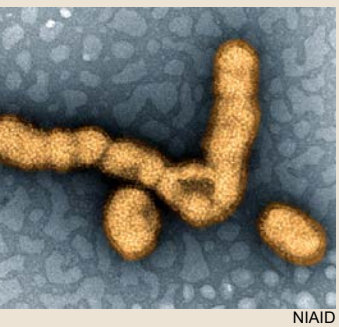
JUNE 2018

Volume 25
Number 6

MSMR

MEDICAL SURVEILLANCE MONTHLY REPORT



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Polypharmacy Involving Opioid, Psychotropic, and Central Nervous System Depressant Medications, Period Prevalence and Association with Suicidal Ideation, Active Component, U.S. Armed Forces, 2016

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This report uses routinely collected data in the Defense Medical Surveillance System (DMSS) to explore the period prevalence of polypharmacy among the active component U.S. military in 2016. The period prevalence across the Department of Defense was 10.8% and was highest for the Army (14.5%) and lowest for the Marine Corps (7.4%). Furthermore, a case control study was conducted to explore the potential association between polypharmacy and incident suicidal ideation (SI). There was an increased adjusted odds of incident SI within 12 months following polypharmacy exposure, with adjusted odds ratios ranging from 1.53 (95% CI, 1.38–1.71) to 3.06 (95% CI, 2.00–4.70), depending on the number of qualifying polypharmacy criteria. Important limitations to the current analysis are discussed. Results suggest that it would be prudent to screen for SI during the polypharmacy clinical encounter, particularly for persons with any of the mental health disorders considered in this report. Inclusion of Department of Defense Suicide Event Report (DoDSER) data along with medically coded SI in future surveillance would increase the sensitivity of identifying incident cases of SI.

Polypharmacy is an ill-defined term with at least 24 unique definitions in the medical literature.[1,2] For example, polypharmacy can refer to the simultaneous use of multiple prescription drugs to treat an individual for one or more medical conditions. Polypharmacy also can be used to describe an individual's pattern of excessive healthcare utilization for the purpose of obtaining prescription drugs. Polypharmacy poses the potential threat of harm from the cumulative impact of drug effects on various human tissues, interactions between one or more drugs, side effects, or a combination of all these. Between 1999 and 2012, the prevalence of polypharmacy increased from 8.4% to an estimated 15% of U.S. adults aged 20 years and older.[3] Concerns about polypharmacy have historically focused on adults ≥65 years of age[4-10]; however, recent research shows that polypharmacy among younger adults, such as the active duty military where the overall average age in 2016 was 28.5 years,[11] is a growing problem.[12-14] According to a cross-sectional analysis of 311,400 Veterans Health Administration (VHA) beneficiaries during 2010–2011, polypharmacy affected 8.4% of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) veterans.[15]

For the purposes of this report, polypharmacy was defined (see Methods for complete definition) according to Defense Health Agency[16] guidance used to screen Military Health System (MHS) beneficiaries with potentially high-risk medication use to target interventions (e.g., referral to a clinical pharmacist).[17] This guidance was derived from the 2015 U.S. Army Office of the Surgeon General (OTSG) Policy Memo 15-039,[18] which focused on polypharmacy associated with psychotropic drugs and central nervous system depressants (CNSDs) from seven broad categories. Psychotropic medications (e.g., stimulants, antidepressants, antipsychotics) act directly on the central nervous system to affect mood, cognition, or perception; CNSDs (opioids, anxiolytics, anticonvulsants, and hypnotics [sleep aids]) down-regulate central nervous system function and some have the potential to suppress function of the respiratory center in the brainstem. The use of multiple psychotropic and/or CNSD medications, especially with the addition of an opioid, is a type of polypharmacy with potential for multiple adverse events[19,20] including overdose,[21,22] which can result in delirium, respiratory suppression, or death.[23-26] Often these adverse events are unintentional[27-31]; however, the authors of the previously cited VHA study found that veterans with polypharmacy (defined as five or more concurrent prescriptions) had odds of suicide-related behavior that were nearly four times higher (adjusted odds ratio [AOR] 3.94; 99% CI, 3.58–4.33) than veterans without polypharmacy after controlling for existing mental illness.[15]

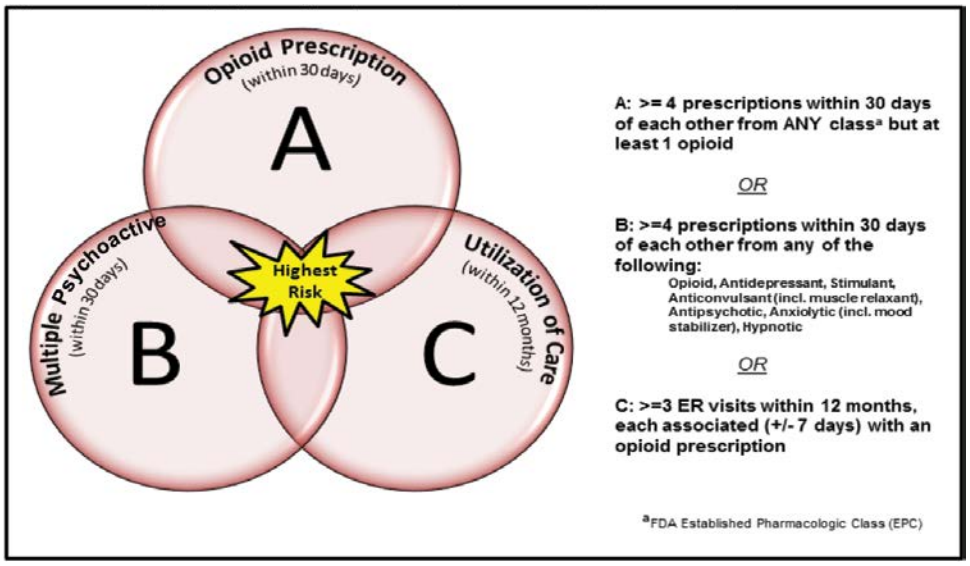
Suicide is one of the top 10 leading causes of death in the U.S.[32] and the overall age-adjusted rate of suicide increased 24% between 1999 and 2014.[33] Since the outset of the war in Afghanistan in 2001, the Department of Defense (DoD) has experienced a dramatic rise in suicide rates.[34] The Army sustained the largest increase in suicide rate, from 8.7 per 100,000 persons in 2001 to 24.4

