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Incidence of Joint Replacement Among Active Component Service Members, U.S. Armed Forces, 2004–2014

Denise O. Daniele, MS; Stephen B. Taubman, PhD; Leslie L. Clark, PhD, MS

In the U.S., joint replacements have become more common and the average age of individuals who undergo joint replacements has decreased. Joint replacements among active component service members increased 10.5% during 2004–2009, then 61.9% during 2009–2014. Knees and hips were the most frequently replaced joints among service members. During the surveillance period (and particularly after 2009), incidence rates increased in each age group of service members 30 years or older. Relative to their respective counterparts, rates of joint replacement overall—and of the hip and knee specifically—were higher among service members who were black, non-Hispanic; officers; and healthcare workers. One year after joint replacement, 18.2% had retired; 5.2% had been medically disqualified from service; 6.3% had otherwise left service; and 70.3% were still in service. By 2 years post-joint replacement, 30.2% had retired; 13.0% had been medically disqualified; 10.0% had otherwise left service; and 46.8% were still in service. Service members aged 30–44 years were the most likely to remain in service post-joint replacement. Given the increases in the frequency of joint replacement among younger service members, the number of service members who remain in service post-joint replacement may continue to increase.

Joint replacement is a surgical procedure during which part or all of a joint is replaced by an artificial joint, or prosthesis. Osteoarthritis, which causes degeneration of the joint, is the most common reason for joint replacement; however, trauma, joint inflammation (i.e., from infection, gout, or autoimmune disorders), loss of adequate blood supply to the joint, or genetic predisposition can also cause joint deterioration.[1,2] Joint replacement is performed after other treatments such as physical therapy and medications have failed to prevent severe joint pain and impairment of mobility. The most frequently replaced joints are the hip, knee, and shoulder; however, wrists, ankles, and joints in the hands and feet can also be replaced. In the U.S., joint replacement has become more common and the average age of individuals undergoing joint replacement has decreased.[3,4] In the past decade, the frequency of total knee replacements has increased the most; this trend has been attributed to a higher U.S. population prevalence of obesity, a known risk factor for knee osteoarthritis.[5–7]

U.S. military service members are at risk for joint replacement for several reasons. Military training and operational activities are often physically demanding and sometimes traumatic (e.g., heavy load bearing; hand-to-hand combat training). Musculoskeletal disorders, including osteoarthritis, have been associated with specific occupations, and some military occupations are inherently stressful to bones and joints (e.g., pilots and crews of fixed- and rotary-wing aircraft; drivers and crews of military vehicles; paratroopers).[8–12] Higher prevalences of musculoskeletal disorders, specifically joint disorders, have been associated with wartime deployment, particularly among those with repeat deployments.[13] During 2000–2009, the numbers and rates of incident diagnoses of osteoarthritis in active component members increased in most military and demographic subgroups.[8] Furthermore, recent increases in the incidence of overweight/obesity in the military could contribute to the increases in osteoarthritis; service members with a diagnosis of overweight or obesity have higher rates of joint and back disorders compared to service members overall.[14]

The objective of this analysis is to estimate the incidence and trends of joint replacement among active component service members. Also, this report describes the numbers and proportions of service members who retired, were medically disqualified from service, otherwise left service, or were still in service 1–2 years following joint replacement. The frequencies of deployment before and after joint replacement were also assessed.

METHODS

The surveillance population included active component members of the Army, Navy, Air Force, Marine Corps, and Coast Guard. The surveillance period was 1 January 2004 through 31 December 2014. Joint replacements were identified through V-coded inpatient and outpatient encounters and procedure codes associated with inpatient encounters **(Table 1)**. Ankle, elbow, wrist, and "other/unspecified" joint replacements were grouped into an "other" category because of the low numbers of cases in each of those categories. An incident case of joint replacement was defined as 1) a joint replacement procedure code in the primary procedure code position of a hospitalization; 2) a joint replacement ICD-9 V-code in any one of the first three diagnostic positions of the record of a hospitalization; or

TABLE 1. ICD-9-CM V-codes and procedure codes for joint replacement

	V-code	PR code
Hip[a]	V43.64	8151, 8152
Knee	V43.65	8154
Shoulder	V43.61	8180, 8181
Other category		
Ankle	V43.66	8156
Elbow	V43.62	8184
Wrist	V43.63	8173
Other/ unspecified	V43.6, V43.60, V43.69	8157, 8171, 8174

[a]Includes partial hip replacement

3) a joint replacement ICD-9 V-code in the first diagnostic position of the records of two outpatient encounters. An individual could be counted as an incident case once per surveillance period per anatomical site (e.g., one individual could be both a hip replacement case and a knee replacement case); however, because the ICD-9 codes do not specify laterality (i.e., left or right side of the body), this analysis does not capture bilateral replacements of the same type of joint (e.g., right shoulder and left shoulder).

Cases of joint replacement during 2004–2012 were analyzed to determine the percentages of affected service members who were medically disqualified from service, retired from service, otherwise left service (e.g., expiration of enlistment, involuntarily separation, death), or remained in service 1–2 years post-joint replacement. Also determined were the proportions who ever deployed before or after joint replacement. Cases from 2013 and 2014 were excluded from this part of the analysis due to insufficient follow-up time. Medical separation was determined by identifying cases with an Interservice Separation Code (ISC) for medical disqualification associated with disability (ISC=011, 012, 013, 014, 016). ISC codes are assigned by each individual Service and were obtained from the Defense Manpower Data Center.

RESULTS

During the 11-year surveillance period, records documented 3,905 joint replacements among 3,805 active component service members **(Table 2)**. Knee and hip joint replacements had the greatest numbers (n=1,825 and 1,694, respectively) and incidence rates (1.16 and 1.08 per 10,000 person-years [p-yrs], respectively). Shoulder joint replacements were reported among 201 service members (0.13 per 10,000 p-yrs). The remaining anatomical locations accounted for 185 joint replacements (ankle [n=51], elbow [n=45], wrist [n=10], hand/finger [n=20], foot/toe [n=9], and other/unspecified [n=50]) **(data not shown)**.

During the surveillance period, overall incidence rates increased 10.5% during 2004–2009, and then 61.9% during 2009–2014 **(Figure 1)**. There were more hip than knee replacements during 2004–2008, and more knee than hip replacements during 2009–2013. In 2014, the rates of knee and hip replacements were identical (1.6 per 10,000 p-yrs) and the highest of each during the surveillance period.

For joint replacements in general and for each joint specifically, age greater than 39 years was by far the strongest correlate of increased risk **(Table 2)**. During 2004–2009, the only age group that had an increase in rate was service members aged 45 years and older **(Figure 2)**. However, during 2009–2014, incidence rates increased in the following age groups: 30–34 years (45%); 35–39 (107%); 40–44 (130%); and 45+ (38%).

In regard to other demographic/military characteristics considered here, rates of joint replacements overall and of the hip and knee specifically were highest among service members who were black, non-Hispanic; officers; and/or in healthcare-related military occupations.

Of the Services, the Army and Coast Guard had the highest overall rates of joint replacement (2.89 and 2.88 per 10,000 p-yrs, respectively) **(Table 2)**. The Coast Guard had the highest rate of hip replacement (1.54 per 10,000 p-yrs) and the Army had the highest rate of knee replacement (1.46 per 10,000 p-yrs). The Army and Coast Guard had the highest rates of shoulder replacement (0.16 and 0.16 per 10,000 p-yrs, respectively).

Outcomes of joint replacement

Among the cohort of service members who had a joint replaced during 2004–2012 (n=2,902), 18.2% had retired; 5.2% had been medically disqualified from service; 6.3% had otherwise left service; and

FIGURE 1. Incidence rates of joint replacement by anatomical locations, active component, U.S. Armed Forces, 2004–2014

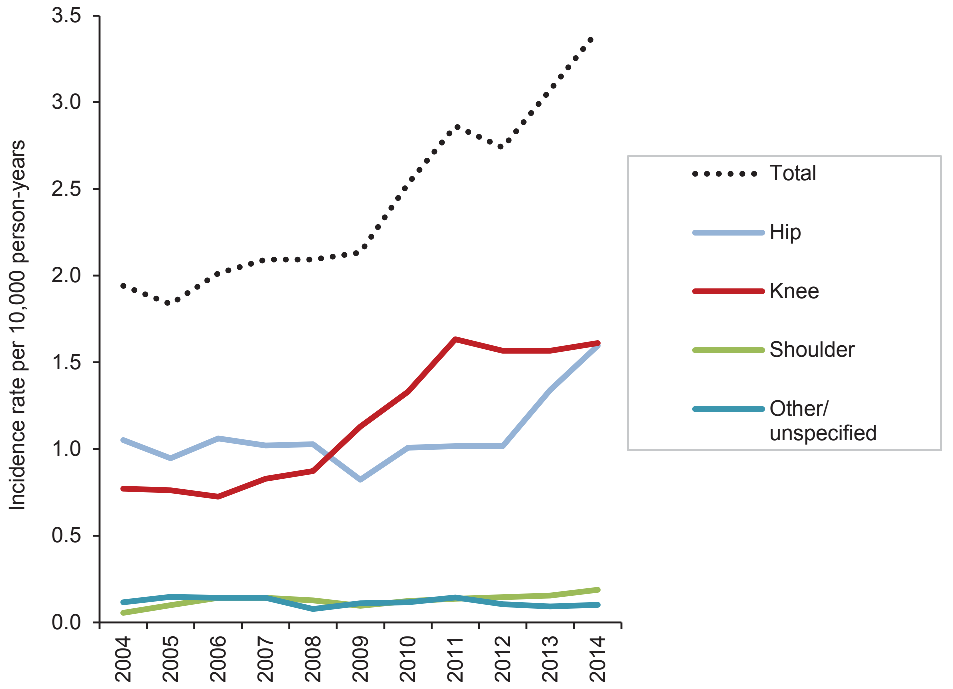


TABLE 2. Incident counts and incidence rates of type of joint replacement by anatomical location and demographic characteristics, active component, U.S. Armed Forces, 2004–2014

