,242	8,157	6,455	5,617	52,635
35–39	5,612	6,579	6,943	5,180	5,380	4,019	3,683	37,396
40–44	3,330	3,975	4,245	3,480	3,466	2,652	2,245	23,393
45-49	1,291	1,562	1,566	1,411	1,403	1,003	943	9,179
50+	513	605	631	645	617	406	420	3,837
Race/ethnicity								
White, non-Hispanic	23,203	27,044	28,996	21,486	23,869	18,379	14,765	157,742
Black, non-Hispanic	13,206	15,526	16,784	12,202	13,846	10,182	8,301	90,047
Hispanic	4,709	6,075	6,490	4,865	5,620	4,353	3,700	35,812
Other	5,279	6,633	7,083	5,159	5,952	4,935	4,040	39,081
Marital status								
Single	19,121	22,487	24,238	17,522	19,855	16,322	13,309	132,854
Married	21,623	25,809	27,458	20,351	22,629	16,549	13,509	147,928
Unknown	5,653	6,982	7,657	5,839	6,803	4,978	3,988	41,900
Rank								
Jr Enlisted (E01–E04)	16,294	19,701	21,870	14,735	18,296	14,280	10,962	116,138
Sr Enlisted (E05–E09)	20,799	24,032	24,641	15,624	18,864	15,542	13,161	132,663
Jr Officer (O01–O04)	7,568	9,367	10,430	10,818	9,898	6,581	5,369	60,031
Sr Officer (O05–O10)	1,293	1,592	1,725	1,708	1,526	1,081	993	9,918
Warrant Officer (W01–W04)	443	586	687	827	703	365	321	3,932
Service								
Army	17,020	22,463	26,051	22,730	24,263	12,665	10,857	136,049
Coast Guard	994	1,136	992	918	834	841	789	6,504
Air Force	18,235	19,297	19,791	10,981	13,567	13,277	9,916	105,064
Marine Corps	1,554	2,034	2,331	1,881	2,442	2,238	1,773	14,253
Navy	8,594	10,348	10,188	7,202	8,181	8,828	7,471	60,812

TABLE 2. Pre-exposure frequency counts and incidence rates of urinary tract infection (UTI), active component, U.S. Armed Forces, 2007–2013

	Year of Pap examination														Pre-exposure total	
	2007		2008		2009		2010		2011		2012		2013			
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	4,601	109.6	5,098	104.0	5,747	109.8	4,039	105.1	4,587	105.1	3,533	105.1	2,752	100.2	30,357	105.9
Age group																
<20	257	231.4	246	188.4	313	226.0	132	179.9	96	181.8	41	242.2	18	277.1	1,103	208.2
20–24	1,853	141.0	2,045	136.7	2,231	140.9	1,514	142.0	1,803	138.2	1,411	136.8	1,100	135.0	11,957	138.9
25–29	1,203	103.8	1,358	99.4	1,554	104.2	1,128	101.2	1,358	103.0	1,025	100.8	764	99.1	8,390	101.8
30–34	620	97.1	661	85.3	767	92.0	559	87.5	650	89.9	518	90.2	414	82.7	4,189	89.4
35–39	354	69.5	434	74.0	485	78.7	370	80.6	370	77.4	286	79.6	264	80.0	2,563	76.8
40–44	211	69.8	234	65.8	285	75.4	234	76.1	200	64.7	176	74.4	127	63.2	1,467	70.2
45-49	77	65.7	85	60.8	81	58.1	72	57.3	76	60.6	63	69.9	48	56.6	502	61.0
50+	26	55.7	35	64.9	31	55.0	30	52.2	34	62.0	13	35.8	17	44.7	186	54.1
Race/ethnicity																
White, non-Hispanic	2,416	115.1	2,644	110.2	2,923	114.2	2,032	107.7	2,302	108.8	1,757	107.6	1,365	103.7	15,439	110.2
Black, non-Hispanic	1,194	99.8	1,297	94.2	1,560	105.3	1,128	105.2	1,198	97.8	910	100.7	691	93.4	7,978	99.8
Hispanic	485	113.9	564	104.6	589	103.1	431	100.6	535	107.5	395	102.2	358	108.4	3,357	105.6
Other	506	105.9	593	100.8	675	108.1	448	98.5	552	104.5	471	107.4	338	93.7	3,583	103.2
Marital status																
Single	1,928	111.4	2,073	104.1	2,381	111.5	1,570	102.0	1,829	103.9	1,484	102.4	1,190	100.3	12,455	105.6
Married	2,058	105.1	2,321	101.0	2,546	104.8	1,826	101.7	2,036	101.4	1,493	101.3	1,177	97.5	13,457	102.2
Unknown	615	120.4	704	114.4	820	122.2	643	126.4	722	120.4	556	126.7	385	108.9	4,445	120.2
Rank																
Jr Enlisted (E01–E04)	2,226	151.5	2,445	140.3	2,868	149.1	1,939	150.5	2,259	139.5	1,787	141.4	1,311	134.5	14,835	144.3
Sr Enlisted (E05–E09)	1,790	95.0	1,927	90.4	2,084	95.9	1,302	94.8	1,509	90.0	1,240	89.6	1,041	88.6	10,893	92.3
Jr Officer (O01–O04)	482	70.2	623	74.6	661	71.5	666	69.6	704	80.7	435	74.3	342	71.3	3,913	73.3
Sr Officer (O05–O10)	71	60.4	66	46.2	77	50.0	81	53.4	62	45.4	43	44.3	39	43.7	439	49.4
Warrant Officer (W01–W04)	32	79.6	37	71.0	57	94.0	51	69.9	53	86.6	28	87.0	19	66.3	277	79.6
Service																
Army	1,793	116.5	2,016	101.0	2,455	106.9	2,130	106.8	2,358	110.6	1,291	115.4	1,009	104.2	13,052	108.4
Coast Guard	118	131.4	134	133.6	107	123.0	110	135.1	95	128.2	97	130.7	75	107.4	736	127.6
Air Force	1,753	106.2	1,840	107.7	1,971	112.7	1,006	104.2	1,224	101.0	1,216	102.8	866	98.0	9,876	105.6
Marine Corps	148	105.2	211	116.7	277	134.7	182	109.8	227	104.1	205	103.0	167	105.7	1,417	111.8
Navy	789	101.4	897	97.7	937	104.1	611	96.1	683	93.6	724	92.0	635	95.2	5,276	97.4

[a]Rate per 1,000 person-years

TABLE 3. Post-exposure frequency counts and incidence rates of urinary tract infection (UTI), active component, U.S. Armed Forces, 2007–2013