per 100,000 persons in 2015,[35,36] surpassing the age- and sex-adjusted U.S. civilian rate for the first time in 2008[35] and only recently declining to a level comparable to the civilian rate.[36] Over the same period, the DoD has made significant efforts to better understand suicide within the ranks to inform policy and develop a comprehensive strategy to combat and prevent suicide. For example, the DoD developed a standardized web-based reporting tool (DoD Suicide Event Report [DoDSER]),[37] which has been in use since 2008. In addition, the services have conducted large-scale research projects, including collaboration with the National Institutes of Health, as was done for the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS).[38] Furthermore, in 2011, the Defense Suicide Prevention Office[39] was established to lead and coordinate prevention activities across the DoD. As a result of these efforts, many characteristics of fatal[40-42] and non-fatal[43-45] suicidal behaviors among U.S. military personnel over the past 16 years have been described.

Suicidal ideation (SI) is considered an important outcome that can predict more serious suicidal behavior.[43,44,46] Lifetime prevalence of SI has been estimated at approximately 14% among active component Army personnel.[43] Recent analysis of more than 10,000 cases of medically documented SI among active component Army personnel between 2006 and 2009 found that the highest risks of SI were associated with enlisted service members with less than 2 years of service, females, and those with a recent mental health diagnosis.[47] Additionally, an examination of 2015 DoDSER data by the Army Public Health Center found that 13% of SI cases met criteria for any polypharmacy (using the same definition from OTSG Policy Memo 15-039) at the time of reporting.[48]

The current level of polypharmacy across the DoD is not well established. This report examines the prevalence of polypharmacy among active component U.S. service members in 2016 and explores the potential association between polypharmacy involving opioids, and other drugs affecting the central nervous system, and SI that is independent of existing psychiatric illness and military and demographic characteristics.

FIGURE. Criteria for types of polypharmacy, adapted from U.S. Army Office of the Surgeon General Policy Memo 15-039[18]



METHODS

All data used to identify polypharmacy and SI were derived from records routinely maintained in the Defense Medical Surveillance System (DMSS). These records include both ambulatory encounters and hospitalizations of active component members of the U.S. Armed Forces in military and civilian (if reimbursed through the MHS) treatment facilities. In addition, these data contain administrative records for all prescriptions written for service members at military treatment facilities or through civilian purchased care. For the purpose of these analyses, prescriptions were limited to one for each drug name per day per service member.

Prevalence of polypharmacy in 2016 was based on the referent population of all individuals serving in the active component on 30 June 2016. The surveillance period was 1 January 2016 through 31 December 2016. The surveillance population included all individuals who served in an active component of the Army, Navy, Air Force, or Marine Corps who were in service on 30 June 2016. Prescription drug data in DMSS were grouped into the seven categories according to U.S. Food and Drug Administration–established pharmacologic class and included opioids, stimulants, antidepressants, antipsychotics, anxiolytics (including mood stabilizers), anticonvulsants (including muscle relaxants), and hypnotics.[49] Polypharmacy was derived from OTSG Policy Memo 15-039[18] **(Figure)** and defined using the following criteria: Group A: four or more prescriptions all within 30 days of one another for *any* drug (including antibiotics, antihypertensives, statins, etc.) where at least one is an opioid; *or* Group B: four or more prescriptions all within 30 days of one another from among the seven categories of psychotropic or CNSD medications listed above; *or* Group C: three or more emergency room (ER) visits during the surveillance period, each within 7 days of an opioid prescription. Of note, for efficiency, the group C inclusion criteria deviate from OTSG Policy Memo 15-039 by limiting analysis to the surveillance period (calendar year 2016) rather than any consecutive 12-month interval that has case-defining (e.g., third) ER visit associated with an opioid prescription in 2016. Additionally, persons who met polypharmacy criteria were further grouped into strata consisting of those meeting criteria for only one group as "low" (i.e., only group A, B, or C), those meeting criteria for two groups but not three as "moderate" (e.g., groups A and B but not C), and those meeting criteria for all three groups as "high."

Prior incident mental health diagnoses were defined according to Armed Forces

Health Surveillance Branch standardized health surveillance case definitions[50] and included: adjustment disorders, alcohol-related disorders, anxiety disorders, bipolar disorders, depressive disorders, personality disorders, psychoses, post-traumatic stress disorder, schizophrenia, and substance-related disorders. For the period prevalence calculation, individuals were considered to have an existing mental health diagnosis if it was diagnosed before the end of the surveillance period (31 December 2016).

A matched case-control design was used to explore the association between incident SI that occurred during 2016 and polypharmacy in the preceding 12 months. The surveillance period for this component of the analysis was, therefore, 1 January 2015 through 31 December 2016. The surveillance population included all individuals who served in an active component of the Army, Navy, Air Force, or Marine Corps at any time during 2016 with evidence in DMSS of at least one existing mental health condition (defined above). An incident case of SI was defined as one inpatient encounter with a diagnosis of SI (ICD-10: R45.851) in the first or second diagnostic position, two outpatient medical encounters within 180 days of each other with a diagnosis of SI in the first or second diagnostic position, or one outpatient medical encounter in a psychiatric or mental healthcare specialty setting with a diagnosis of SI in the first or second diagnostic position. Individuals who received a diagnosis of SI before 1 January 2016 were excluded as prevalent cases. Each individual could be counted as an incident case once during the surveillance period. Controls were sampled cumulatively from those in service at the time of the SI case diagnosis, assigned at a ratio of three controls per case (3:1), matched on age (within 1 year) and sex. Cases and controls were excluded if the service member deployed within 12 months prior to the incident date of SI diagnosis. Analysis of matched groups was conducted by using conditional logistic regression to estimate the odds of SI among those with polypharmacy, compared to those without after adjusting for potential confounders, including race/ethnicity, military rank/grade, deployment history, marital status, education level, length of service, and military occupation.