	Total[a]			Hip[b]			Knee[b]			Shoulder[b]			Other[b]		
	No.	Rate[c]	IRR	No.	Rate	IRR	No.	Rate	IRR	No.	Rate	IRR	No.	Rate	IRR
Total	3,805	2.43	.	1,694	1.08	.	1,825	1.16	.	201	0.13	.	185	0.12	.
Sex															
Male	3,298	2.46	1.11	1,498	1.12	1.30	1,540	1.15	0.92	188	0.14	2.46	158	0.12	0.99
Female	507	2.23	Ref	196	0.86	Ref	285	1.25	Ref	13	0.06	Ref	27	0.12	Ref
Race/ethnicity															
White, non-Hispanic	2,454	2.50	Ref	1,078	1.10	Ref	1,177	1.20	Ref	157	0.16	Ref	116	0.12	Ref
Black, non-Hispanic	835	3.27	1.31	406	1.59	1.45	398	1.56	1.30	23	0.09	0.56	26	0.10	0.64
Hispanic	261	1.53	0.61	106	0.62	0.56	126	0.74	0.61	11	0.06	0.40	22	0.13	0.80
Asian/ Pacific Islander	75	1.19	0.47	20	0.32	0.29	44	0.70	0.58	2	0.03	0.20	10	0.16	0.99
American Indian/ Alaskan Native	39	2.09	0.83	22	1.18	1.07	18	0.96	0.80	0	0.00	0.0	0	0.00	0.0
Other/unknown	141	1.77	0.71	62	0.78	0.71	62	0.78	0.65	8	0.10	0.63	11	0.14	0.86
Age															
≤19	12	0.12	Ref	4	0.04	Ref	2	0.02	Ref	0	0.00	0.0	6	0.06	Ref
20–24	214	0.42	3.52	69	0.13	3.40	96	0.19	9.47	11	0.02	Ref	39	0.08	3.85
25–29	270	0.74	6.23	93	0.25	6.44	118	0.32	16.33	15	0.04	1.91	45	0.12	6.23
30–34	293	1.25	10.52	147	0.63	15.84	111	0.47	23.92	18	0.08	3.57	21	0.09	4.53
35–39	584	3.14	26.47	309	1.66	42.02	236	1.27	64.19	25	0.13	6.26	27	0.15	7.34
40–44	951	8.54	71.97	431	3.87	97.85	463	4.16	210.22	59	0.53	24.68	22	0.20	9.99
45+	1,481	26.30	221.73	641	11.39	287.91	799	14.19	717.75	73	1.30	60.41	25	0.44	22.46
Service															
Army	1,668	2.89	1.93	704	1.22	1.72	841	1.46	2.37	90	0.16	1.82	82	0.14	1.66
Navy	818	2.23	1.49	382	1.04	1.47	394	1.08	1.75	34	0.09	1.08	32	0.09	1.02
Air Force	876	2.37	1.58	390	1.06	1.49	411	1.11	1.81	52	0.14	1.64	40	0.11	1.26
Marine Corps	314	1.50	Ref	149	0.71	Ref	129	0.62	Ref	18	0.09	Ref	25	0.12	Ref
Coast Guard	129	2.88	1.92	69	1.54	2.17	50	1.12	1.81	7	0.16	1.82	6	0.13	1.56
Rank															
Enlisted	2,482	1.90	Ref	1,027	0.79	Ref	1,220	0.93	Ref	131	0.10	Ref	150	0.11	Ref
Officer	1,323	5.04	2.65	667	2.54	3.23	605	2.30	2.46	70	0.27	2.66	35	0.13	1.16
Occupation															
Combat-specific	475	2.30	1.16	204	0.99	1.15	211	1.02	1.06	43	0.21	2.73	30	0.15	1.90
Armor/ motor transport	137	2.12	1.07	56	0.87	1.00	70	1.08	1.13	2	0.03	0.41	11	0.17	2.23
Pilot/aircrew	146	2.51	1.27	83	1.43	1.66	61	1.05	1.09	6	0.10	1.35	3	0.05	0.68
Repair/engineer	906	1.98	Ref	395	0.86	Ref	440	0.96	Ref	35	0.08	Ref	50	0.11	Ref
Communications/ intelligence	866	2.49	1.26	352	1.01	1.18	455	1.31	1.37	51	0.15	1.92	37	0.11	1.40
Health care	529	4.05	2.05	237	1.81	2.11	256	1.96	2.04	30	0.23	3.01	24	0.18	2.41
Other/unknown	746	2.47	1.25	367	1.22	1.41	332	1.10	1.15	34	0.11	1.48	30	0.10	1.30

[a]Total column equals one joint replacement per person per period.
[b]An individual could be counted once in each of the types of joint replacements.
[c]Rate per 10,000 person-years
IRR=incidence rate ratio

FIGURE 2. Incidence rates of joint replacement by age group, active component, U.S. Armed Forces, 2004–2014

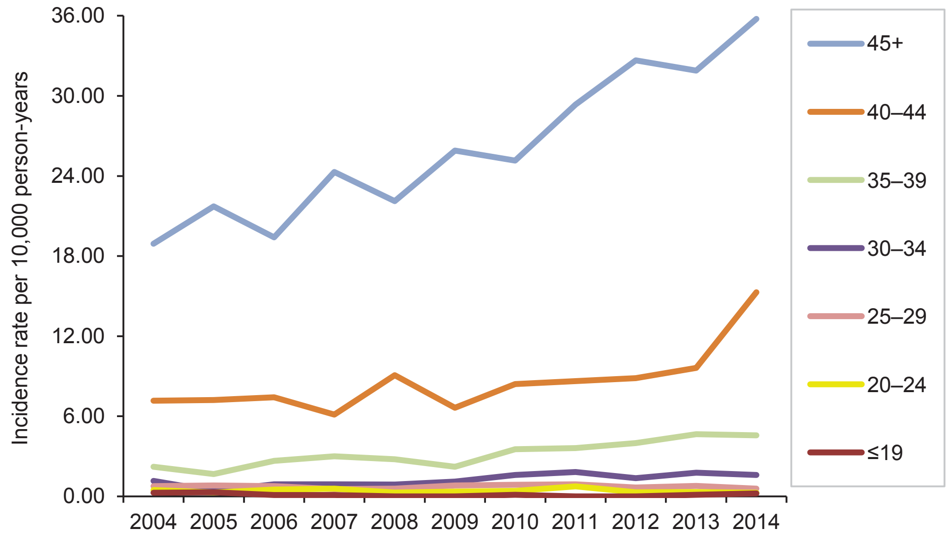
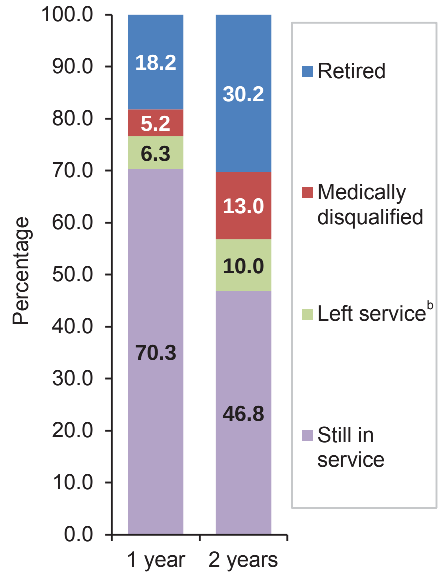


FIGURE 3. Percentages of joint replacement cases who remained in service or had left service, 1 and 2 years post-joint replacement, active component, U.S. Armed Forces, 2004–2012[a]



[a]Cases from 2013 and 2014 were excluded from this part of the analysis due to insufficient follow-up time.
[b]Includes all other reasons for leaving service (e.g., expiration of enlistment, involuntarily separation, death)

70.3% were still in service 1 year after joint replacement **(Table 3, Figure 3)**. By 2 years post-joint replacement, 30.2% had retired; 13.0% had been medically disqualified; 10.0% had otherwise left service; and 46.8% were still in service.

In a comparison of joint replacements by anatomical location, service members with "other" joint replacements and hip replacements had the highest percentages of individuals still in service 1 year (75.2% and 73.6%, respectively) and 2 years (52.4% and 51.2%, respectively) after replacement **(Table 3)**. Knee replacement had the lowest percentages of cases remaining in service (1 year: 67.0%; 2 years: 42.0%).

After 2 years, the proportion of service members who remained in service were similar among males (46.8%) and females (47.1%) **(Table 3, Figure 4)**. However, a greater proportion of males had retired (30.9%) compared to females (26.1%), and greater proportions of females had been medically disqualified (14.6%) or had otherwise left service (12.3%) compared to males (12.7% and 9.6%, respectively).

Two years post-joint replacement, in general, service members who were younger were more likely to be medically disqualified or leave service compared to older service members who were more likely to retire **(Table 3, Figure 5)**. Service members in their 30s had greater proportions of cases that remained in service post-joint replacement.

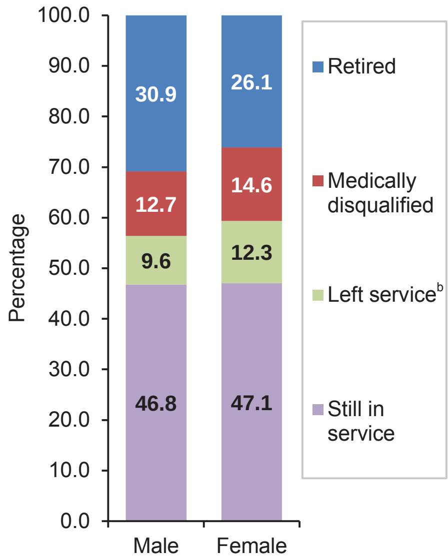
Greater proportions of Air Force service members and those in pilot/aircrew occupations had retired both 1 and 2 years post-joint replacement compared to their respective counterparts **(Table 3)**. However, greater proportions of service members in the Marine Corps, enlisted ranks, and armor/motor transport occupations had been medically disqualified. Within 2 years, nearly one-third (31.7%) of all service members in armor/motor transport had been medically disqualified compared to only 4.4% of pilots/aircrew.

Among all those with joint replacements, 66.9% had deployed prior to joint replacement and 13.9% deployed after joint replacement **(Table 4)**. Service members with shoulder replacements had the highest percentage of both pre- and post-joint replacement deployments (74.3% and 19.6%, respectively). Service members with knee replacements had the lowest percentage (11.4%) of post-joint replacement deployments.

EDITORIAL COMMENT

Overall incidence rates of joint replacement increased during 2004–2014, particularly after 2009. This trend can be attributed

FIGURE 4. Percentages of joint replacement cases who remained in service or had left service, 2 years post-joint replacement, by gender, active component, U.S. Armed Forces, 2004–2012[a]



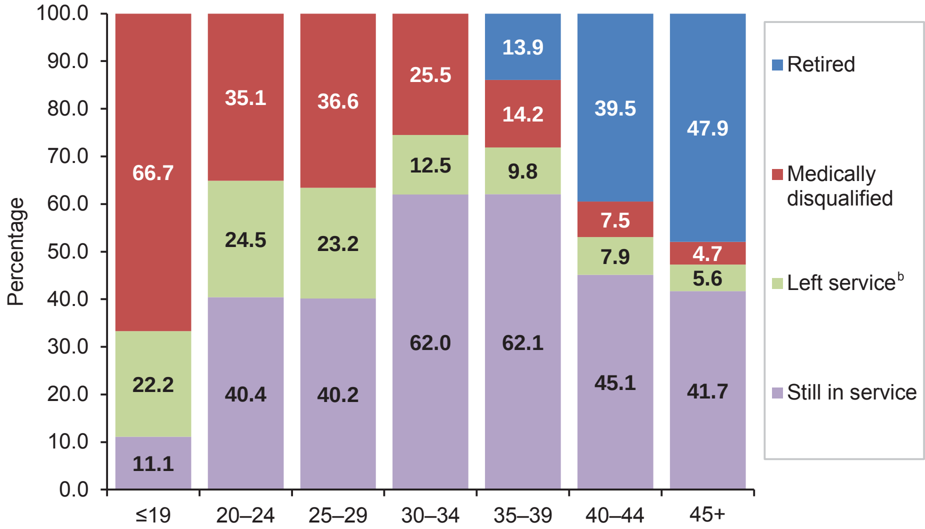
[a]Cases from 2013 and 2014 were excluded from this part of the analysis due to insufficient follow-up time.
[b]Includes all other reasons for leaving service (e.g., expiration of enlistment, involuntarily separation, death)

TABLE 3. Number and percentage of individuals with joint replacements in relation to retirement, and remaining in service post-joint replacement, active component, U.S. Armed Forces, 2004–2012[a]