	Year of Pap examination														Post-exposure total	
	2007		2008		2009		2010		2011		2012		2013			
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	570	149.0	584	128.2	638	130.5	473	131.4	524	129.0	401	128.6	262	103.2	3,452	129.8
Age group																
<20	27	265.0	21	173.8	35	272.1	15	219.1	11	224.4	2	128.4	0	0	111	226.3
20–24	209	174.0	236	169.1	248	166.8	173	172.0	203	167.0	154	160.4	111	147.0	1,334	166.3
25–29	169	160.1	162	127.2	188	134.5	137	130.8	150	122.0	128	135.2	68	95.1	1,002	130.7
30–34	83	142.9	77	107.4	82	105.9	67	112.3	74	110.1	61	114.7	38	82.1	482	111.2
35–39	48	103.8	54	99.7	50	87.4	38	89.1	44	99.3	33	99.6	24	79.1	291	94.5
40–44	21	76.6	24	73.4	27	77.3	25	87.2	29	101.6	14	64.2	13	70.3	153	79.4
45-49	8	75.5	8	62.2	5	38.8	10	86.2	11	95.0	9	109.1	6	77.3	57	75.5
50+	5	118.1	2	40.1	3	57.8	8	150.4	2	39.4	0	0	2	57.8	22	69.6
Race/ethnicity																
White, non-Hispanic	303	158.5	284	127.5	342	143.1	230	130.0	257	130.8	203	134.0	130	106.8	1,749	134.6
Black, non-Hispanic	158	145.1	152	118.8	153	110.7	134	133.3	139	121.8	97	115.7	61	89.2	894	120.5
Hispanic	60	154.5	62	124.0	69	129.0	53	132.4	62	133.9	45	125.5	31	101.8	382	129.5
Other	49	112.6	86	157.1	74	126.9	56	131.7	66	134.4	56	137.5	40	120.1	427	132.5
Marital status																
Single	246	156.0	253	136.5	253	126.7	188	130.3	208	127.1	169	125.6	115	104.8	1,432	130.8
Married	245	137.5	241	113.3	292	129.1	230	137.2	232	124.4	180	132.0	106	95.2	1,526	125.2
Unknown	79	169.6	90	156.6	93	147.5	55	114.5	84	149.8	52	126.7	41	124.8	494	143.1
Rank																
Jr Enlisted (E01–E04)	261	194.2	273	168.0	321	178.1	229	188.5	249	165.0	190	161.4	118	130.5	1,641	171.4
Sr Enlisted (E05–E09)	227	132.4	236	119.2	238	117.2	130	101.0	194	124.8	152	118.7	107	98.7	1,284	117.5
Jr Officer (O01–O04)	68	109.0	69	89.5	73	85.0	92	103.3	64	78.6	49	90.4	32	72.4	447	90.4
Sr Officer (O05–O10)	9	84.5	2	15.3	2	14.1	14	99.7	8	63.8	6	67.3	3	36.7	44	53.9
Warrant Officer (W01–W04)	5	137.2	4	82.8	4	70.8	8	117.8	9	155.6	4	132.3	2	75.4	36	111.2
Service																
Army	215	153.3	254	137.2	300	139.7	264	141.0	291	145.5	147	140.8	118	131.8	1,589	141.7
Coast Guard	16	194.7	21	223.9	5	61.5	8	106.2	11	160.4	16	230.7	7	107.6	84	156.8
Air Force	204	135.7	189	118.9	222	136.2	114	126.1	123	110.1	119	108.8	66	80.8	1,037	119.8
Marine Corps	26	202.7	23	137.3	25	130.3	24	154.7	26	129.1	26	140.7	14	95.8	164	139.6
Navy	109	153.9	97	113.8	86	102.5	63	106.2	73	108.3	93	127.9	57	92.6	578	115.4

[a]Rate per 1,000 person-years

women younger than 20 years to 54.1 per 1,000 p-yrs for women older than 50 years **(Table 2)**. A pattern of decreasing UTI incidence with increasing military rank was also noted with the highest incidence among junior enlisted members (144.3 per 1,000 p-yrs) and the lowest among senior officers O05–O10 (49.4 per 1,000 p-yrs). There was a trend toward fewer identified routine Pap encounters annually across the surveillance period **(Figure 2)**.

The overall incidence of STI in the baseline period was 9.3 per 1,000 p-yrs. Similar to UTI incidence, STIs rates were inversely related to age ranging from 29.5 per 1,000 p-yrs among women younger than 20 years to 0.3 per 1,000 p-yrs for women older than 50 years. When stratified by age group, STI incidence was strongly correlated with UTI incidence (two-tailed Pearson, $r^2 = 0.96$) with the highest rates of both outcomes occurring in women younger than 20 years **(Figure 3)**. In this cohort, a considerable increase in number of STI diagnoses was observed in the 30 days following a Pap test when compared to baseline **(Figure 4)**.

The post-Pap UTI incidence rate was 129.8 per 1,000 p-yrs aggregated over the surveillance period, on the basis of 3,452 incident diagnoses over 26,589 p-yrs **(Table 3)**. When compared to the baseline UTI incidence, this represents a post-to-pre-exposure rate ratio of 1.23 (95% CI: 1.22–1.23). UTI incidence rate ratios post- versus pre-Pap smear were significantly greater than 1 for each of the covariates examined **(Figure 5)**.

Poisson regression yielded an unadjusted relative risk of incident UTI post Pap of 1.23 (95% CI: 1.18–1.27) when compared to the pre-Pap (baseline) period. When adjusted for age, race/ethnicity, marital status, Service rank, history of UTI in the pre-exposure period, history of STI in the pre-exposure period and calendar year of examination, Pap screening was associated with an increase in the short-term risk of UTI by 14% (95% CI: 10.1%–18.2%) **(Table 4)**. The final parsimonious model limited to a subset of co-variants with established significant univariate effects on UTI risk yielded similar results when compared to the fully adjusted model.

A positive history of UTIs during the pre-Pap period was the strongest risk factor for post-exposure UTI. After adjusting for this association, however, the relative risk of UTI remained significantly elevated. The adjusted attributable risk percentage for Pap examination on UTI diagnosis was 12.2% (95% CI: 9.1%–15.2%). In this cohort, approximately one out of every eight UTIs diagnosed in the 30 days following a routine screening Pap smear may be attributable to that examination.

TABLE 4. Poisson regression model outputs of relative risk (RR) for urinary tract infection (UTI) diagnosis post-exposure

	Crude		Adjusted		Parsimonious	
	RR	95% CI	RR	95% CI	RR	95% CI
Model summary						
Pre-Pap	Ref	Ref	Ref	Ref	Ref	Ref
Post-Pap	1.23	1.18–1.27	1.14	1.10–1.18	1.14	1.10–1.18
Age group						
<20	3.78	3.27–4.38	1.07	0.91–1.25	1.08	0.92–1.27
20–24	2.55	2.22–2.92	1.08	0.93–1.25	1.08	0.93–1.25
25–29	1.88	1.64–2.16	1.04	0.90–1.21	1.04	0.90–1.21
30–34	1.65	1.43–1.89	1.03	0.89–1.20	1.03	0.89–1.20
35–39	1.41	1.23–1.63	1.00	0.87–1.17	1.00	0.86–1.16
40–44	1.28	1.11–1.48	1.01	0.87–1.17	1.01	0.87–1.17
45–49	1.12	0.96–1.32	1.00	0.85–1.17	0.99	0.85–1.17
50+	Ref	Ref	Ref	Ref	Ref	Ref
Race/ethnicity						
White, non-Hispanic	Ref	Ref	Ref	Ref	-	-
Black, non-Hispanic	0.90	0.88–0.93	0.97	0.94–0.99	-	-
Hispanic	0.96	0.93–0.99	0.99	0.95–1.02	-	-
Other	0.94	0.91–0.97	0.99	0.96–1.02	-	-
Marital status						
Single	Ref	Ref	Ref	Ref	Ref	Ref
Married	0.97	0.95–0.99	1.00	0.98–1.03	1.01	0.98–1.03
Other	1.13	1.10–1.17	1.05	1.01–1.08	1.05	1.02–1.09
Service						
Army	Ref	Ref	Ref	Ref	n/a	n/a
Coast Guard	1.17	1.09–1.26	1.04	0.97–1.11	n/a	n/a
Air Force	0.96	0.94–0.99	0.99	0.96–1.01	n/a	n/a
Marine Corps	1.03	0.97–1.08	0.97	0.93–1.03	n/a	n/a
Navy	0.89	0.86–0.92	0.98	0.95–1.01	n/a	n/a
Rank						
Jr Enlisted (E01–E04)	2.95	2.69–3.22	1.11	1.00–1.23	1.1	0.99–1.23
Sr Enlisted (E05–E09)	1.90	1.73–2.08	1.07	0.97–1.19	1.06	0.96–1.18
Jr Officer (O01–O04)	1.50	1.37–1.65	1.05	0.95–1.17	1.05	0.95–1.17
Sr Officer (O05–O10)	Ref	Ref	Ref	Ref	Ref	Ref
Warrant Officer (W01–W04)	1.65	1.43–1.91	1.09	0.94–1.27	1.09	0.94–1.26
History of UTI during the baseline period						
Negative	Ref	Ref	Ref	Ref	Ref	Ref
Positive	150.7	144.7–156.8	148.1	142.2–154.2	148.4	142.5–154.5
History of STI during the baseline period						
Negative	Ref	Ref	Ref	Ref	-	-
Positive	2.09	1.92–2.27	1.16	1.05–1.28	-	-
Year of Pap examination						
2007	1.12	1.08–1.18	1.04	0.99–1.08	-	-
2008	1.06	1.01–1.10	1.01	0.97–1.06	-	-
2009	1.11	1.06–1.16	1.04	0.99–1.08	-	-
2010	1.07	1.02–1.12	1.05	1.00–1.10	-	-
2011	1.07	1.02–1.12	1.02	0.97–1.06	-	-
2012	1.07	1.02–1.12	1.03	0.98–1.08	-	-
2013	Ref	Ref	Ref	Ref	-	-