RESULTS

Period prevalence of polypharmacy

The percentages of polypharmacy overall and stratified by covariate subgroups are shown in **Table 1**. In 2016, a total of 139,249 individuals met any of the three criteria for polypharmacy, corresponding to an overall period prevalence of 10.8% across the active component military. The highest levels of polypharmacy were among Army members (14.5%) and the lowest levels were among those in the Navy (7.8%) or the Marine Corps (7.4%). The most common type of polypharmacy in 2016 was group A (those with four or more prescriptions, at least one opioid), accounting for 120,569 (86.6%) of the individuals. The highest-risk group (those who met all three criteria) accounted for only 976 (0.7%) of all individuals with polypharmacy. Overall, 54,860 (39.4%) of all persons who met at least one criterion for polypharmacy had been diagnosed with a mental health disorder at any point in time before the end of 2016. The conditional probability of having a prior mental health diagnosis and meeting criteria for group B was very high (3,196 of 3,727 = 85.8%), compared with that of group A (35.1%) and group C (22.3%).

Covariate analysis showed that, on 30 June 2016, polypharmacy was most prevalent among active component service members with the following characteristics: aged 35 years or older (14.9%), female (17.8%), senior enlisted (12.2%) or warrant officer (13.4%) ranks, non-Hispanic black (13.3%), other/unknown marital status (16.3%), an educational attainment of either non-completion of high school (13.1%) or having completed some college (13.8%), 11 or more years of service (13.6%), multiple deployments (12.1%), working in a healthcare occupation (15.3%), and among those diagnosed with a mental health disorder (20.8%).

Association with suicidal ideation

The frequency distributions of the covariates among cases and controls are shown in **Table 2**. A total of 2,754 cases of incident SI were identified among service members with existing mental health disorders in 2016. A total of 8,262 age- and sex-matched controls were randomly selected from all other service members who had been identified with a diagnosis of a mental health condition. The differences between the distributions of service, rank, race/ethnicity, marital status, educational attainment, length of service, deployment history, and military occupation of cases and controls were statistically significant ($p<0.05$). In particular, compared to age- and sex-matched controls, cases were more frequently in the Army, junior enlisted (E1–E4), and with less than 2 years of service.

The adjusted odds ratios of polypharmacy exposure within 1 year prior to date of incident SI diagnosis are presented in **Table 3**. Among similar service members with existing mental health conditions, those diagnosed with incident SI in 2016 had higher adjusted odds of polypharmacy exposure in the preceding 12 months. The adjusted odds of incident SI were 53% higher for those classified in the "low" stratum (AOR 1.53; 95% CI, 1.38–1.71), 120% higher for those in the "moderate" stratum (AOR 2.20; 95% CI, 1.92–2.53), and more than 200% higher for those service members in the "high" stratum (AOR 3.06; 95% CI, 2.00–4.70).

EDITORIAL COMMENT

The first part of this report examines the period prevalence of polypharmacy in active component military members during 2016. The overall period prevalence of 10.8% across the active component military is higher than the previous estimate of 8.4% from among OEF/OIF veterans in 2011.[15] However, it is difficult to compare these two studies that used different definitions of polypharmacy. When compared to results from a study using the same definition as this report, the estimated prevalence of 14.5% among Army personnel observed in the current analysis was considerably higher than the previous estimate of 2.2%–7.6% from among active duty Army in combat brigades at Fort Campbell, KY, in 2012.[17] One possible explanation for this difference is that the compositions of units with combat-specific missions differ from

TABLE 1. Number and period prevalence (PP) of polypharmacy, by military and demographic characteristics, active component, U.S. Armed Forces, 2016