	Total no. of cases (2004–2012)[a]	1 year post-joint replacement								2 years post-joint replacement (cumulative)							
		Retired		Medically disqualified		Left service[b]		Still in service		Retired		Medically disqualified		Left service[b]		Still in service	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	2,902	527	18.2	151	5.2	183	6.3	2,041	70.3	877	30.2	377	13.0	289	10.0	1,359	46.8
Anatomical location																	
Hip	1,267	207	16.3	71	5.6	56	4.4	933	73.6	355	28.0	172	13.6	91	7.2	649	51.2
Knee	1,342	281	20.9	61	4.5	101	7.5	899	67.0	465	34.6	158	11.8	156	11.6	563	42.0
Shoulder	148	32	21.6	7	4.7	9	6.1	100	67.6	46	31.1	17	11.5	14	9.5	71	48.0
Other	145	7	4.8	12	8.3	17	11.7	109	75.2	11	7.6	30	20.7	28	19.3	76	52.4
Sex																	
Male	2,511	466	18.6	127	5.1	151	6.0	1,767	70.4	775	30.9	320	12.7	241	9.6	1,175	46.8
Female	391	61	15.6	24	6.1	32	8.2	274	70.1	102	26.1	57	14.6	48	12.3	184	47.1
Race/ethnicity																	
White, non-Hispanic	1,876	342	18.2	107	5.7	112	6.0	1,315	70.1	570	30.4	244	13.0	175	9.3	887	47.3
Black, non-Hispanic	644	135	21.0	26	4.0	41	6.4	442	68.6	214	33.2	70	10.9	76	11.8	284	44.1
Hispanic	192	22	11.5	9	4.7	16	8.3	145	75.5	40	20.8	33	17.2	22	11.5	97	50.5
Asian/Pacific Islander	56	7	12.5	3	5.4	6	10.7	40	71.4	13	23.2	10	17.9	8	14.3	25	44.6
American Indian/ Alaskan Native	27	3	11.1	2	7.4	1	3.7	21	77.8	8	29.6	6	22.2	1	3.7	12	44.4
Other/unknown	107	18	16.8	4	3.7	7	6.5	78	72.9	32	29.9	14	13.1	7	6.5	54	50.5
Age group																	
≤19	9	0	0.0	1	11.1	0	0.0	8	88.9	0	0.0	6	66.7	2	22.2	1	11.1
20–24	188	0	0.0	30	16.0	28	14.9	130	69.1	0	0.0	66	35.1	46	24.5	76	40.4
25–29	224	0	0.0	29	12.9	40	17.9	155	69.2	0	0.0	82	36.6	52	23.2	90	40.2
30–34	216	0	0.0	31	14.4	17	7.9	168	77.8	0	0.0	55	25.5	27	12.5	134	62.0
35–39	438	34	7.8	25	5.7	34	7.8	345	78.8	61	13.9	62	14.2	43	9.8	272	62.1
40–44	709	159	22.4	17	2.4	29	4.1	504	71.1	280	39.5	53	7.5	56	7.9	320	45.1
45+	1,118	334	29.9	18	1.6	35	3.1	731	65.4	536	47.9	53	4.7	63	5.6	466	41.7
Service																	
Army	1,221	190	15.6	63	5.2	80	6.6	888	72.7	297	24.3	185	15.2	129	10.6	610	50.0
Navy	622	115	18.5	33	5.3	73	11.7	401	64.5	196	31.5	67	10.8	104	16.7	255	41.0
Air Force	709	169	23.8	33	4.7	16	2.3	491	69.3	276	38.9	71	10.0	31	4.4	331	46.7
Marine Corps	250	39	15.6	21	8.4	14	5.6	176	70.4	78	31.2	51	20.4	23	9.2	98	39.2
Coast Guard	100	14	14.0	1	1.0	0	0.0	85	85.0	30	30.0	3	3.0	2	2.0	65	65.0
Rank																	
Enlisted	1,903	287	15.1	142	7.5	159	8.4	1,315	69.1	490	25.7	344	18.1	247	13.0	822	43.2
Officer	999	240	24.0	9	0.9	24	2.4	726	72.7	387	38.7	33	3.3	42	4.2	537	53.8
Occupation																	
Combat-specific	360	63	17.5	18	5.0	22	6.1	257	71.4	92	25.6	62	17.2	33	9.2	173	48.1
Armor/motor transport	101	9	8.9	13	12.9	9	8.9	70	69.3	14	13.9	32	31.7	16	15.8	39	38.6
Pilot/aircrew	114	33	28.9	0	0.0	2	1.8	79	69.3	52	45.6	5	4.4	4	3.5	53	46.5
Repair/engineer	690	128	18.6	47	6.8	49	7.1	466	67.5	196	28.4	97	14.1	80	11.6	317	45.9
Communications/ intelligence	674	118	17.5	37	5.5	38	5.6	481	71.4	212	31.5	84	12.5	62	9.2	316	46.9
Health care	404	67	16.6	20	5.0	22	5.4	295	73.0	117	29.0	44	10.9	30	7.4	213	52.7
Other/unknown	559	109	19.5	16	2.9	41	7.3	393	70.3	194	34.7	53	9.5	64	11.4	248	44.4

[a]Cases from 2013 and 2014 were excluded from this part of the analysis due to insufficient follow-up time.
[b]Includes all other reasons for leaving service (e.g., expiration of enlistment, involuntarily separation, death)

FIGURE 5. Percentages of joint replacement cases who remained in service or had left service, 2 years post-joint replacement, by age, active component, U.S. Armed Forces, 2004–2012[a]



[a] Cases from 2013 and 2014 were excluded from this part of the analysis due to insufficient follow-up time.
[b] Includes all other reasons for leaving service (e.g., expiration of enlistment, involuntarily separation, death)

to striking increases in knee replacements from 2008 to 2011 and hip replacements during 2012–2014. Shoulder replacements also increased during the period. Not surprisingly, of the factors considered here, older age was the strongest risk factor for joint replacement overall, and in all joint replacement types described. During the surveillance period (and particularly after 2009), incidence rates increased in each age group of service members 30 years or older. Similar to trends in the civilian population,[3,4] this observation indicates that service members and their clinicians may be electing to have joint replacements at earlier ages. Improvements in total joint replacement outcomes as a result of increased durability and longevity of prosthetic joints and advancements in surgical techniques may be encouraging individuals to seek joint replacement at a younger age.[15–17]

Among race/ethnicity groups, black, non-Hispanic service members had the highest rates of joint replacement overall and in the two largest joint replacement categories, hip and knee. Osteoarthritis, one of the leading causes of joint replacement, is diagnosed at higher rates among active component service members who are black, non-Hispanic.[8] Among active military members older than 39 years, rates of osteoarthritis were 57% higher among black, non-Hispanics than white, non-Hispanics. However, in civilian settings, rates of joint replacement are reportedly higher among white, non-Hispanics than all other race/ethnicity groups.[18] In contrast to civilian settings, in military service, all members have access to care, at no cost to the patient, for all indicated treatment of osteoarthritis, including total joint replacement. Differences in access to care undoubtedly account, to a great extent, for the relatively higher rates of joint replacement among black versus white, non-Hispanics in military versus civilian settings.

Also, rates of overweight/obesity—a risk factor for osteoarthritis (particularly of the knee)—are highest among active component women and black, non-Hispanic service members.[8] These factors likely explain the higher incidence of joint replacement among black, non-Hispanic service members and of knee replacement in women documented in this report.

Previous studies reporting return to duty among active component service members post-joint replacement showed differing results. One study among 45 service members cited an 86% return to duty among knee and hip replacements, with 70% of those able to deploy to the combat zone.[19] A similar study among 183 active component service members reported 31% returning to active duty post-hip replacement.[20] Differences in the percentages of service members who return to duty post-joint replacement likely depend on characteristics such as age at joint replacement, type of replacement, military occupation, physical fitness, severity of joint disease, and weight of the service members in the study populations.

In this analysis, which included all active component service members, approximately half of those who received joint replacement (46.8%) were still in active service 2 years later. The most striking differences between joint replacement outcomes were associated with the age groups of the joint replacement recipients. Because age markedly varies in relation to other factors considered here (e.g., rank, Service, occupation), the effects of age differences should be accounted for when assessing joint replacement rates in relation to such factors. For example, enlisted service members, Marines, and individuals in combat-specific and armor/motor transport occupations are relatively young

TABLE 4. Number and percentage of individuals with deployments pre- and post-joint replacements, active component, U.S. Armed Forces, 2004–2012[a]

	Total no. of individuals diagnosed (2004–2012)[a]	Ever deployed pre-joint replacement		Ever deployed post-joint replacement	
		No.	%	No.	%
Total	2,902	1,940	66.9	404	13.9
Hip	1,267	826	65.2	180	14.2
Knee	1,342	923	68.8	153	11.4
Shoulder	148	110	74.3	29	19.6

[a] Cases from 2013 and 2014 were excluded from this part of the analysis due to insufficient follow-up time.

compared to their respective counterparts; as such, the joint replacement experiences of these groups reflect those of relatively young active members overall.

There are limitations to this analysis that should be considered when interpreting the results. For example, some care providers may be more likely to offer or suggest joint replacement based on their experience or the availability of the procedures at their locations. Similarly, the decision to replace a joint relies on the individual's level of disability and pain and willingness to replace a joint. Therefore, the number of individuals who underwent total joint replacement may underestimate the number of individuals who need or could benefit from joint replacement. For example, the incidence rate of joint replacement was highest among healthcare professionals. This finding may indicate increased knowledge about joint replacement surgery and recovery, and easier access to health care among service members in healthcare occupations.

It should also be noted that this study documents only joint replacements that took place while active component service members were still in uniform. It is certain that large numbers of former service members have, and will have, undergone such surgery, but such events are beyond the scope of this report. The risk factors for needing such surgery are generally the same as those described in this report, especially advancing age.

In conclusion, similar to civilian trends, more service members have been undergoing total joint replacement surgery and at younger age. The greatest recent increases were seen in service members aged 30–44 years, and these individuals had the greatest proportions of cases that remained in service post-joint replacement. Thus, the number of service members who remain in service after joint replacement may continue to increase. Future studies should measure the impact of joint replacement on the operational effectiveness of U.S. Armed Forces.

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

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Case Series: Chikungunya and Dengue at a Forward Operating Location

Will K. Reeves, PhD; Natasha M. Rowe, MD (Maj, USAF); Richard K. Kugblenu, MPH; Cheryl L. Magnuson, DVM, MPH (Maj, USAF)

Chikungunya virus is a mosquito-borne arbovirus in the genus *Alphavirus*. In humans, infection with chikungunya virus causes a painful but self-limiting febrile illness that is often associated with a maculopapular rash and polyarthritis.[1] The virus can cause encephalitis, long-term (>3 months) arthritis, and rarely death.[2] There is no commercially available vaccine or antiviral treatment for chikungunya; however, experimental vaccines are under development and the U.S. military was involved in vaccine development in the 1990s.[3] Chikungunya epidemics are often significant because most infected people become symptomatic (72%–97%) and large portions of the population can be sick at the same time.[4,5] Prior to 2013, the majority of the population of the New World had never been exposed to chikungunya and had no immunity to the virus.[5] The first modern epidemic of chikungunya in the Americas began in late 2013, and there were more than 1 million suspected cases by the end of 2014.[6]

In recent years, U.S. military bases in the Caribbean and worldwide have been on alert for cases. The island nation of Curaçao had notified the Pan American Health Organization of more than 1,800 cases of chikungunya by February 2015, with up to 20,000 reported in local media (i.e., up to 13% of the population).[6,7] In addition, all four serotypes of dengue viruses circulate in the Americas, including the Caribbean, and the clinical presentation of dengue fever can be confused with that of chikungunya.[8] The mosquito vectors of dengue and chikungunya viruses in the Caribbean are the same species, *Aedes albopictus* and *Aedes aegypti*.