CI=confidence interval; STI=sexually transmitted infection

EDITORIAL COMMENT

The annual trend toward fewer screening Pap tests across the surveillance period is in keeping with a change in U.S. Preventive Services Task Force recommendations toward performing fewer examinations among defined populations of women established to be at lower risk for cervical cancer. For example, between 2007 and 2011, Pap tests were recommended either annually or at 2- to 3-year intervals for women older than 30 years who had at least three consecutive annual Pap screenings that were documented as normal.[13] However, for the last 2 years of this study's surveillance period, the task force's recommendation changed to performing Pap smears only every 3 years for established low-risk women older than 21 years and every 5 years (when combined with additional measures such as human papillomavirus DNA testing) in similarly low-risk women older than 30 years.[14]

Despite using the same case definition as a previously published report on UTI incidence the U.S. Armed Forces, the baseline UTI incidence in this cohort (105.9 per 1,000 p-yrs) was notably higher than the previously reported rate among active component women (70.4 per 1,000 p-yrs).[11] Potential reasons for this discrepancy include using a different denominator (current study restricted calendar time to before and after a Pap examination) and different surveillance timeframes. Additionally, person-time in this study was censored by 30 days for each incident UTI diagnosis (subjects were not at risk of UTI during these periods) so that the amount of at-risk person-time used for these rate calculations was less than in the previous report.

Several hypotheses unrelated to the Pap examination itself may explain some of the observed increased risk of UTI diagnosis post-Pap. Some women may have consented to submit to a urinalysis as a part of their clinical encounter. Because such testing is generally not indicated for asymptomatic women, the contribution of such "incidental" diagnoses on the overall incidence of UTIs in this cohort is likely to be small. Conversely, additional testing at the time of cervical cancer screening (such as cervical swab collection for STI testing) is commonplace and may explain a considerable amount of the increase in STI diagnoses post-Pap observed in this cohort.

Routine Pap tests may also represent a surrogate marker for sexual activity (a known independent risk factor for UTI development). This might occur, for example, if women tended to schedule routine pelvic examinations in conjunction with STI screening related to a new sexual partner.[6] In 2011, however, the Department of Defense Health Related Behaviors Survey of Active Duty Military Personnel revealed that a majority (67.9%) of married and unmarried active component U.S. military did not report a new sexual partner in the last 12 months.[15] Although it remains possible that a minority of women undergo Pap examination along with STI screening because of a new sexual partner, this is

unlikely to account for a significant number of encounters in this cohort.

Interpretation of the analyses in this report is subject to some limitations. First, diagnoses of interest were ascertained from administrative coding data based on individual health records. Miscoded clinical encounters will affect the accuracy of the available data. Second, the UTI case definition required a single clinical encounter that met the specified criteria and did not require confirmation. This type of case definition (sensitive at the potential expense of reduced specificity) may overestimate incidence. Third, concurrent use of medications at the time of the encounter was not assessed. Women who were taking antibiotics at the time of their Pap examination or during the baseline period may have decreased the risk for UTI. Finally, there are a number of independent risk factors for UTI development that were not excluded from the study or adjusted for in the analysis (e.g., women who are catheter dependent, have neurologic or anatomic abnormalities affecting the genitourinary tract, have depressed immune responses). Given the healthy worker effect, the medical fitness requirements for active component U.S. Armed Forces, and the large sample size investigated, the contribution of these less common UTI risk factors in this specific study population is expected to be low.

There are several strengths of this report. The numbers of Pap examinations

FIGURE 3. Relationship between incidence rates of sexually transmitted infection (STI) and urinary tract infection (UTI) diagnoses in the pre-exposure (baseline) period, by age group aggregated over 2007–2013

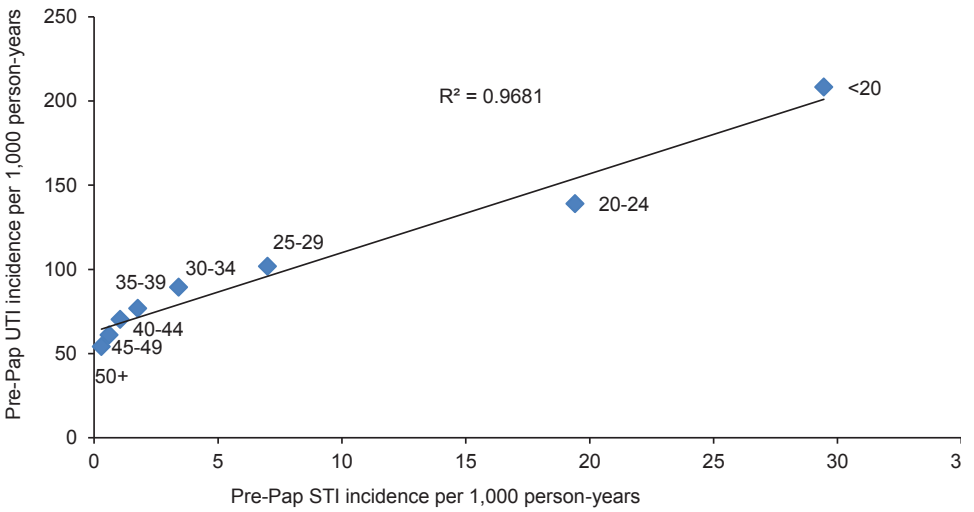


FIGURE 4. Comparison of sexually transmitted infection (STI) and urinary tract infection (UTI) incident rate ratios post- versus pre-exposure, 2007–2013

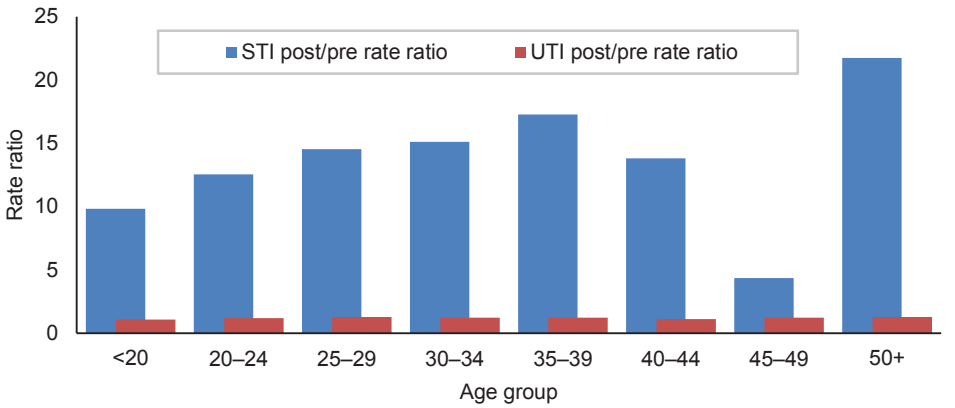
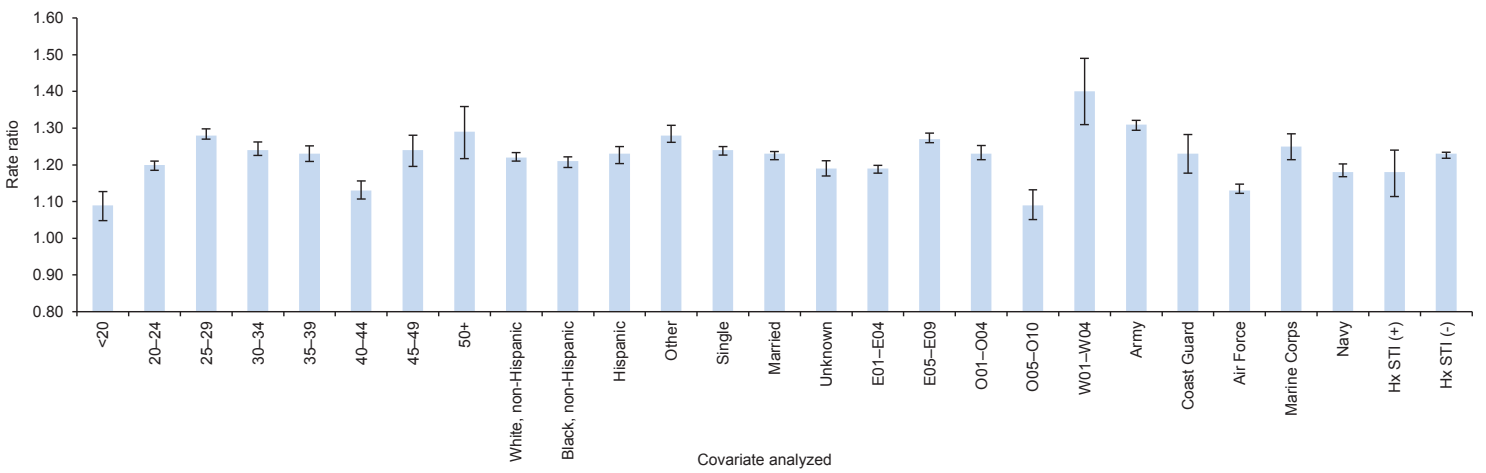