			1 criterion (low)								2 criteria[a] (moderate)						3 criteria (high)		
	Any group		Group A only		Group B only		Group C only		Total		Groups A and B		Groups A and C		Total		Groups A, B, and C		Population on 30 June 2016
	No.	PP (%)	No.	PP (%)	No.	PP (%)	No.	PP (%)	No.	PP (%)	No.	PP (%)	No.	PP (%)	No.	PP (%)	No.	PP (%)	No.
Total	139,249	10.8	120,569	9.3	3,727	0.29	197	0.02	124,493	9.6	11,984	0.93	1,796	0.14	13,780	1.07	976	0.08	1,291,250
Sex																			
Male	102,949	9.5	88,608	8.1	2,853	0.26	156	0.01	91,617	8.4	9,472	0.87	1,178	0.11	10,650	0.98	682	0.06	1,087,226
Female	36,300	17.8	31,961	15.7	874	0.43	41	0.02	32,876	16.1	2,512	1.23	618	0.30	3,130	1.53	294	0.14	204,024
Age (years)																			
17–24	45,610	9.2	41,666	8.4	774	0.16	90	0.02	42,530	8.6	1,996	0.40	794	0.16	2,790	0.56	290	0.06	494,200
25–34	51,568	10.0	43,946	8.5	1,611	0.31	75	0.01	45,632	8.9	4,863	0.95	641	0.12	5,504	1.07	432	0.08	514,491
35+	42,071	14.9	34,957	12.4	1,342	0.47	32	0.01	36,331	12.9	5,125	1.81	361	0.13	5,486	1.94	254	0.09	282,559
Race/ethnicity																			
Non-Hispanic white	76,937	10.3	65,379	8.8	2,215	0.30	105	0.01	67,699	9.1	7,670	1.03	966	0.13	8,636	1.16	602	0.08	743,669
Non-Hispanic black	28,159	13.3	25,061	11.9	631	0.30	42	0.02	25,734	12.2	1,856	0.88	404	0.19	2,260	1.07	165	0.08	211,239
Hispanic	19,934	10.5	17,641	9.3	480	0.25	27	0.01	18,148	9.5	1,402	0.74	258	0.14	1,660	0.87	126	0.07	190,167
Asian/Pacific Islander	5,309	10.2	4,743	9.1	155	0.30	6	0.01	4,904	9.4	337	0.65	52	0.10	389	0.75	16	0.03	52,000
American Indian/Alaska Native	1,342	10.2	1,126	8.5	50	0.38	2	0.02	1,178	8.9	122	0.93	22	0.17	144	1.09	20	0.15	13,185
Other/unknown	7,568	9.3	6,619	8.2	196	0.24	15	0.02	6,830	8.4	597	0.74	94	0.12	691	0.85	47	0.06	80,990
Education																			
Less than high school	297	13.1	241	10.6	13	0.57	1	0.04	255	11.3	35	1.55	5	0.22	40	1.77	2	0.09	2,264
High school	85,312	10.5	74,305	9.1	2,187	0.27	149	0.02	76,641	9.4	6,689	0.82	1,293	0.16	7,982	0.98	689	0.08	813,839
Some college	22,802	13.8	19,166	11.6	675	0.41	20	0.01	19,861	12.0	2,519	1.52	252	0.15	2,771	1.67	170	0.10	165,532
Bachelor's or advanced degree	28,756	10.3	25,019	8.9	796	0.28	23	0.01	25,838	9.2	2,588	0.92	219	0.08	2,807	1.00	111	0.04	280,306
Unknown	2,082	7.1	1,838	6.3	56	0.19	4	0.01	1,898	6.5	153	0.52	27	0.09	180	0.61	4	0.01	29,309
Marital status																			
Single, never married	46,174	8.5	41,880	7.7	990	0.18	86	0.02	42,956	7.9	2,283	0.42	663	0.12	2,946	0.54	272	0.05	542,195
Married	84,536	12.1	71,624	10.3	2,434	0.35	107	0.02	74,165	10.6	8,686	1.25	1,038	0.15	9,724	1.40	647	0.09	696,613
Other/unknown	8,539	16.3	7,065	13.5	303	0.58	4	0.01	7,372	14.1	1,015	1.94	95	0.18	1,110	2.12	57	0.11	52,442
Service																			
Army	68,089	14.5	58,295	12.4	2,013	0.43	68	0.01	60,376	12.8	6,356	1.35	826	0.18	7,182	1.53	531	0.11	470,281
Navy	25,292	7.8	21,968	6.7	587	0.18	68	0.02	22,623	6.9	1,963	0.60	492	0.15	2,455	0.75	214	0.07	326,073
Air Force	32,263	10.4	28,669	9.2	632	0.20	33	0.01	29,334	9.4	2,448	0.79	325	0.10	2,773	0.89	156	0.05	311,527
Marine Corps	13,605	7.4	11,637	6.3	495	0.27	28	0.02	12,160	6.6	1,217	0.66	153	0.08	1,370	0.75	75	0.04	183,369
Military rank/grade																			
Junior enlisted (E1–E4)	58,052	10.4	52,178	9.3	1,215	0.22	103	0.02	53,496	9.6	3,141	0.56	988	0.18	4,129	0.74	427	0.08	559,790
Senior enlisted (E5–E9)	60,843	12.2	50,613	10.1	1,948	0.39	77	0.02	52,638	10.5	7,056	1.41	672	0.13	7,728	1.54	477	0.10	500,443
Warrant officer (W1–W5)	2,493	13.4	2,122	11.4	75	0.40	1	0.01	2,198	11.8	274	1.48	12	0.06	286	1.54	9	0.05	18,553
Junior officer (O1–O3)	9,098	7.0	7,962	6.1	251	0.19	9	0.01	8,222	6.3	759	0.58	76	0.06	835	0.64	41	0.03	129,877
Senior officer (O4–O10)	8,763	10.6	7,694	9.3	238	0.29	7	0.01	7,939	9.6	754	0.91	48	0.06	802	0.97	22	0.03	82,587
Length of service (years)																			
Less than 2	25,934	9.5	24,267	8.9	285	0.10	45	0.02	24,597	9.0	803	0.29	407	0.15	1,210	0.44	127	0.05	273,504
2–4	33,086	9.4	29,227	8.3	797	0.23	63	0.02	30,087	8.6	2,135	0.61	579	0.17	2,714	0.77	285	0.08	350,318
5–10	31,433	10.2	26,417	8.6	1,086	0.35	47	0.02	27,550	9.0	3,235	1.05	389	0.13	3,624	1.18	259	0.08	307,334
11 or more	48,796	13.6	40,658	11.3	1,559	0.43	42	0.01	42,259	11.7	5,811	1.61	421	0.12	6,232	1.73	305	0.08	360,094
Deployment history																			
Never deployed	65,924	10.1	59,138	9.1	1,342	0.21	101	0.02	60,581	9.3	3,850	0.59	1,019	0.16	4,869	0.75	474	0.07	652,882
1 deployment	27,796	10.6	23,639	9.0	839	0.32	44	0.02	24,522	9.4	2,729	1.04	338	0.13	3,067	1.17	207	0.08	262,181
2 or more deployments	45,529	12.1	37,792	10.0	1,546	0.41	52	0.01	39,390	10.5	5,405	1.44	439	0.12	5,844	1.55	295	0.08	376,187
Military occupation																			
Infantry/artillery/combat engineering/armor	17,880	9.9	15,194	8.4	558	0.31	25	0.01	15,777	8.7	1,773	0.98	192	0.11	1,965	1.09	138	0.08	180,670
Motor transport	4,281	11.5	3,693	9.9	104	0.28	7	0.02	3,804	10.2	365	0.98	79	0.21	444	1.19	33	0.09	37,294
Pilot/air crew	2,917	6.0	2,554	5.2	77	0.16	4	0.01	2,635	5.4	259	0.53	9	0.02	268	0.55	14	0.03	48,799
Repair/engineer	38,111	9.9	33,107	8.6	878	0.23	67	0.02	34,052	8.8	3,224	0.84	547	0.14	3,771	0.98	288	0.07	385,307
Communications/ intelligence	34,976	12.4	30,349	10.7	961	0.34	35	0.01	31,345	11.1	2,978	1.05	421	0.15	3,399	1.20	232	0.08	282,852
Health care	17,665	15.3	15,097	13.1	590	0.51	17	0.01	15,704	13.6	1,609	1.40	216	0.19	1,825	1.58	136	0.12	115,294
Other/unknown	23,419	9.7	20,575	8.5	559	0.23	42	0.02	21,176	8.8	1,776	0.74	332	0.14	2,108	0.87	135	0.06	241,034
Existing psychiatric diagnosis[b]																			
Yes	54,860	20.8	42,352	16.1	3,196	1.21	44	0.02	45,592	17.3	7,803	2.96	784	0.30	8,587	3.26	681	0.26	263,576
No	84,389	8.2	78,217	7.6	531	0.05	153	0.01	78,901	7.7	4,181	0.41	1,012	0.10	5,193	0.51	295	0.03	1,027,674