The U.S. Forward Operating Location (FOL), 429th Expeditionary Operations Squadron, is based in Curaçao, a tropical island nation in the Caribbean located approximately 50 miles north of the coast of Venezuela. The FOL operations include U.S. Air Force (USAF) and U.S. Navy active duty personnel. The epidemic of chikungunya extended to several active duty personnel located at the FOL. Based on reported cases, the outbreak was the largest single cluster of chikungunya cases in USAF active duty personnel to date. This report describes a case series and discusses the significance of this disease in the Americas and diagnostic challenges when other arboviruses such as dengue are present.

Between November 2014 and January 2015, six active duty USAF personnel from the FOL presented with signs and symptoms compatible with chikungunya and dengue fever. Chikungunya can be diagnosed by polymerase chain reaction (PCR), virus isolation, or detecting IgM antibodies in patient serum. Serum samples from all patients were tested for chikungunya and dengue IgM at a local hospital in Curaçao. All six personnel were male; none required hospitalization or evacuation to the U.S. All patients lived in a modern hotel leased by the Department of Defense (DoD). The majority of the duty day for the patients was neither outdoors nor in a mosquito prone location. Patients were given acetaminophen for pain management.

Patient 1

The first reported case from the FOL was a 37-year-old male who presented at the clinic on 7 November 2014 with a fever of 100.6°F (38.1°C). Signs and symptoms included headache, body rash, muscle fatigue, chills, dyspnea, nausea and vomiting, and lightheadedness. He was administered acetaminophen for his elevated temperature and for pain management. Serum was drawn and sent for laboratory testing. Results were negative for dengue but positive for chikungunya IgM on 21 November. The serologic confirmation took more than 2 weeks and the patient was able to return to duty after a few days of rest.

Patient 2

On 8 November 2014, a 24-year-old patient presented at the clinic with a general feeling of malaise, chills, and fatigue. No elevated temperature was noted. He had a rash on his torso in the following days. Serum was drawn and it tested negative for dengue but positive for chikungunya IgM.

Patient 3

On 18 November 2014, a 43-year-old patient presented at the clinic. Onset of symptoms was reported by the patient as 14 November. The patient's temperature was normal at 98.9°F (37.1°C). The patient reported symptoms of fatigue and joint and muscle pain and he was found to have a rash on his scalp, arms, face, and trunk. Serum was drawn. He was released without duty limitations. Lab results were negative for dengue but positive for chikungunya IgM antibody.

Patient 4

On 20 November 2015, a 38-year-old patient presented at the clinic with a fever of 102.7°F (39.3°C). He complained of chills, knee and other joint pain, and fatigue. Serum was drawn and he was released with work/duty limitations. The patient's serum was positive for dengue virus IgM but not chikungunya. The patient reported being bitten by mosquitoes around the lodging area.

Patient 5

On 27 November 2014, a 24-year-old patient presented at the clinic with a fever of 102.6°F (39.2°C). His complaints included joint and muscle pain, chills, fever, body rash, and headache. Serum was drawn and the laboratory reported that he was negative for dengue but positive for chikungunya IgM. The patient was released to duty after 2 days of convalescence.

Patient 6

On 8 January 2015, a 24-year-old patient presented with complaint of general diffuse joint and muscle aches. He reported having diarrhea, rash, headache, fever, and weakness. The patient's temperature was 99.8°F (37.7°C). Serum was drawn and the tests were positive for chikungunya IgM but negative for dengue.

During this ongoing epidemic of chikungunya, the six patients presented at the FOL clinic with a range of similar complaints associated with arboviral infections. There were five confirmed cases of chikungunya and one confirmed case of dengue. These cases in active duty personnel demonstrate the potential for similar clinical presentations of the two diseases and the difficulty in distinguishing them without serology, PCR, or virus isolation. Both the dengue case and most chikungunya cases had fever and complaints of chills, joint pain, and general malaise. Although infections with chikungunya virus are more likely to cause symptoms, infections with dengue viruses can be more serious due to the potential for hemorrhagic complications. In the U.S. Special Operations Command, up to 11% of the active duty population has been infected with dengue.[8] Most FOLs and Forward Operating Bases have relatively modest physical facilities and staffing. Many have 100–500 active duty personnel, so even if chikungunya and dengue are not fatal, they can cause debilitating joint pain in a significant percentage of a base population.

The DoD uses a multiple layer personnel protection system to prevent insect bites and associated diseases. The guidance recommends treating uniforms with permethrin and sleeping under a treated bed net in addition to the use of a topical insect repellent.[9] Some services have factory-treated, permethrin-impregnated uniforms; however, the USAF does not and the Airman Battle Uniform (ABU) can only be treated with a short-term treatment using a 6-ounce aerosol spray. The newer Ripstop ABU can be treated with a permanent post-production treatment, but responsibility for doing so is the wearer's. At the FOL, contractors are responsible for the control of mosquitos that are competent vectors of dengue and chikungunya virus transmission. Most patients reported that they had not consistently used insect repellents on exposed skin.

Dengue has been an ongoing threat in the Caribbean with periodic epidemics since the 1970s.[10] Now chikungunya is also a significant concern. Long-term control of dengue and chikungunya in the Americas has been difficult due to the rapid emergence of insecticide resistance and a lack of vaccines.[11] In addition to the ongoing threat from chikungunya, there is a potential for introduction of Mayaro virus, an *Alphavirus* from mainland South America, which causes a disease that is symptomatically similar to chikungunya and can be transmitted by *Aedes aegypti*.[12] Several other vector-borne diseases such as rickettsial infections, (e.g., *Rickettsia felis*) can also be symptomatically mistaken as dengue and have been detected among vectors collected by U.S. military operations during dengue outbreaks.[13]

The seasonality of the vectors of chikungunya and dengue in Curaçao can be expected to follow the rain patterns with the majority of mosquitoes breeding from September through March following rains. All of the patients at this FOL were seen during the rainy season. The FOL pest control operators conduct surveillance for mosquitoes and have regularly collected *Aedes aegypti* in and around the hotel where service members live (unpublished data). These mosquitoes have all been identified and tested for dengue and chikungunya viruses at the U.S. Air Force School of Aerospace Medicine but have not been positive for either virus. However, detection of virus in vectors, even during outbreaks, can be rare. The specific exposure locations for the patients in this outbreak are not known, but *Aedes aegypti* is primarily a daytime feeding mosquito.

This outbreak of mosquito-transmitted viral infections in a known endemic area emphasizes the importance of the proper and consistent use of personal protective measures against arthropod-transmitted infections. These measures include the proper wear of permethrin-treated uniforms and the consistent use of DEET- or picaridin-containing (e.g., military-issued) repellents.

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Tdap Vaccination Coverage During Pregnancy, Active Component Service Women, 2006–2014

Angelia A. Eick-Cost, PhD; Zheng Hu, MS

Tetanus, diphtheria, and acellular pertussis (Tdap) vaccines have been licensed for use in the U.S. since 2006 and have been recommended during pregnancy since 2011. Low vaccination coverage during pregnancy among the general U.S. population has been reported. Therefore, this surveillance study was conducted to assess the percentage of service women with a live birth delivery during 2006–2014 who received a Tdap vaccination during their pregnancy. Only 1%–3% of service women during 2006–2011 received a Tdap vaccine during their pregnancy. However, coverage increased to 8% in 2012 and 54% in 2014. Although this moderate Tdap coverage among military service women is an improvement over past years, more education and attention by military physicians and pregnant service women to the benefits of Tdap vaccination are needed to bring coverage closer to 100%.

Pertussis ("whooping cough") is a vaccine-preventable illness commonly reported among children but is capable of causing disease in adults. Infection during the first few months of life can be particularly severe.[1,2] Cases among adults occur at a much lower rate than among children.[3] Almost all deaths from pertussis occur in infants less than 6 months of age.[3] Approximately 400 probable and 50 confirmed cases occur annually among service members and other adult beneficiaries of the Military Health System.[4] A study of service members who deployed to Afghanistan found that 2.2%–13.6% of subjects seroconverted to pertussis while deployed.[5]

Vaccines to prevent pertussis have been available since the 1940s. The earliest vaccines were preparations of whole cell, inactivated *Bordetella pertussis*, the bacterial cause of pertussis. Although these vaccines were highly efficacious, dramatically reducing the incidence of pertussis and associated mortality in the U.S., their common side effects prompted their replacement with acellular vaccines, beginning in 1991. Tetanus, diphtheria, and acellular pertussis vaccines (Tdap) were licensed for use in the U.S. in 2005. These vaccines were approved for individuals aged 10–64 years and there was no specific contraindication for pregnancy.[6] In 2011, the Advisory Committee on Immunization Practices (ACIP) recommended Tdap for pregnant women in an effort to reduce the burden of pertussis in infants; however, the recommendation was only for women who had never received Tdap.[7] In 2012, the ACIP updated their guidance and recommended Tdap during every pregnancy.[8] Infants less than 2 months of age are not eligible to receive pertussis vaccines. However, maternal vaccination during pregnancy has been shown to result in transplacental transfer of pertussis antibodies and protection from pertussis infection for infants during the first 2 months of life.[9–13]

Since the ACIP recommendations were issued in 2011, several studies have assessed the impact of this recommendation on vaccination rates among pregnant women. Among the general U.S. pregnant population, Tdap vaccinations rates remained low, ranging from 2.6% to 30%, depending on the population and year of the study.[8,14,15] Among non-service member beneficiaries of the Military Health System, similar rates were found among women of childbearing age with only 13.9% receiving Tdap (December 2010–April 2011).[16] No studies have assessed Tdap vaccination rates among pregnant service women or for an ample amount of time following the 2012 updated recommendation. Therefore, this surveillance study was conducted to assess Tdap vaccination coverage among pregnant service women following licensure of Tdap in 2005 through the end of 2014.

METHODS

Data from the Defense Medical Surveillance System (DMSS) were used for this analysis. The surveillance population included all active component service women with a hospitalization for a live birth delivery from 1 January 2006 through 31 December 2014. A live birth delivery was defined by a hospitalization record with an ICD-9-CM code of 650.xx–659.xx (if fifth digit specified, must be 1), 660.xx–669.xx (if fifth digit specified, must be 1 or 2), or V27.x in any diagnostic position. Individuals were allowed one live birth delivery every 280 days. The estimated date of conception (EDC) was defined as the date 280 days prior to the start of the delivery hospitalization.

Women were considered to have been vaccinated during their pregnancy if their health records documented receipt of a Tdap vaccine (CVX code=115) at any point during the interval from the date of delivery back to 310 days prior to delivery. Timing of vaccination was categorized as "prior" (1–31 days prior to EDC), "first trimester" (0–90 days after EDC), "second trimester" (91–181 days after EDC), or "third trimester" (182–280 days after EDC). If multiple Tdap vaccines were received during the pregnancy, then the most recent vaccine was used for the purpose of classifying vaccination timing.