FIGURE 5. Post- versus pre-Pap exposure urinary tract infection (UTI) incidence rate ratios



analyzed were large (322,862) and the nature of the study ensured that individual-level data were available for each of the women before and after their Pap examinations. The use of internal controls in this manner has the benefit of helping to minimize the potential effect of unmeasured and/or unknown confounders on the outcome of interest. This study design also allowed specific adjustment for known confounders, including age, marital status, and previous STI and UTI histories among others. The post-exposure period was limited to 30 days rather than the 60-day post-Pap period used in Tiemestra's report.[6] The biological plausibility of a single short exposure (Pap test) contributing to UTI incidence is arguably strengthened when the at-risk period is more closely related in time to the exposure.

This analysis suggests that women are at greater risk of being diagnosed with a UTI in the month after a Pap smear than they are in the 11 months before it. In this study, Pap tests were used as a surrogate marker for pelvic examinations in asymptomatic women. Given the lack of consensus on whether these encounters provide a benefit to low-risk non-pregnant women, providers may wish to inform their patients of this potential increased risk of UTI following such exams. This information may serve as an additional data point in the shared patient-provider decision-making process that informs a woman's choice to receive a routine screening pelvic examination. In addition, this analysis supports a correlation between STI and UTI incidence in young women, and highlights that young women presenting with UTI symptoms may represent a potential higher-risk subgroup for STI.

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Diarrheal and Respiratory Illness Surveillance During US-RP Balikatan 2014

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Diarrheal and respiratory illness surveillance was conducted during the 2014 Republic of the Philippines–U.S. Exercise Balikatan in the Philippines. Seven stool and three respiratory specimens that met the inclusion criteria were collected. Diarrhea stool specimens were tested with commercial enzyme-linked immunosorbent assay kits and real-time polymerase chain reaction (PCR) for 12 viral, bacterial, and protozoan pathogens. *Campylobacter*, enterotoxigenic *Escherichia coli* (ETEC), and enteropathogenic *Escherichia coli* (EPEC) were detected in four of seven (57%), two of seven (29%), and four of seven (57%) specimens, respectively. There were co-infections of EPEC and ETEC in two cases and EPEC and *Campylobacter* spp. in one case. Respiratory samples were tested using RT-PCR. One of three samples was positive for influenza B. Laboratory-based surveillance is important in determining causative agents for illnesses experienced by military personnel during deployment. Development of vaccines for enteric diseases should be expedited to mitigate their impact on operational readiness.

Acute infectious diarrhea and respiratory infections are leading causes of illness, lost person-days, and significant operational impact among U.S. military personnel, especially in deployed settings.[1–7] Outbreaks due to diarrhea[1,8–10] and respiratory[11–13] infections have been previously documented among deployed military troops. The Republic of the Philippines–U.S. Exercise Balikatan is an annual bilateral military exercise conducted in the Philippines for approximately 2 weeks, during which several thousand troops participate. Incorporating a disease surveillance component during this military exercise is important to determine locally circulating infectious agents where the exercise is being held and for health planners to be informed to make necessary medical interventions for succeeding military exercises.

A diarrheal outbreak occurred during the 2013 Balikatan military exercise wherein approximately 80 U.S. Air Force (USAF) personnel sought care for diarrhea prior to the start of the exercise and 33 cases of gastroenteritis were seen at the U.S. Marine Corps Battalion Aid Station (BAS) at Clark Field during the exercise (data unpublished; personal communication by LT Hammel and LT Raj Singaraju). Unfortunately, the medical support teams were not able to obtain any stool specimens for testing and confirmation because either the service members did not submit stool specimens or they did not give their consent to participate.

Unique conditions in some field deployment locations (i.e., crowded living conditions, unavailability of a potable water supply, contaminated water sources, and unsanitary preparation of food obtained from the local economy) may place military forces at greater risk of outbreaks of respiratory and enteric disease that can have negative effects on operational readiness and efficiency of those forces.[14] This report describes the results from respiratory and diarrheal disease surveillance of service members participating in the Republic of the Philippines–U.S. Exercise Balikatan 2014.

METHODS

The Exercise Balikatan study was conducted 5–15 May 2014 and covered three sites: Clark Air Base BAS and the Hotel Stotsenberg clinic (both located within Clark Air Base), and the BAS at Crow Valley. These medical units were responsible for medical support to approximately 2,500 U.S. military personnel from the 31st Marine Expeditionary Unit and an aviation combat element deployed at Clark Air Base. Crow Valley is located at Capas, Tarlac, and is approximately 30 miles from Clark Air Base. Crow Valley served as a bombing/gunnery range for the annual Balikatan exercise. Temporary U.S. and Philippine military camps were set up in Crow Valley for the exercise. Local civilian vendors erected nearby makeshift shanties or "cafeterias" that offered food and drinks. U.S. personnel based in Crow Valley slept in tents and usually ate at the mess area of the camp or consumed Meals Ready to Eat but sometimes opted to eat at the cafeterias located just outside the camp.

Within Clark Air Base (in Angeles, Pampanga) the medical clinic of Hotel Stotsenberg served as the medical support unit for USAF personnel. U.S. service members based at Clark Air Base were housed in hotels within the Clark Freeport Zone, which is urbanized with restaurants, cafeterias, and malls.

U.S. active duty personnel presenting with a chief complaint of acute diarrhea (three or more unformed stools during a

24-hour period and seen within 72 hours of the onset of illness) or acute respiratory symptoms (history of fever of 100.4° F or higher with cough or sore throat) were considered eligible for collection of specimens and other information. Verbal consent from the participant was required prior to collection of data such as demographics and clinical symptoms. Approximately 4–10 grams of stool were collected from each patient and 3 aliquots of stool (approximately 1 gram each) were prepared from each specimen. For respiratory specimens, two nasal swabs were collected from each patient and placed into a viral transport medium tube. Both diarrheal and respiratory specimens were stored in liquid nitrogen. After the end of the exercise, the specimens were shipped on dry ice to Armed Forces Research Institute of Medical Sciences (AFRIMS) Bangkok, Thailand, for further testing. All data gathered were anonymized by using unique identification numbers with no link between the identification number and the patient's name.

For diarrheal etiology testing at AFRIMS, commercially available enzyme-linked immunosorbent assay (ELISA) kits for *Giardia, Cryptosporidium,* and *Entamoeba histolytica* (Giardia/Cryptosporidium Chek, Giardia II, Cryptosporidium II, E. Histolytica II, TechLab Inc., USA), and rotavirus, adenovirus, astrovirus, and *Campylobacter* (Ridascreen, R-Biopharm AG, Germany) were used. In addition, real-time PCR to detect diarrhea etiologic agents (*Campylobacter coli, Campylobacter jejuni*, enteropathogenic *Escherichia coli* [EPEC], enterotoxigenic *Escherichia coli* [ETEC], *Salmonella, Shigella*, and *Vibrio cholera*) using TaqMan® Gold kit (Applied Biosystems, USA) on an ABI 7900 instrument was performed using methods described previously.[15] Nucleic acids were extracted with the QIAamp stool DNA kit (QIAGEN, USA).