[a]No individuals met criteria for both groups B and C in 2016.
[b]Adjustment disorder, alcohol-related disorder, anxiety disorder, bipolar disorders, depressive disorder, personality disorders, psychoses, post-traumatic stress disorder, schizophrenia, and/or substance-related disorder on or before 31 December 2016

TABLE 2. Comparison of cases of suicidal ideation and selected controls, by military and demographic characteristics, service members with a previous diagnosis of mental health disorder, active component, U.S. Armed Forces, 2016

	Case (n=2,754)		Control (n=8,262)	
	No.	%	No.	%
Sex				
Male	2,007	72.9	6,021	72.9
Female	747	27.1	2,241	27.1
Age (years)				
17–24	1,339	48.6	4,017	48.6
25–34	1,003	36.4	2,996	36.3
35+	412	15.0	1,249	15.1
Race/ethnicity				
Non-Hispanic white	1,494	54.3	4,686	56.7
Non-Hispanic black	589	21.4	1,581	19.1
Hispanic	387	14.1	1,203	14.6
Asian/Pacific Islander	127	4.6	258	3.1
American Indian/Alaska Native	22	0.8	94	1.1
Other/unknown	135	4.9	440	5.3
Marital status				
Single, never married	1,201	43.6	3,337	40.4
Married	1,364	49.5	4,404	53.3
Other/unknown	189	6.9	521	6.3
Education				
Less than high school	6	0.2	14	0.2
High school	2,129	77.3	6,150	74.4
Some college	364	13.2	1,109	13.4
Bachelor's or advanced degree	222	8.1	891	10.8
Unknown	33	1.2	98	1.2
Service				
Army	1,639	59.5	4,123	49.9
Navy	350	12.7	1,587	19.2
Air Force	517	18.8	1,616	19.6
Marine Corps	248	9.0	936	11.3
Grade				
Junior enlisted (E1–E4)	1,695	61.6	4,446	53.8
Senior enlisted (E5–E9)	939	34.1	3,220	39.0
Warrant officer (W1–W5)	8	0.3	78	0.9
Junior officer (O1–O3)	83	3.0	313	3.8
Senior officer (O4–O10)	29	1.1	205	2.5
Length of service (years)				
Less than 2	650	23.6	1,320	16.0
2–4	914	33.2	2,969	35.9
5–10	680	24.7	2,090	25.3
11 or more	510	18.5	1,883	22.8
Deployment history				
Never deployed	1,683	61.1	4,764	57.7
1 deployment	474	17.2	1,539	18.6
2 or more deployments	597	21.7	1,959	23.7
Military occupation				
Infantry/artillery/combat engineering/armor	412	15.0	1,127	13.6
Motor transport	102	3.7	326	4.0
Pilot/air crew	22	0.8	64	0.8
Repair/engineering	751	27.3	2,266	27.4
Communications/intelligence	654	23.8	2,091	25.3
Health care	352	12.8	1,121	13.6
Other/unknown	461	16.7	1,267	15.3
Polypharmacy exposure				
1 criterion (low)	814	29.6	2,002	24.2
2 criteria (moderate)	442	16.1	736	8.9
3 criteria (high)	46	1.7	49	0.6

that of the Army overall and, over time, select for healthier soldiers who do not have deployment-limiting conditions. Soldiers with complex medical problems that limit deployment, who are more likely to require multiple medications and potentially meet criteria for polypharmacy, are less likely to serve in such a unit and thus the prevalence estimate would be lower. Furthermore, it is possible that the prevalence of prescription drug use and polypharmacy have increased since 2012.

The observation that individuals in group B (those with multiple psychotropic or CNSD drugs) had the highest conditional probability of a comorbid mental health disorder is expected. Individuals who are prescribed multiple psychotropic drugs are more likely to have one or more mental health conditions for which these types of medications are clinically indicated. Similarly, the fact that most (86.6%) of the polypharmacy exposure in this study arose from individuals meeting criteria for group A is not surprising as there are many more types of clinical situations for which sufficient medications to satisfy the criteria for group A would be prescribed than there are for the other two groups.