For each year of the surveillance period, the numbers of deliveries and the percent of mothers who had been vaccinated against pertussis were calculated. Vaccination numbers and percentages were further stratified by age, race/ethnicity, service branch, military rank, and parity (all defined at the date of delivery). Service women who had been vaccinated during their pregnancies were additionally stratified by timing of vaccination.

RESULTS

Records of a total of 137,133 live birth deliveries to service women were captured during the surveillance period. The annual proportions of pregnant service women who had been vaccinated were very low during 2006–2011 (1%–3%) but increased substantially during 2012–2014 (8%–54%) **(Figure 1)**. Vaccine coverage by service followed the same annual trend, but Navy women had the highest annual proportion of coverage (65% in 2014) and Coast Guard women had the lowest coverage (21% in 2014) **(Figure 2)**. The proportions vaccinated did not vary by parity until 2014 when first deliveries had the highest vaccination coverage (57%) and 4th or greater deliveries had the lowest coverage (41%) **(Figure 3)**. No noticeable differences in vaccine coverage by age and race/ethnicity were noted **(data not shown)**.

Among Tdap-vaccinated pregnant women, the timing of vaccination during pregnancy varied over the surveillance period **(Figure 4)**. The highest percentages of vaccinations occurred during the first trimester from 2007 (54%) through 2011 (43%). However, during 2012–2014, the vast majority of vaccinations occurred during the third trimester.

FIGURE 1. Annual percentages of active component service women with a live birth delivery who received a Tdap vaccine during pregnancy, by year of delivery, 2006–2014

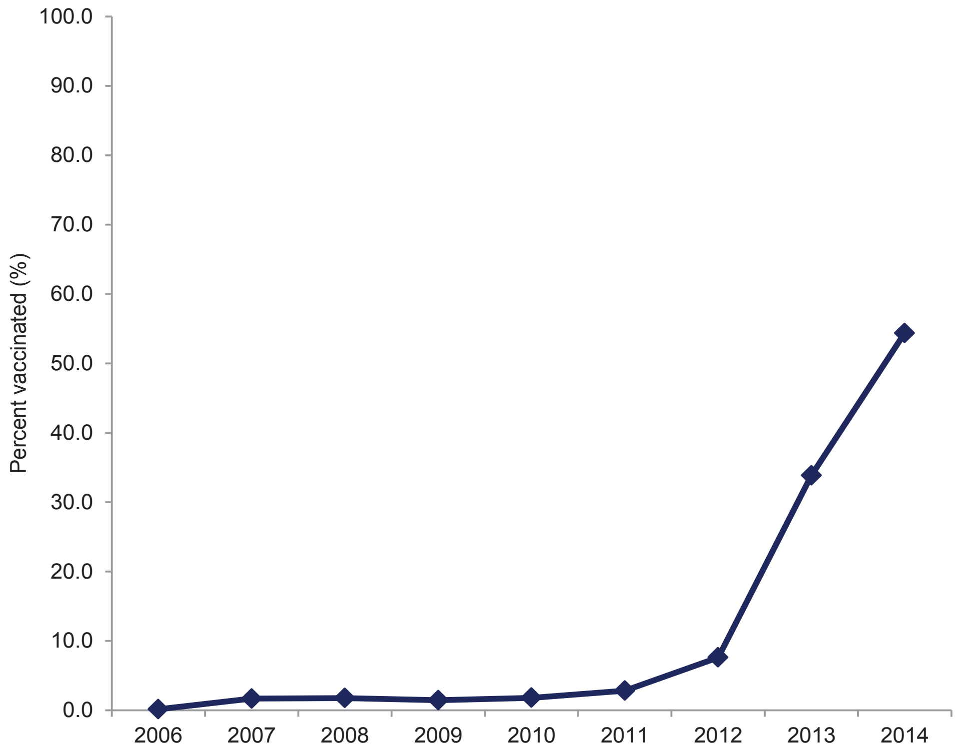
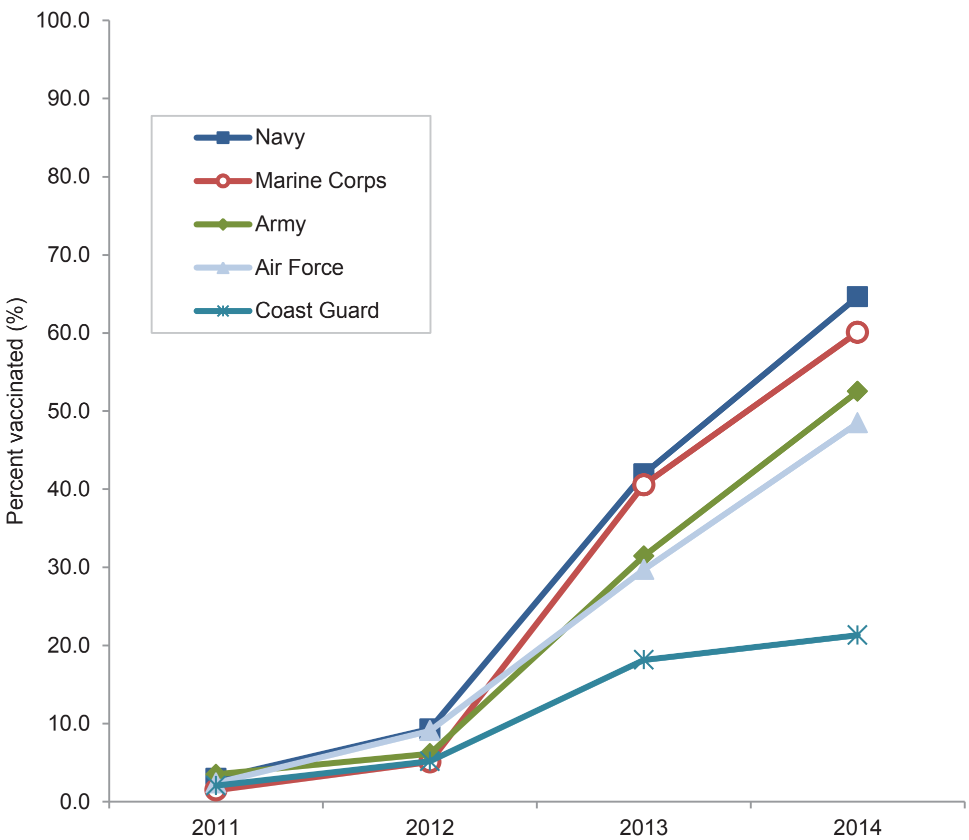


FIGURE 2. Annual percentages of active component service women with a live birth delivery who received a Tdap vaccine during pregnancy, by year of delivery and service, 2011–2014



This surveillance study found that Tdap vaccination coverage has increased substantially among pregnant service women since 2006. Vaccination coverage increased in conjunction with the ACIP recommendations in 2011 and 2012.[7,8] Improved vaccination coverage means greater protection from pertussis infection for the pregnant service women and, more importantly, protection of their newborn infants during the first 2 months of life when they are most vulnerable to severe infections.

In 2012, Tdap vaccination coverage among pregnant service women was comparable to reported rates among the general U.S. population; however, coverage was substantially higher among service women in 2013 and 2014. A study by Khabanda et al reported that Tdap coverage during pregnancy for women with live births ranged from 0.8% (2007) to 16% (2012) among six Vaccine Safety Datalink (VSD) sites and 0.3% (2007) to 30% (2011) among the California VSD site.[15] Similarly, other studies have reported Tdap coverage among pregnant women ranging from 2.6% to 14.3% during the same time period.[8,14] This study reports coverage for more recent years, which may explain the discrepancy between the women in the general U.S. population and service women. Current vaccination coverage in the general U.S. pregnant population may actually be higher than the 2012 numbers, but no studies have reported on this to date.

Although half of pregnant military service women received Tdap during their pregnancies in 2014, this proportion is still not optimal because the goal should be 100% coverage. DoD policy does not specifically address vaccination of pregnant service women, so medical providers and pregnant women need to be knowledgeable on the benefit of receiving Tdap during pregnancy to facilitate vaccination. Several studies have investigated factors associated with the decision to receive vaccinations during pregnancy, specifically for Tdap and influenza vaccines. Common factors associated with antenatal vaccination include provider recommendation and offer of the vaccine, availability of the vaccine in the obstetrician-gynecologist's (OB/GYN's) office, safety/

FIGURE 3. Annual percentages of active component service women with a live birth delivery who received a Tdap vaccine during pregnancy, by year of delivery and parity, 2011–2014

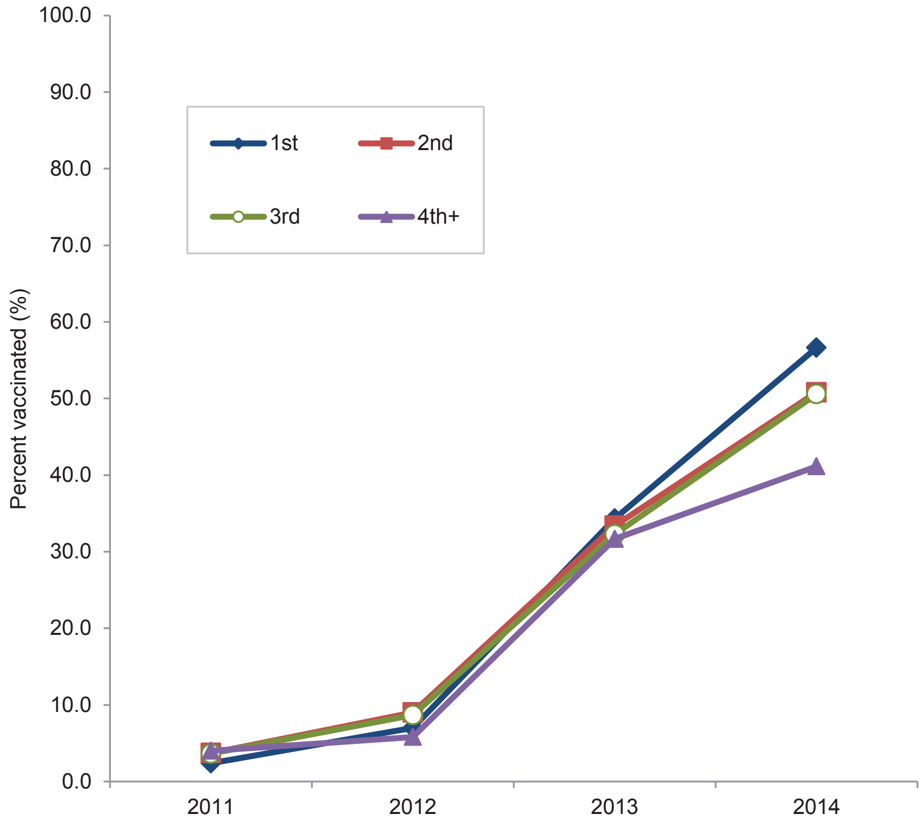
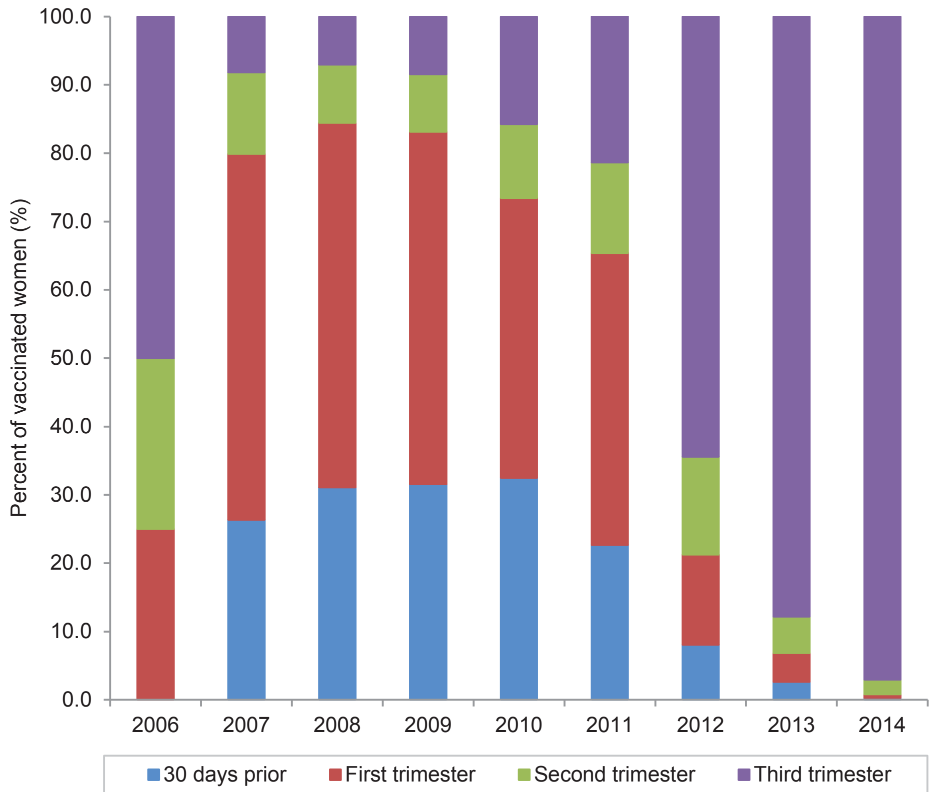