For the respiratory samples, detection and characterization of human influenza was performed by following the methods previously described by Velasco et al. in 2011.[15] Viral ribonucleic acid (RNA) was extracted from 140 µl of each viral transport medium tube using QIAamp Viral RNA Mini kit (QIAGEN, USA). The Centers for Disease Control and Prevention one-step real-time reverse transcription polymerase chain reaction (rRT-PCR) protocol was performed using SuperScript III Platinum One-Step Quantitative RT-PCR System (Invitrogen) with the addition of 5 units of RNaseOUT (Invitrogen). The rRT-PCR reactions were set separately using primers and probes to detect influenza A and B matrix gene and influenza A hemagglutinin gene for typing human seasonal H1, H3, and swine H1 as previously described.[15,16] The amplification reaction was performed in the ABI 7500 Fast Dx Real-Time PCR instrument.

RESULTS

Seven enteric and three respiratory specimens were collected from 15 patients (five patients were not able to submit stool samples). The average age of the seven patients with acute diarrhea who submitted samples was 29 years (age range, 19–42 years) while the specimen from the single respiratory case of influenza B was collected from a 41-year-old patient. All patients were male. There were seven patients from the Marine Corps, one patient from the Navy, and two patients from the Air Force. Most of the respiratory and diarrheal specimens came from Clark Air base (seven of 10; 70%).

All seven diarrhea samples collected were positive for at least one diarrhea etiologic agent by real-time PCR **(Table)**. *Campylobacter*, ETEC, and EPEC were detected in four of seven (57%), two of seven (29%), and four of seven (57%) cases, respectively. *C. coli* was detected in two cases; one case had a co-infection with *C. jejuni* and the other case had a co-infection with EPEC. One case was positive for EPEC alone and two cases were positive for both EPEC and ETEC. Three cases were also positive for *Campylobacter* by ELISA testing which was correlated with *C. jejuni* detected by real-time PCR **(Table)**. None of the samples tested positive for viral enteric pathogens or enteric parasites or protozoa by ELISA.

DISCUSSION

In this study, bacterial etiologies, diarrheagenic *E. coli* (EPEC and ETEC) and *Campylobacter* spp. *(C. jejuni* and *C. coli),* were detected in the majority of diarrheal cases; this finding is similar to data from other studies.[5,6,17,18] The fact that no viral etiologies were detected contrasts with some studies which reported viral agents as the most common underlying diarrheal etiology.[19]

Although four of seven stool samples contained two microorganisms, it is not

TABLE. Testing results for bacterial etiologies of seven diarrhea stool samples by real-time polymerase chain reaction

Agent	Specimen number and laboratory test results						
	1	2	3	4	5	6	7
Campylobacter coli	—	—	—	—	+	+	—
Campylobacter jejuni	+[a]	—	—	—	+[a]	—	+[a]
EPEC	—	+	+	+	—	+	—
ETEC	—	+ (LT[b]/ST[c])	+ (ST[d])	—	—	—	—

[a]Indicates samples also positive by *Campylobacter* ELISA test

[b]LT=*E. coli*-producing heat labile toxin

[c]ST=*E. coli*-producing heat stable toxin (STIb)

[d]ST=*E. coli*-producing heat stable toxin (STIa)

EPEC=enteropathogenic *Escherichia coli*; ETEC=enterotoxigenic *Escherichia coli*

feasible to accurately determine which microorganisim was responsible for the onset of acute diarrhea or if the symptoms were exacerbated by having two pathogens as opposed to just one. It is not uncommon to find two or more organisms in one stool sample. In diarrhea surveillance studies conducted in Southeast Asia, isolation of *Campylobacter* spp. (including *C. jejuni* and *C. coli*) is common, so it is not surprising to isolate these two species in the same sample. *Campylobacter*, particularly *C. jejuni*, is the number one bacterial cause for diarrhea in Southeast Asia.[20,21]

There is a frequent lack of on-site diagnostic capabilities during military deployments, particularly in remote or rugged settings. Although advanced laboratory-based diagnostics (i.e., molecular methods such as those used in this study) can provide an increased sensitivity to detect and confirm the presence of specific pathogens[22] and can give healthcare planners and preventive medicine officers a more accurate assessment of the local infectious disease threat, this capability has limited utility for healthcare providers in clinical decision making or in guiding disease control efforts during an ongoing military exercise or deployment. Real-time PCR is highly sensitive for microorganism detection and can detect minute quantities of DNA that indicate the organism is present but cannot establish that organisms are present at levels sufficient to cause clinical disease. One should keep in mind that a delicate balance exists between overdetection of pathogens and detection of an actual, clinically relevant infection during interpretation of results of PCR-based assays.[23] In most cases, there is a trade-off between a test's sensitivity and its practical usability and utility in the field. Point-of-care tests that possess high sensitivity and specificity in detecting particular pathogens and which are easy to use, inexpensive, and field deployable are highly desirable.

This study was able to detect only one case of influenza B but the potential of influenza to cause debilitating outbreaks during military deployments should not be underestimated, as shown by previous studies,[24–27] particularly in crowded environments.[28] A possible influenza outbreak in one of the camps may have been averted due to the early detection of an influenza B infection in a U.S. reservist who came directly from the continental U.S. to the Crow Valley site. The QuickVue Influenza A+B (Quidel, San Diego, CA) rapid test was used to diagnose the patient; isolation and hand-washing measures were instituted in the camp to encourage hand washing among the troops.

During military deployments, it is very difficult to completely restrict personnel from consuming food from non-military sources;[18,29] consequently, health briefings will have limited impact in preventing diarrheal infections. Vaccination is still considered a highly desirable goal for effective and long-term prevention to mitigate the threat of enteric pathogens.[30] A vaccine for infectious diarrhea is considered one of the top priorities of the U.S. Department of Defense. ETEC and *Campylobacter* in particular are target pathogens of the U.S. military due to their association with travelers' diarrhea.[31,32]

This study had several limitations. The number of cases of diarrheal and respiratory illness reported in this study very likely underestimated the actual disease burden of respiratory and diarrhea cases among deployed service members participating in the exercise. Lack of access to BAS medical records limited the ability to estimate attack rates, number of eligible patients seen but not enrolled, and patients who passed the inclusion criteria but did not provide verbal consent. Because of the difficulty in conducting this type of disease surveillance and associated logistical limitations (i.e., manpower, distance between sites), only selected BAS were included in the surveillance; these constraints limited the number of cases captured. In addition, the number of military personnel at each location was in constant flux with many military personnel coming in, going out, or transferring to other locations every day, thus limiting the ability to accurately compute disease attack rates or prevalence. The short duration of the military exercise (approximately 10 days) could have limited the number of cases identified because some patients could have developed clinical symptoms only after the exercise ended, particularly if they were exposed or infected near the end of the exercise.

In summary, it is recommended that disease surveillance be an integral component of military deployments and, whenever possible, a preventive medicine technician be included in forces deployed to remote settings. It is also important to note the likely benefit of improved and rapid point-of-care field diagnostics to provide awareness, early recognition, and identification of disease etiology for on-site healthcare providers and to subsequently assist in clinical decision making and guide efforts in mitigating disease spread. Even though there were relatively few diarrhea cases documented in this surveillance study, acute diarrhea is still considered one of the most important diseases encountered during military deployments[6] and the most common illness which affects international travelers to underdeveloped regions of the world.[20] There is still no commercially licensed enteric multiplex vaccine for the most common enteropathogens (i.e., ETEC, *Campylobacter, Shigella*), although several candidates are in the early phases of development.[31–36] Co-administration of individual enteric vaccines would be a promising preventive intervention for the future.[37] The ideal vaccine should be a cost-effective[31,38] multiplex vaccine administered via the mucosal/oral route[32] and offer protection against the most common causes of infectious diarrhea.[31]

Disclaimer: The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Army, Department of Defense, or U.S. Government.