The observation that higher prevalence of polypharmacy exposure was found among individuals working in healthcare occupations echoes the observation that healthcare workers accounted for the highest rates of overall prescription drugs in 2014.[51] These findings highlight a trend seen in surveillance reports on low back pain,[52] acute respiratory illness,[53] alcohol-related diagnoses,[54] and obstructive sleep apnea,[55] among others. A possible explanation is that healthcare workers have easier access to medical treatment by virtue of working in the same facility. Alternatively, persons with medical needs may select for healthcare occupations that are generally less physically demanding than combat-specific or other support occupations.

The second part of this report explores the association between incident SI and precedent polypharmacy exposure within 12 months. Polypharmacy was found to be associated with incident SI (AOR = 1.53–3.06), which supports similar findings from a 2010–2011 study of OEF/OIF veterans.[15] The strength of the association increased as

TABLE 3. Crude (OR) and adjusted[a] odds ratio (AOR) of suicidal ideation, active component service members with a previous diagnosis of mental health disorder, U.S. Armed Forces, 2016

	OR	95% CI	AOR	95% CI
Polypharmacy exposure				
1 criterion (low)	1.32	(1.20–1.45)	1.53	(1.38–1.71)
2 criteria (moderate)	1.97	(1.73–2.24)	2.20	(1.92–2.53)
3 criteria (high)	2.84	(1.90–4.26)	3.06	(2.00–4.70)
Race/ethnicity				
Non-Hispanic white	ref		ref	
Non-Hispanic black	1.18	(1.05–1.32)	1.08	(0.95–1.21)
Hispanic	1.01	(0.89–1.15)	1.00	(0.87–1.14)
Asian/Pacific Islander	1.55	(1.24–1.93)	1.46	(1.16–1.85)
American Indian/Alaska Native	0.73	(0.46–1.16)	0.81	(0.49–1.32)
Other/unknown	0.96	(0.79–1.18)	1.13	(0.91–1.40)
Marital status				
Single, never married	ref		ref	
Married	0.82	(0.73–0.91)	0.84	(0.75–0.94)
Other/unknown	0.95	(0.78–1.16)	0.95	(0.77–1.18)
Education				
Less than high school	1.15	(0.44–3.00)	1.43	(0.52–3.94)
High school	ref		ref	
Some college	0.88	(0.77–1.02)	0.87	(0.75–1.01)
Bachelor's or advanced degree	0.65	(0.55–0.78)	0.65	(0.52–0.83)
Unknown	0.94	(0.63–1.41)	1.06	0.69–1.63)
Service				
Army	ref		ref	
Navy	0.55	(0.48–0.63)	0.58	(0.50–0.67)
Air Force	0.80	(0.71–0.90)	0.88	(0.77–1.00)
Marine Corps	0.67	(0.57–0.78)	0.76	(0.64–0.89)
Military rank/grade				
Junior enlisted (E1–E4)	ref		ref	
Senior enlisted (E5–E9)	0.45	(0.39–0.52)	0.65	(0.54–0.77)
Warrant officer (W1–W5)	0.13	(0.06–0.28)	0.20	(0.09–0.43)
Junior officer (O1–O3)	0.42	(0.32–0.55)	0.61	(0.43–0.86)
Senior officer (O4–O10)	0.16	(0.10–0.25)	0.33	(0.20–0.54)
Length of service (years)				
Less than 2	ref		ref	
2–4	0.42	(0.36–0.49)	0.42	(0.36–0.49)
5–10	0.28	(0.23–0.34)	0.35	(0.28–0.45)
11 or more	0.14	(0.11–0.18)	0.19	(0.14–0.26)
Deployment history				
Never deployed	ref		ref	
1 deployment	0.79	(0.69–0.90)	0.99	(0.85–1.15)
2 or more deployments	0.73	(0.63–0.85)	1.01	(0.84–1.21)
Military occupation				
Infantry/artillery/combat engineering/ armor	1.01	(0.86–1.18)	0.94	(0.80–1.12)
Motor transport	0.86	(0.67–1.10)	0.79	(0.61–1.03)
Pilot/air crew	0.94	(0.57–1.56)	1.78	(1.03–3.05)
Repair/engineering	0.91	(0.80–1.05)	0.96	(0.83–1.11)
Communications/intelligence	0.86	(0.75–0.98)	0.86	(0.74–0.99)
Health care	0.86	(0.73–1.01)	0.88	(0.74–1.04)
Other/unknown	ref		ref	

CI, confidence interval

[a]Conditional logistic regression of age- and sex-matched groups, adjusted for listed covariates with indicated reference groups

more criteria for polypharmacy exposure were satisfied, although the CIs widen to reflect the smaller sample sizes. This association should be interpreted with some caution as there are limitations to this report. It is possible that this observation reflects the influence of confounding from some variable that was not included in this analysis such as financial stress, recent loss of a loved one, baseline variations in accession standards by year of entry into the military, or perhaps most importantly, the type or severity of the underlying mental health disorder. For example, individuals with more severe mental health disorders might be more likely to report SI to a healthcare provider and also more likely to be prescribed more medications, which would confound association between polypharmacy and incident SI found in this report. The administrative data used for this analysis have limited capacity to ascertain illness severity and future study should take this into consideration.

Another limitation of the current analysis is that it did not account for differences between individuals who meet polypharmacy criteria repeatedly (e.g., chronic prescription use) compared with those who only meet criteria transiently (e.g., following an acute injury or surgical procedure). The duration of polypharmacy exposure may serve as an indicator of conditions that are more chronic and that previous research has demonstrated increase the risk of suicidal behaviors.[56,57] Therefore, polypharmacy may have been misclassified in this analysis, which could have biased the observed association with SI toward null. Future studies should explore the difference between chronic and acute polypharmacy on outcomes such as SI. Finally, this report did not capture medications dispensed in the deployed environment or aboard ship for the U.S. Navy, so the true period prevalence may have been underestimated.