FIGURE 4. Timing of Tdap vaccination during pregnancy among active component service women with a live birth delivery, 2006–2014



confidence in the vaccine, perceived severity of the disease, and cost of the vaccine.[17–21] A study of pregnant women seeking prenatal care at a Massachusetts hospital found that 81.6% of the women received a Tdap vaccine during pregnancy.[22] The authors suggested that the remarkably high vaccination coverage was due to education of the staff and patients, workflow modifications to vaccinate every pregnant woman, and notifying patients that there was no fee for the vaccination due to universal coverage by private insurance and state subsidies. Similar efforts within military treatment facilities (MTFs) may be able to improve Tdap coverage of pregnant service women. Providers need to be routinely educated on the benefits of Tdap during pregnancy and then pass this information along to their patients. Similar to the Massachusetts study, payment for the vaccine should not be an issue for active component service women due to universal healthcare coverage.

Timing of Tdap vaccination during pregnancy is also of importance for protecting the newborn from infection. Studies have shown that, based on highest umbilical cord blood levels for pertussis antibody, the third trimester (ideally, between 27 and 30 weeks) is the optimal time for receiving a Tdap vaccination.[8,12,13] An increasing trend in vaccinating during the third trimester was seen in this study population; the majority of vaccinations occurred during the third trimester during 2012–2014.

Study limitations may have affected the results of this study. Under-ascertainment of Tdap vaccinations may have occurred if a vaccine was not recorded in the service specific immunization tracking system or the type of pertussis vaccine was recorded incorrectly. However, by restricting this analysis to active component service women, the majority of vaccinations should have been captured. Initially, all pertussis vaccines administered during the pregnancy were identified, but the number of non-Tdap vaccines was negligible and miscoding of the vaccine type did not appear to be an issue. Another limitation is the calculation of the EDC. The medical encounter data in DMSS are based on ICD-9 codes without physician notes and therefore do not provide an accurate means for identifying when a woman became pregnant. Additionally, ICD-9 codes for gestational age of the newborn are typically not recorded in the data in DMSS. Therefore, the estimated EDC was standardized for all pregnancies; this approach could have led to an under- or overestimate of the duration of the pregnancy. To account for possible underestimates of pregnancy duration, vaccinations occurring 30 days prior to the EDC were captured in the overall coverage estimates.

This surveillance study has provided the first reported estimates of Tdap vaccine coverage among pregnant military service women. Although vaccine coverage appears to be higher among pregnant military service women than among pregnant women in the general U.S. population, there is still room for improvement. Increased education on the value of Tdap vaccination during pregnancy to OB/GYN providers on a regular basis and subsequent education of the pregnant service women may help to increase vaccination coverage. Focused studies among MTF OB/GYN providers may be necessary to better understand the factors associated with Tdap vaccination of pregnant women in the military setting.

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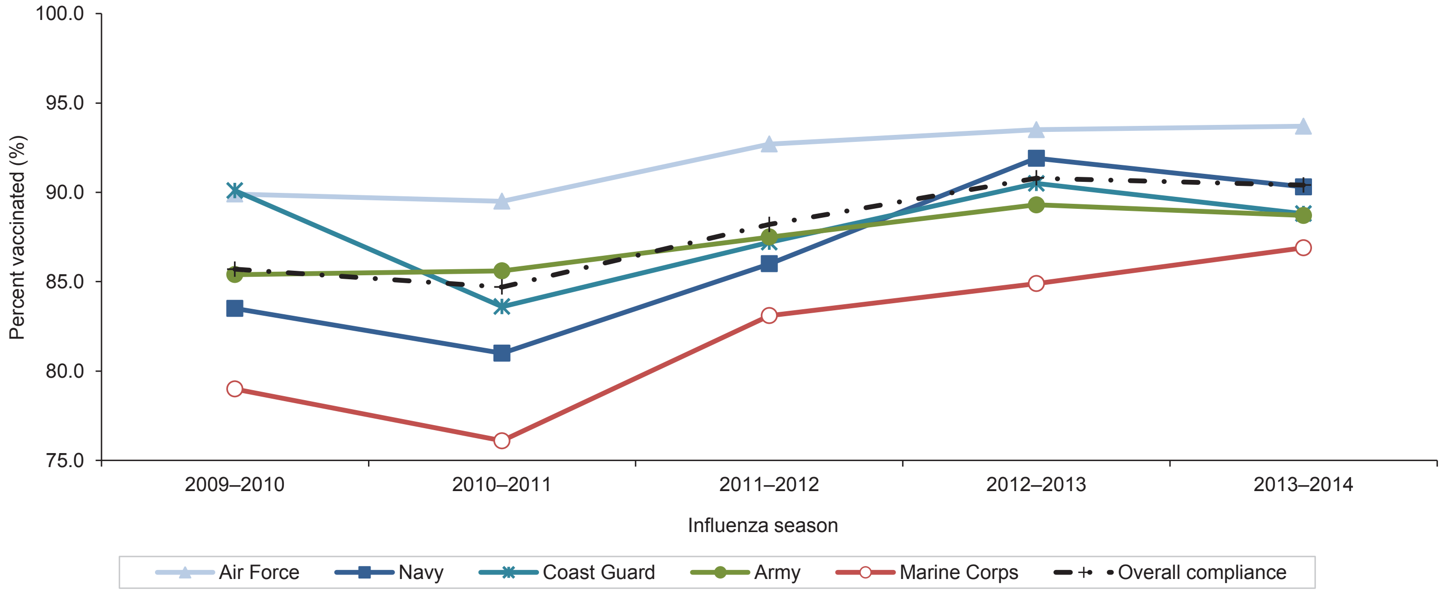
Surveillance Snapshot: Influenza Vaccination Coverage During Pregnancy, Active Component Service Women, October 2009–April 2014

Angelia A. Eick-Cost, PhD; Devin J. Hunt, MS

FIGURE. Percentage of pregnant women who had a live birth delivery whose health records document receipt of influenza vaccine, by influenza season (1 October through 30 April) and service, active component U.S. Armed Forces, October 2009–April 2014



The U.S. Advisory Committee on Immunization Practices' recommendations for influenza immunization of women who will be pregnant during an influenza season, regardless of trimester, have been in place for more than a decade.[1,2] These recommendations were made to help protect pregnant women from influenza infection as they are at increased risk for serious influenza-related complications. The Department of Defense (DoD) requires mandatory annual influenza immunization of all uniformed personnel (except those who are medically exempt).[3,4] Influenza vaccination coverage among pregnant women in the general U.S. population has been increasing over the past 5 years and ranged from 38% (2008–2009 season) to 52.2% (2013–2014 season).[5,6]

This snapshot provides data on influenza vaccination coverage during pregnancy among active component service women who had a live birth delivery and who were pregnant during an influenza season. The surveillance period covers five influenza seasons, 1 October 2009 through 30 April 2014. Pregnant women were considered vaccinated if they received an influenza vaccine between the July 1 before the season of interest and 14 days prior to the date of delivery or April 30 of the season of interest, whichever came first. Vaccination coverage increased for all services since the 2009–2010 influenza season. Overall, influenza vaccine coverage was 90.4% for the 2013–2014 season but ranged from 86.9% (Marine Corps) to 93.7% (Air Force), depending on the Service. Of all influenza vaccinations among pregnant women during the 2013–2014 season, 39.7% occurred prior to the estimated date of conception and the remaining vaccinations were evenly distributed during each trimester (approximately 20% during each trimester). Higher vaccination coverage among pregnant women in the U.S. military compared to those in the general U.S. population is most likely due to the mandatory influenza vaccination policy in the DoD.

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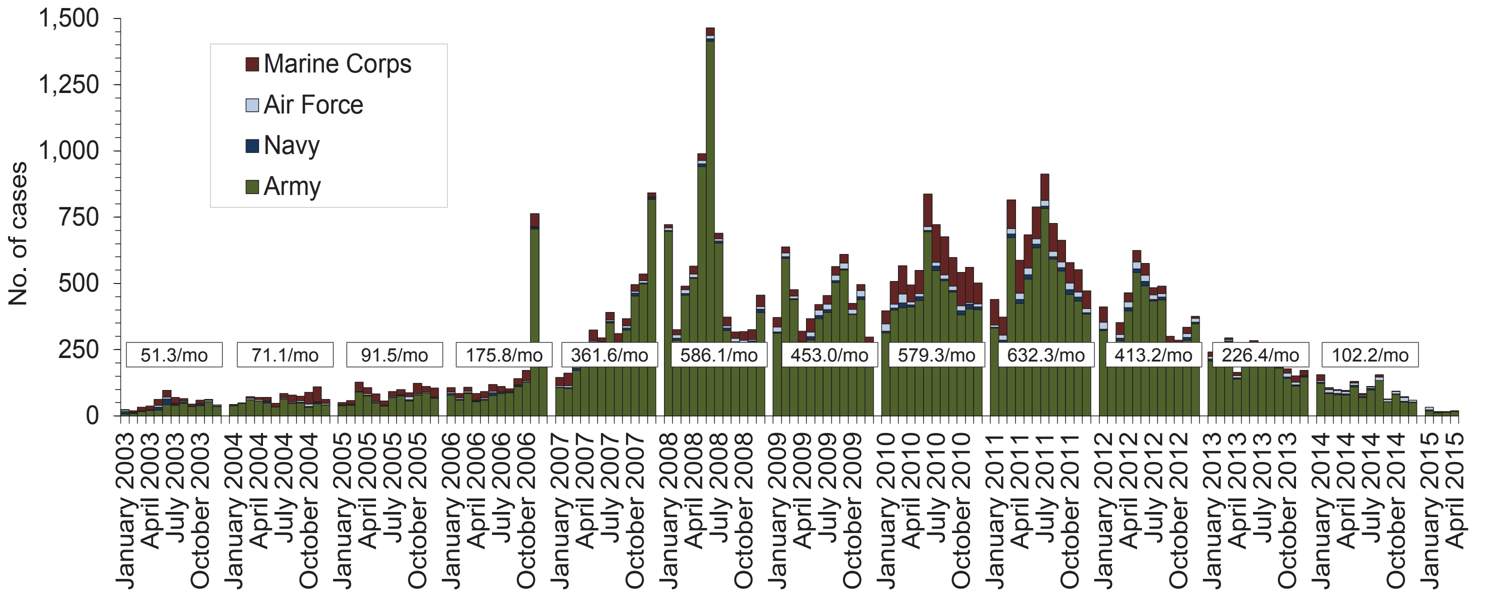
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–April 2015 (data as of 18 May 2015)