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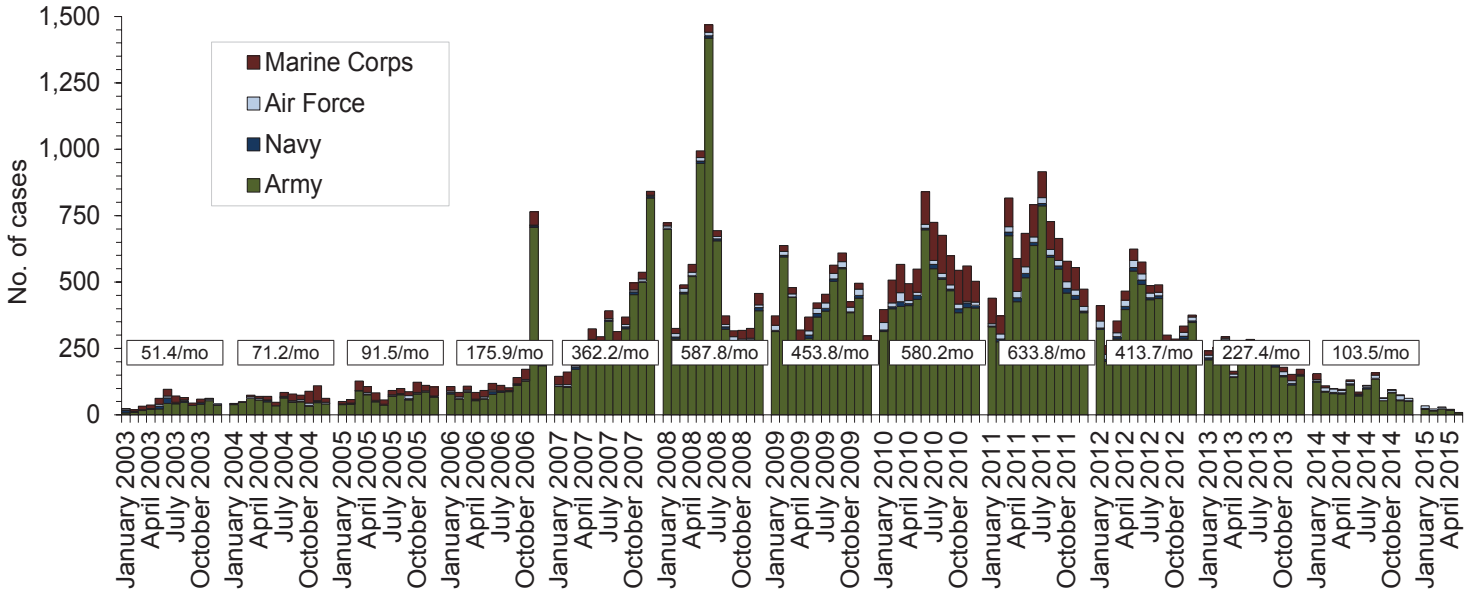
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–May 2015 (data as of 19 June 2015)

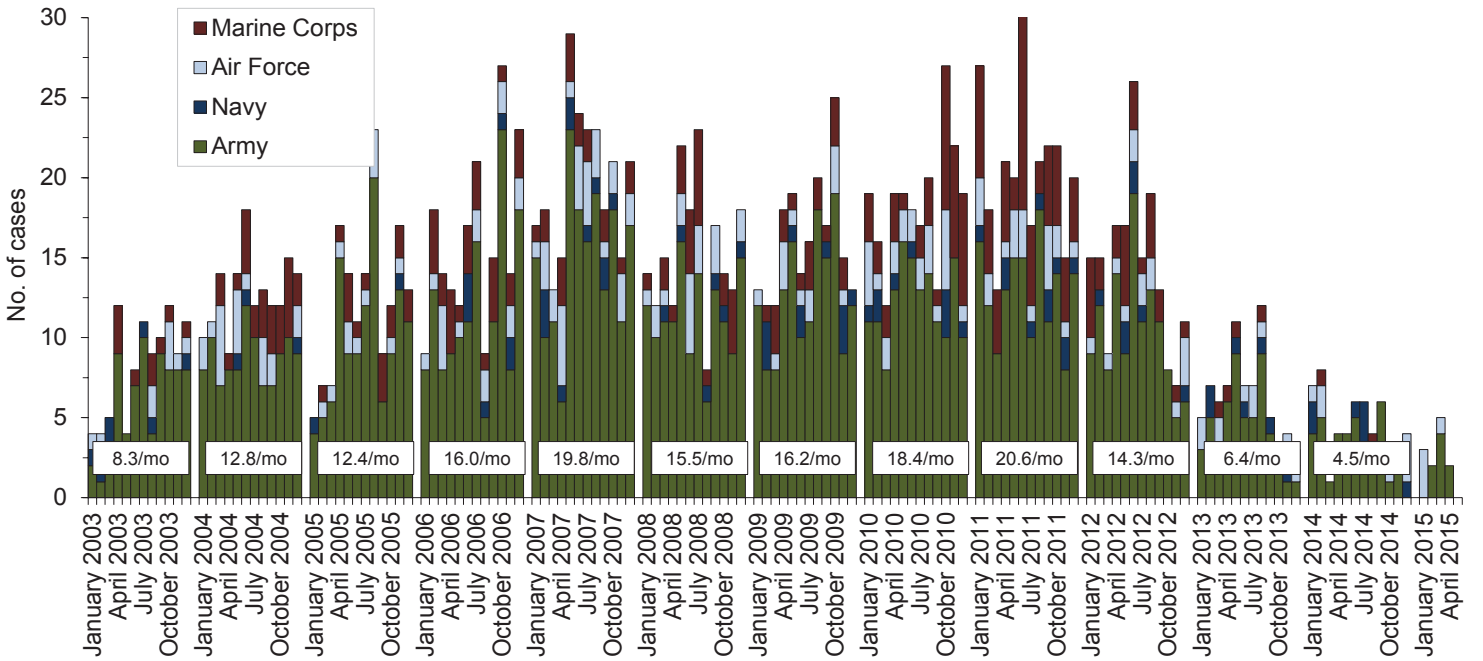
Traumatic brain injury (TBI) (ICD-9: 310.2, 800–801, 803-804, 850–854, 907.0, 950.1–950.3, 959.01, V15.5_1–9, V15.5_A–F, V15.52_0–9, V15.52_A–F, V15.59_1–9, V15.59_A–F)[a]



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 4,597 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]

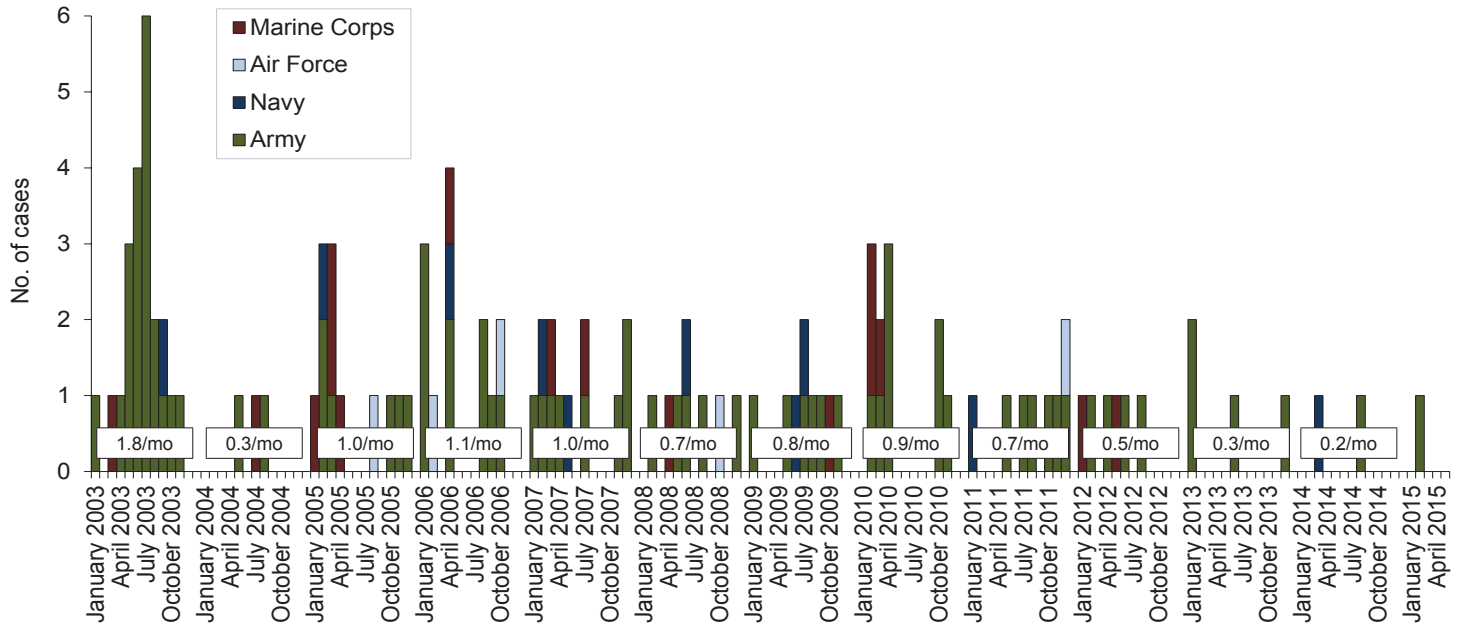


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379–383.