This report describes the findings of an exploratory analysis of the prevalence of polypharmacy among active component service members of the U.S. Armed Forces. The observation of an independent association between incident SI and precedent polypharmacy in the previous year is concerning. However, there are important limitations to the current analysis that should

be addressed in future studies before trying to infer a causal relationship. Nevertheless, it would be prudent to screen for SI during the polypharmacy clinical encounter, particularly for persons with any of the mental health disorders considered in this report. Inclusion of DoDSER data along with medically coded SI in future surveillance would serve to increase the sensitivity of identifying incident cases of SI.

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Acknowledgments: The authors thank Dr. Saixia Ying for her invaluable assistance with data collection and analysis; COL (Dr.) P. Ann Loveless for project oversight, mentorship, and feedback; and Ms. Amaris Thurston for project coordination and maintaining timeline.

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Variations in the Incidence and Burden of Illnesses and Injuries Among Non-retiree Service Members in the Earliest, Middle, and Last 6 Months of Their Careers, Active Component, U.S. Armed Forces, 2000–2015

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This report uses routinely collected data in the Defense Medical Surveillance System (DMSS) to characterize the incidence and burden of medical conditions throughout the careers of service members separating from the active component of the U.S. Armed Forces between 1 October 2014 and 30 September 2015. Three surveillance periods between 30 September 2000 and 30 September 2015 were defined by each individual's time in service: early (first 6 months), middle (middle 6 months), and late (last 6 months). Overall, separating service members were most often aged 25–34 years (59.4%), male (84.0%), non-Hispanic white (64.0%), junior enlisted (52.4%), in the Marine Corps (33.1%), serving in a repair/engineering occupation (33.0%), and had never deployed (52.5%). The top five burden of disease categories across surveillance periods by sex were very similar, including mental health disorders, which exhibited similar upward trends across the three surveillance periods (males: 1.3%, 17.0%, and 35.6%; females: 1.8%, 15.1%, and 32.4%, respectively). The most common diagnoses exhibiting upward, downward, or bimodal trends by incidence rate differences were mental health disorders, respiratory infections/diseases, and musculoskeletal diseases, respectively.

The burden and incidence of medical conditions among residents of the U.S. vary by age, sex, race/ethnicity, socioeconomic status, insurance status, occupation, clinical setting, geographical region, and time.[1-7] Active component service members (ACSMs) represent a unique subset of this population. Entrance into the U.S. Armed Forces requires a minimum level of health and fitness among applicants,[8] making ACSMs, at least upon entry, healthier than their civilian counterparts, a phenomenon known as the "healthy soldier effect."[9,10] After entry, occupational and readiness requirements expose service members to numerous unique hazards not commonly found outside the military. The selection of healthy men and women for accession and the subsequent exposure profile of active service prevent the generalization of civilian incidence and burden findings to military populations.

Military medical standards for accession are stricter than retention standards. For instance, potential recruits with symptomatic hemorrhoids and/or abdominal wall hernias would likely not meet accession standards, but ACSMs with these conditions, with rare exceptions, would not be medically separated.[8,11-13] However, ACSMs must continue to meet health and fitness requirements to maintain their service eligibility. These requirements are updated periodically and vary across occupational class and branch of service.[8,11-13] The distinct occupations within each service expose ACSMs to unique work settings and environments, both in garrison and while deployed. For those ACSMs pursuing career longevity and certain military occupations, there are disincentives for reporting medical conditions or seeking care. The development of post-accession medical conditions raises the possibility of adverse personnel actions such as medical evaluation boards and subsequent medical separation, duty location or deployment limitations, or career field denial or termination, particularly special-duty occupations such as aviation and special forces.

On the other hand, as ACSMs approach and prepare for retirement (service of 20 or more years) or separation (service of less than 20 years), there are positive incentives for reporting health issues and having them evaluated, treated if necessary, and documented in their health records. Service members who retire or separate with service-connected health conditions or disabilities are eligible for disability compensation and health care for those conditions through the Department of Veterans Affairs.[14] Because of the occupational disincentives for healthcare-seeking behaviors and the pre-separation incentives for such behaviors, precise estimates of the burden and incidence of medical conditions throughout service members' careers are difficult to ascertain.

Two previous studies characterized the incidence of illnesses and injuries immediately prior to retirement. Service members within 6 months of retirement were more likely than pre-retirees (12–18 months before retirement) to receive any medical diagnosis, particularly those diagnoses common among similarly aged Americans and compensable as service-connected disabilities.[15] Additionally, 72.1% of retirees were diagnosed with a new medical condition within 6 months of retirement, and the number of illnesses and injuries, both new and old, differed by occupational group and

rank.[16] However, these studies included only retirees, and, on average, about 17% of enlisted service members and officers across all branches ever reach retirement eligibility.[17] The remaining 83% of ACSMs that separate from service tend to be younger, lower ranking, and less advanced in their careers than retirees. Although other differences likely exist, these alone make separating service members a distinct subpopulation, warranting further study to better characterize illness and injury across the careers of ACSMs.

Medical readiness is the core focus of the Military Health System.[18,19] Service-specific databases that log readiness statistics indicate that deployment-limiting medical conditions are the main reasons why ACSMs are not deployable and thus not medically ready.[20-22] Characterization of the temporality of when medical conditions occur throughout the career of ACSMs, stratified by demographic and military characteristics, may offer insight for preventive interventions to improve the health and medical readiness of service populations. The purpose of this study is to characterize the incidence and burden of medical conditions throughout the careers of separating service members.

METHODS

The surveillance population included all individuals who entered active military service after 30 September 2000 and separated from the active component of the Air Force, Army, Marine Corps, or Navy between 1 October 2014 and 30 September 2015, and who had at least 48 months of continuous active service at the time of separation. Three surveillance periods were determined by the individual's dates of service: early (first 6 months), middle (middle 6 months), and late (last 6 months of service). Retirees (service members with 240 or more months of active service) and service members with any breaks in service during their careers (n = 9,585) or deployment days during any of the three surveillance periods (n = 16,339) were excluded.