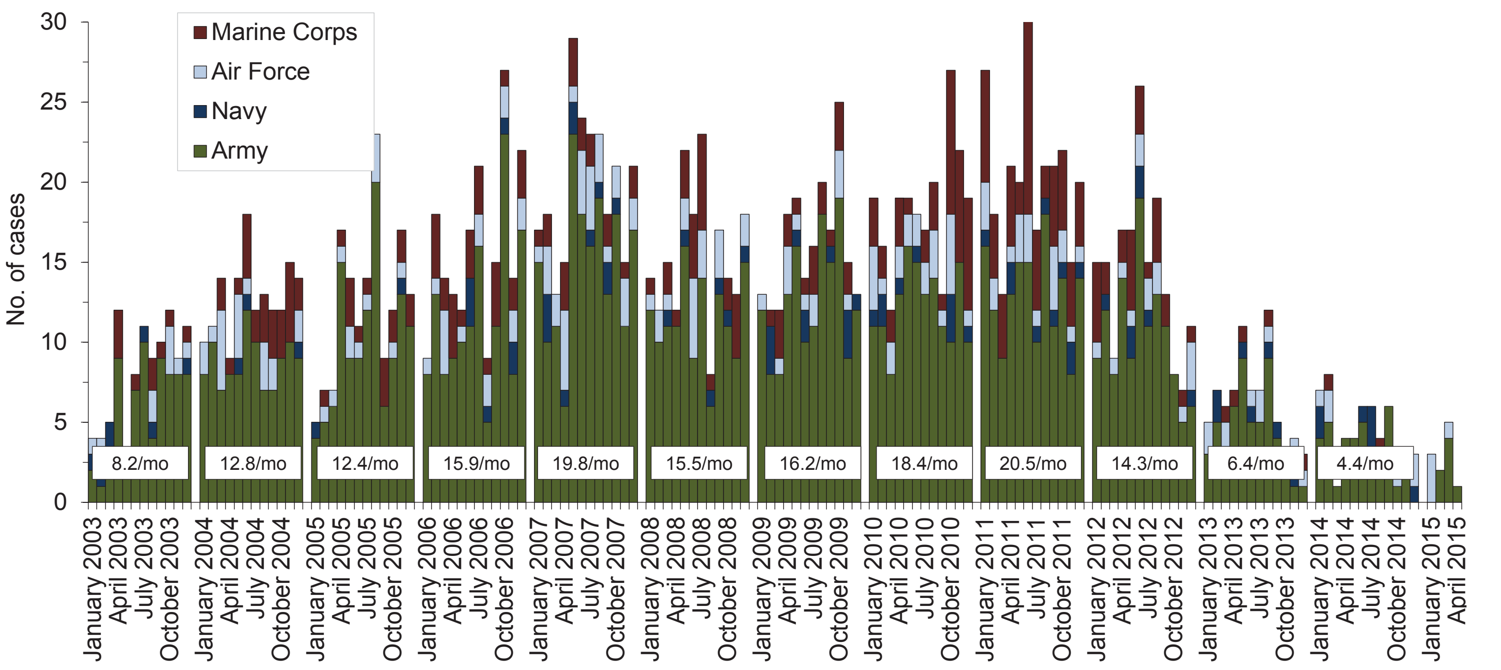
Traumatic brain injury (TBI) (ICD-9: 310.2, 800–801, 803-804, 850–854, 907.0, 950.1–950.3, 959.01, V15.5_1–9, V15.5_A–F, V15.52_0–9, V15.52_A–F, V15.59_1–9, V15.59_A–F)[a]



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 4,577 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]

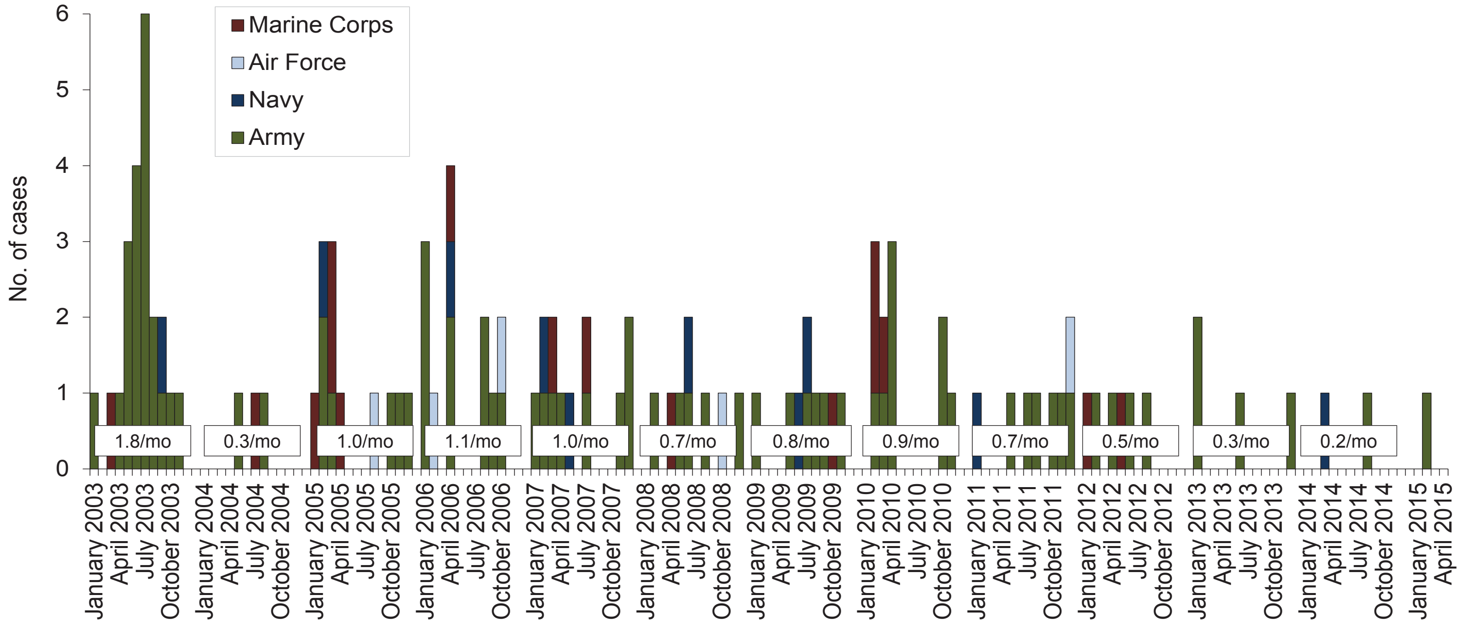


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379–383.

[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–April 2015 (data as of 18 May 2015)

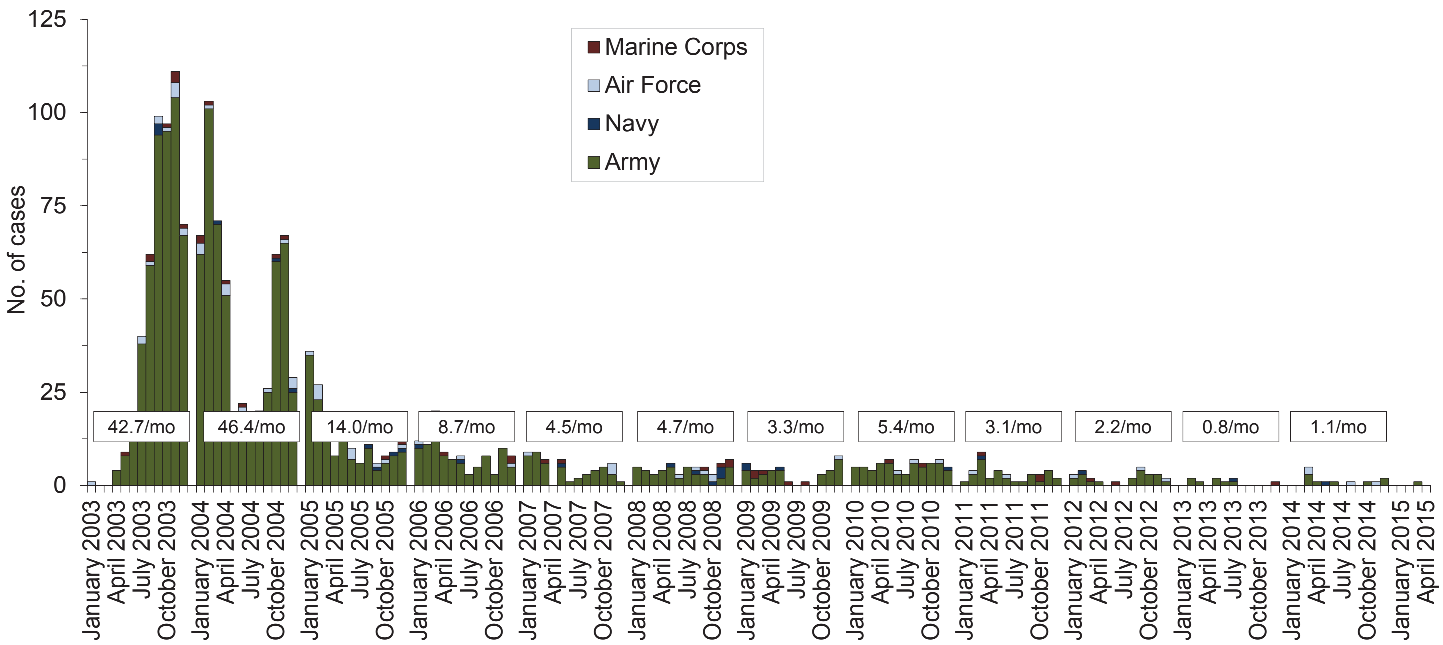
Severe acute pneumonia (ICD-9: 518.81, 518.82, 480–487, 786.09)[a]



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]