[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.

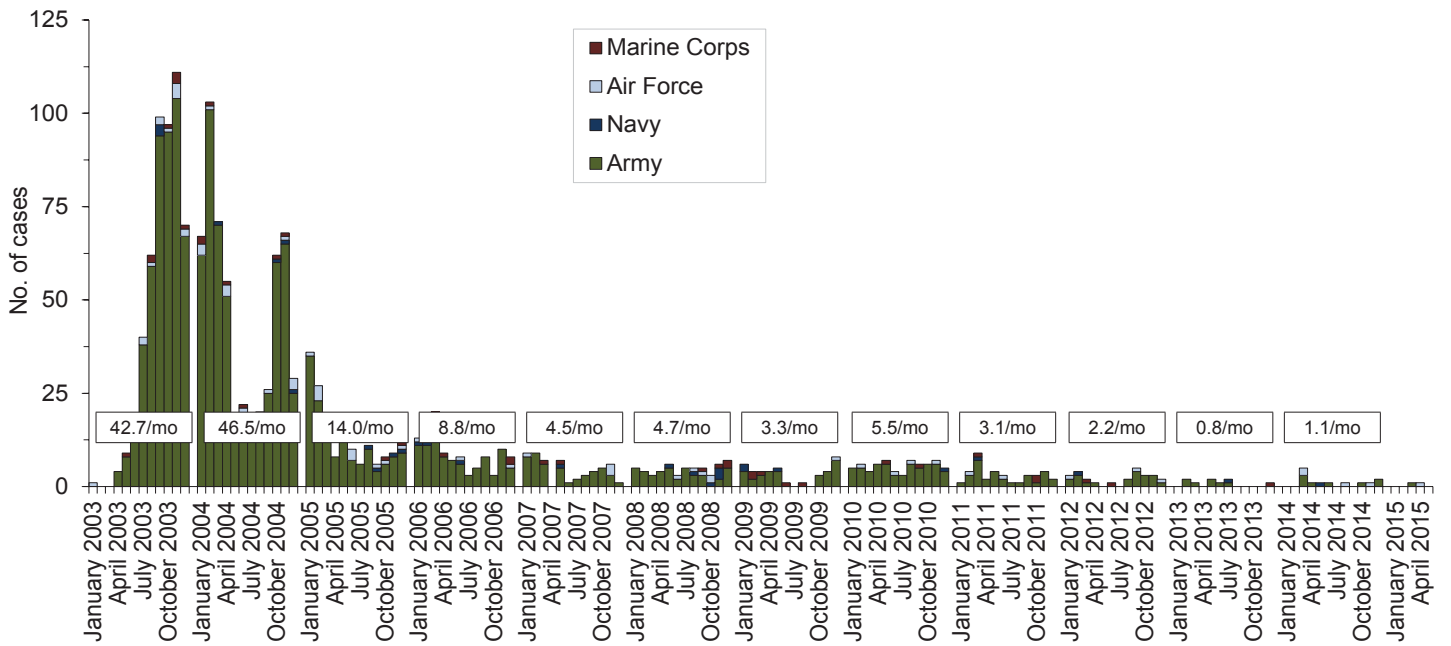
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–May 2015 (data as of 19 June 2015)

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.

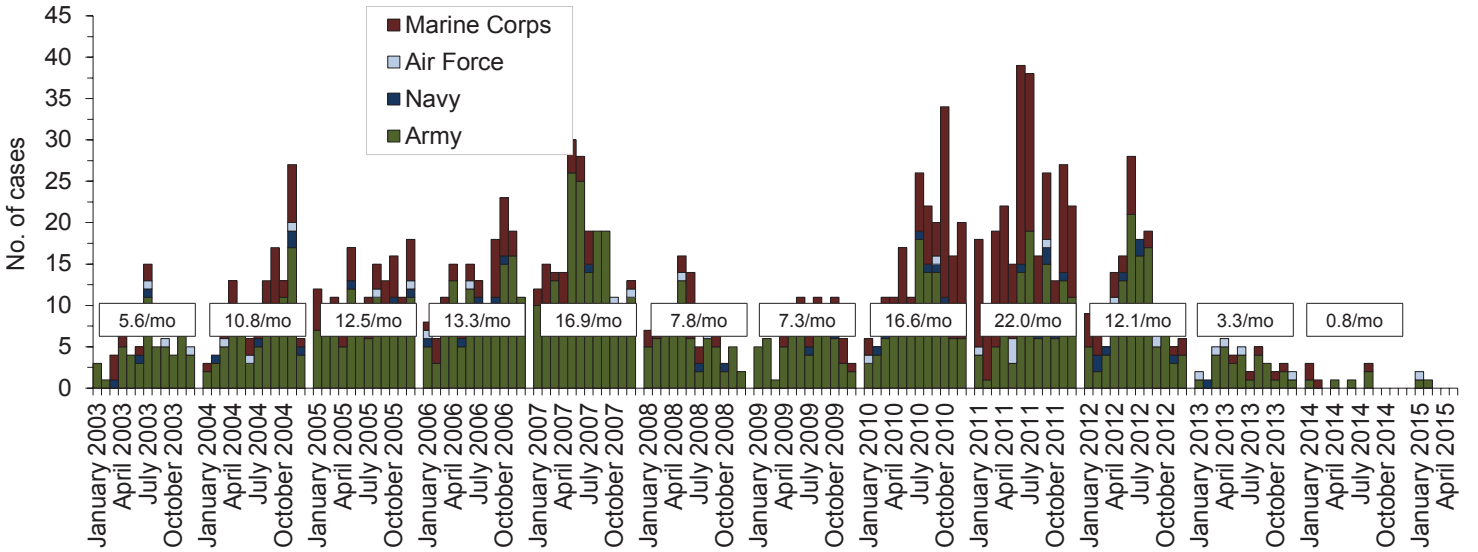
Leishmaniasis (ICD-9: 085.0–085.9)[b]



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.

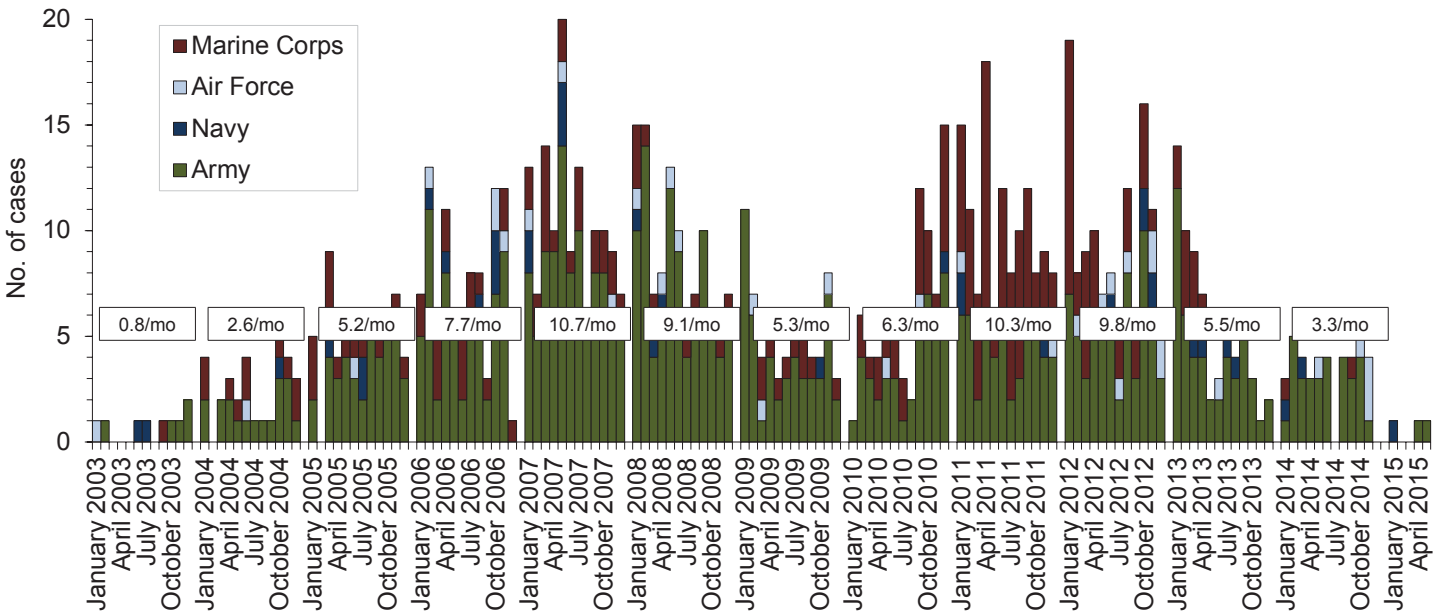
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–May 2015 (data as of 19 June 2015)

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

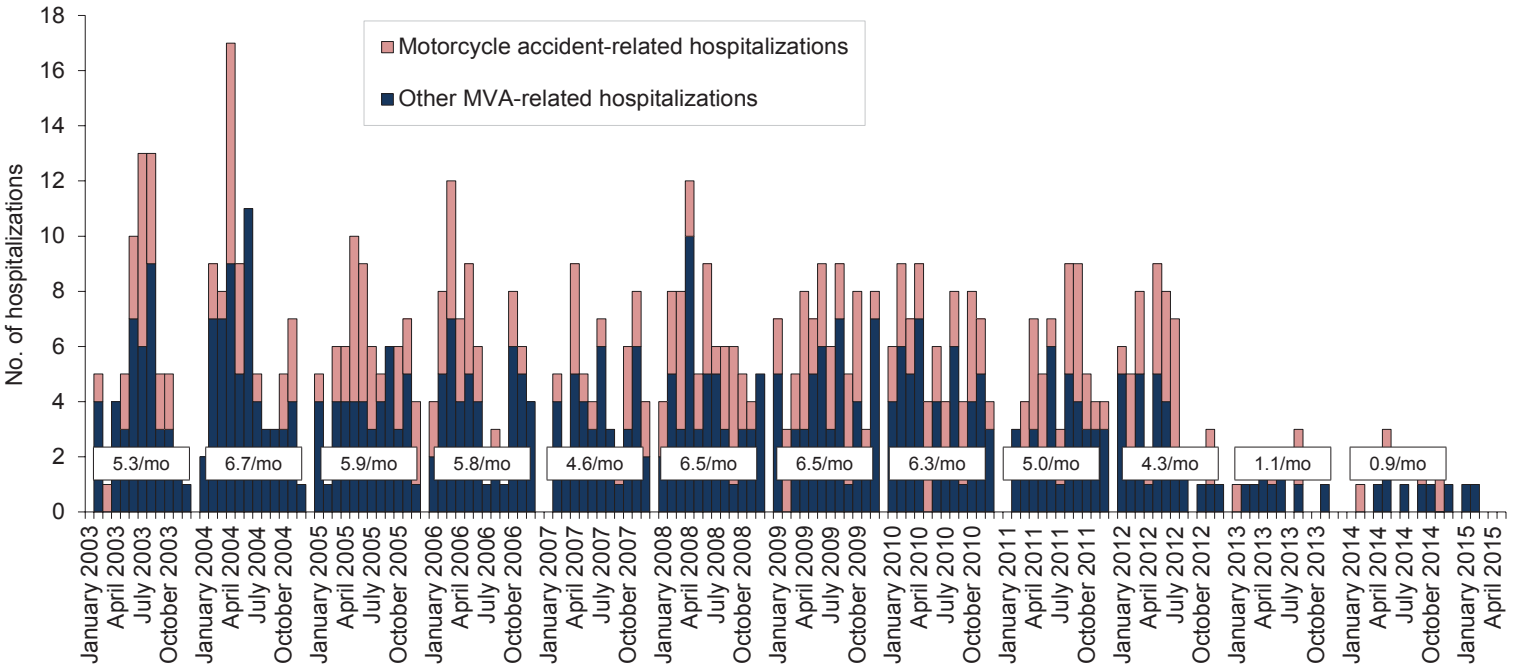
Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)[b]



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

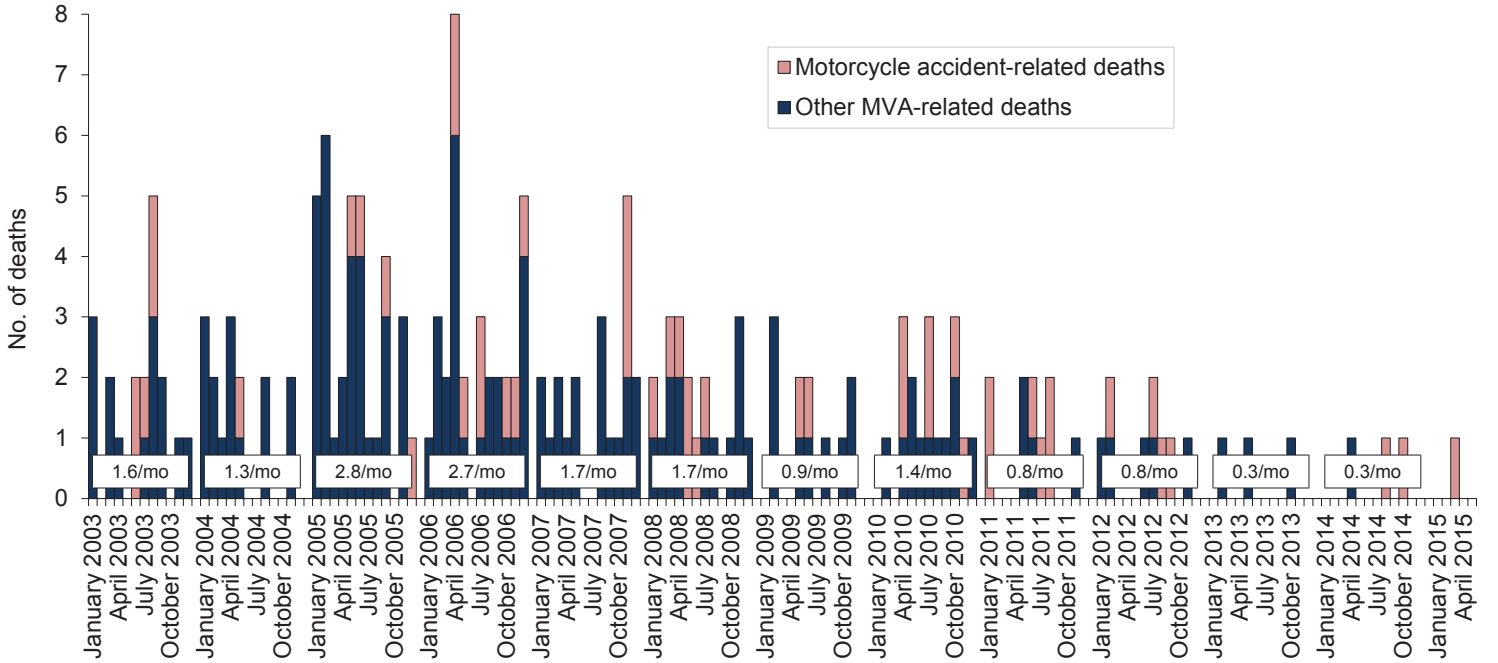
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–May 2015 (data as of 19 June 2015)

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*. Mar 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.

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