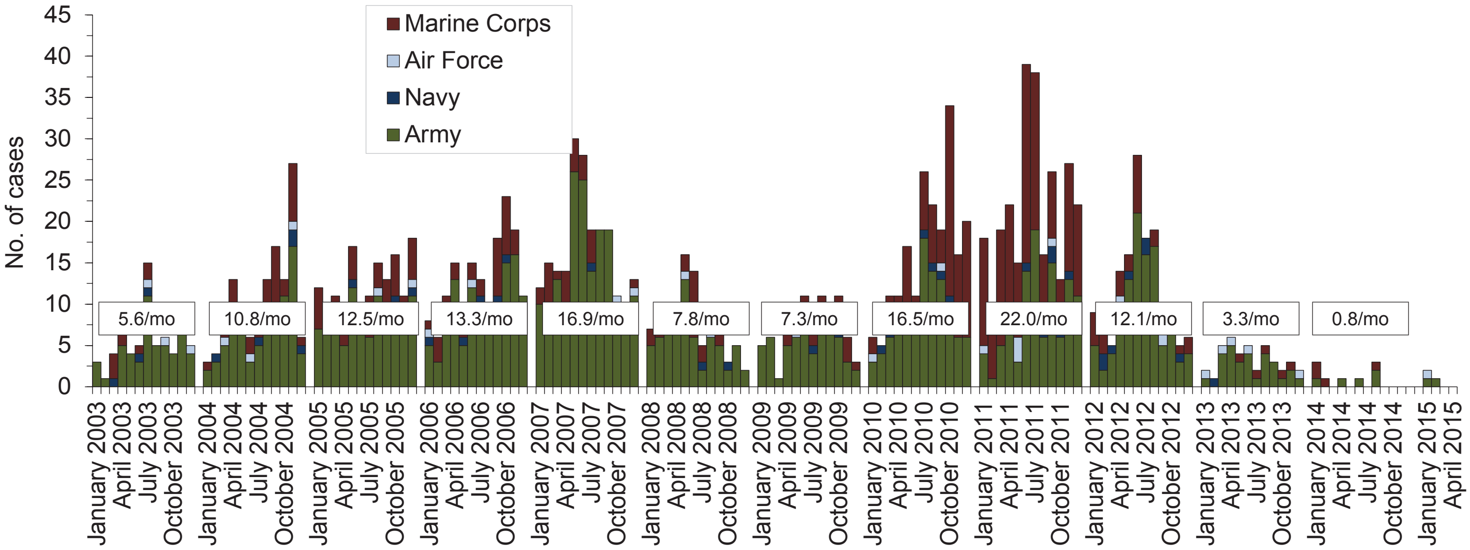


Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003–November 2004. *MSMR*. 2004;10(6):2–4.

[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.

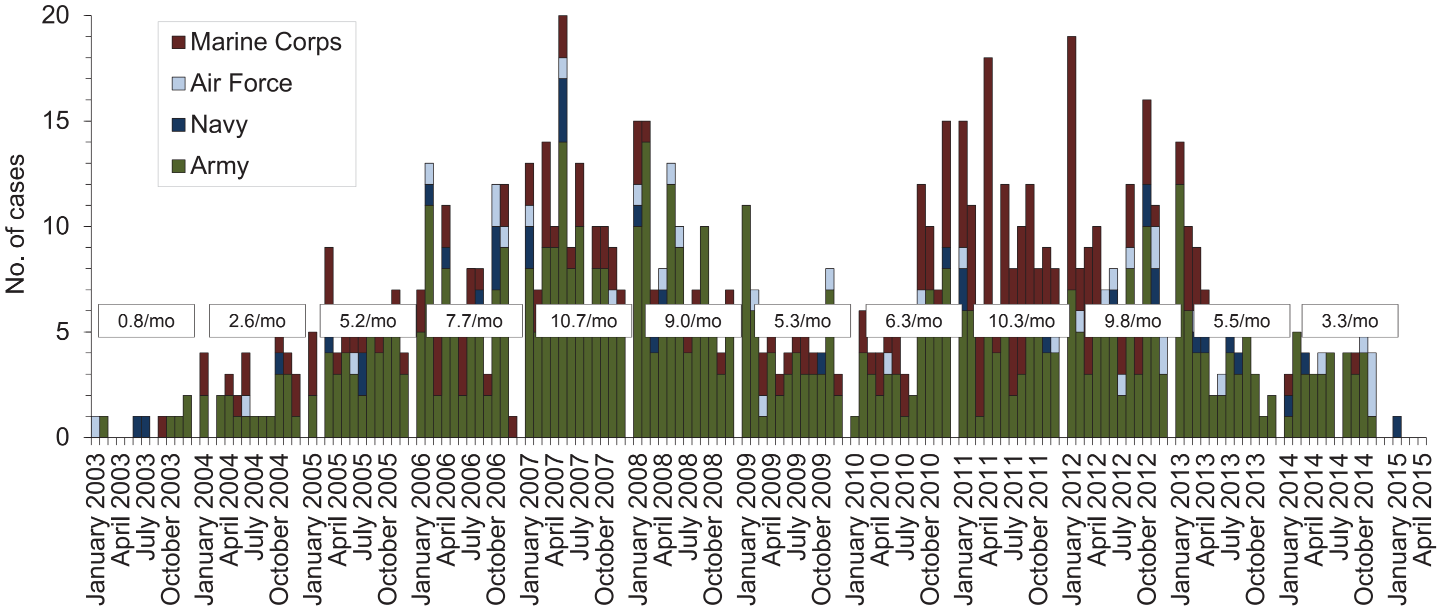
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–April 2015 (data as of 18 May 2015)

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

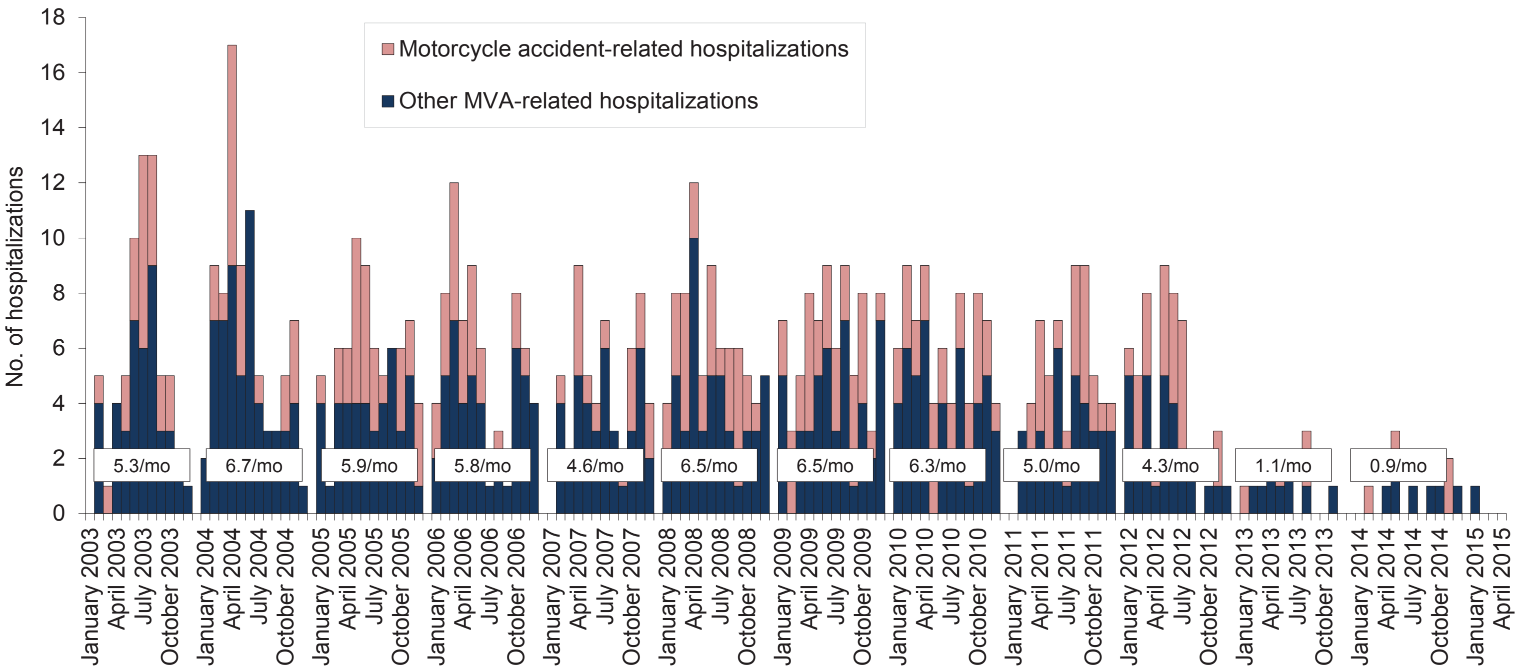
Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)[b]



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

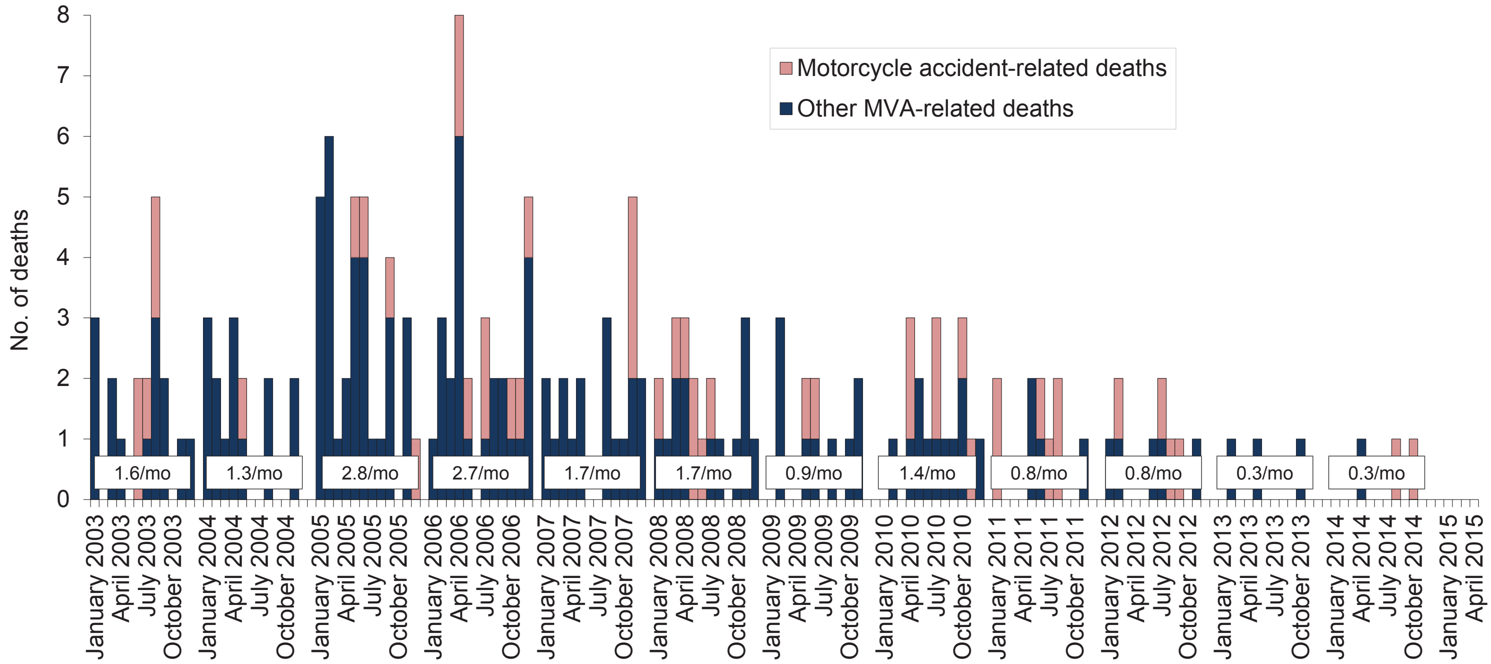
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–April 2015 (data as of 18 May 2015)

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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