For each individual in the study population, all illness and injury diagnoses (ICD-9: 000–999) that were recorded during inpatient and outpatient medical encounters in U.S. military medical facilities, and from purchased-care providers, were obtained from standardized medical records routinely maintained in the Defense Medical Surveillance System (DMSS). All ICD codes were grouped into 25 major burden of disease categories based on a modified version[23] of the Global Burden of Disease Study.[24] This grouping was done to provide an overall estimate of the most common conditions affecting service men and women during the three different surveillance periods.

To calculate the total hospitalizations and outpatient visits for each diagnosis, only three-digit ICD-9 codes in the first diagnostic position were included, with no more than one encounter per three-digit ICD code per individual per day. The proportion of total encounters for each burden of disease category was calculated by dividing the total encounters for each category by the overall total number of encounters.

Three-digit ICD-9 codes documented in any diagnostic position recorded for the first time in an ACSM's career and during each surveillance period were considered incident (first-time) occurrences. The total number of at-risk ACSMs for each surveillance period was the number of service members in the study population not diagnosed with the respective ICD code prior to the start of the surveillance period. Incidence rates (IRs) were calculated by dividing the number of first-time occurrences by the number of at-risk service members for each ICD code for each surveillance period.

Three trends in IR—upward, downward, and bimodal—were chosen for analyses. An upward trend was defined as an increase in IR between both the early and middle and middle and late surveillance periods. Diagnoses exhibiting an upward trend were ranked by the total difference in the IR between the late and early surveillance periods from largest to smallest. A downward trend was defined as a decrease in the IR between both the early and middle and middle and late surveillance periods. Diagnoses exhibiting a downward trend were ranked by the total difference in the IR between the late and early surveillance periods from largest to smallest. A bimodal trend was defined as a decrease in the IR between the early and middle surveillance period and an increase between the middle and late period. Diagnoses exhibiting a bimodal trend in the IRs were ranked by the sum of the absolute value of the difference between the early and middle surveillance period and the absolute value of the difference between the middle and late period from largest to smallest. For all trends, results were stratified by sex.

RESULTS

The demographic and military characteristics of the study population by time in service are shown in **Table 1**. Of the 45,363 total separating service members between 1 October 2014 and 30 September 2015 with at least 4 years of continuous active component service, 32,597 (71.9%) separated with 4–8 years of active service, 10,040 (22.1%) with 8–12 years, and 2,726 (6.0%) with 12–15 years. Overall, separating service members were most often aged 25–34 years (59.4%), male (84.0%), non-Hispanic white (64.0%), and junior enlisted (52.4%). The Marine Corps (33.1%) contributed more ACSMs to the study population than any of the other services. The occupational category of repair/engineering was the most common (33.0%). Among all members of the study population, 52.5% had never deployed.

Overall, females had more total encounters per service member in the early, middle, and late surveillance periods (5.0, 6.3, and 12.3, respectively) than males (3.0, 2.6, and 7.3, respectively) **(data not shown)**. The proportions of total outpatient and inpatient encounters by burden of disease major categories for each surveillance period and sex are shown in the **Figure**. The five top-ranking burden of disease major categories in all surveillance periods in both sexes were very similar. Injuries/poisonings, musculoskeletal diseases, and signs and symptoms were present in the five top-ranking categories in both sexes across all three surveillance periods. Respiratory infections (males: 29.9%; females: 17.0%) were among the top-ranking diagnoses in the first surveillance period but were

TABLE 1. Demographic and military characteristics[a] of service members who separated between 1 October 2014 and 30 September 2015 with 4–15 years of continuous active service, active component, U.S. Armed Forces

	No.	%
Total individuals	45,363	100.0
Sex		
Male	38,092	84.0
Female	7,271	16.0
Age (years) at time of separation		
17–24	15,788	34.8
25–34	26,936	59.4
35–39	1,934	4.3
40–49	678	1.5
50+	27	0.1
Race/ethnicity		
Non-Hispanic white	29,028	64.0
Non-Hispanic black	5,471	12.1
Hispanic	5,868	12.9
Asian/Pacific Islander	1,632	3.6
American Indian/Alaska Native	606	1.3
Other/unknown	2,758	6.1
Service		
Army	13,414	29.6
Navy	10,046	22.1
Air Force	6,879	15.2
Marine Corps	15,024	33.1
Grade at time of separation		
Junior enlisted (E1–E4)	23,761	52.4
Senior enlisted (E5–E9)	18,424	40.6
Warrant officer (W1–W5)	76	0.2
Junior officer (O1–O3)	2,500	5.5
Senior officer (O4–O10)	602	1.3
Military occupation		
Infantry/artillery/combat engineering/armor	7,901	17.4
Motor transport	1,444	3.2
Pilot/air crew/air traffic	659	1.5
Repair/engineering	14,969	33.0
Communications/ intelligence	9,876	21.8
Health care	4,365	9.6
Other/unknown	6,149	13.6
Time in service (years)		
4–8	32,597	71.9
8–12	10,040	22.1
12–15	2,726	6.0
No. of deployments		
None	23,828	52.5
One	12,689	28.0
More than one	8,846	19.5

[a]Characteristics at the time of military separation

not among the five top-ranking diagnoses thereafter. Additionally, mental health disorders exhibited similar upward trends across the three surveillance periods representing one-third of total encounters in both sexes in the last period (males: 1.3%, 17.0%, and 35.6%; females: 1.8%, 15.1%, and 32.4%, respectively).

Although the distributions of the major burden of disease categories in the surveillance periods were broadly similar for males and females, several differences emerged. Injuries/poisonings remained consistent at 15.5% across the first and middle surveillance period and then fell to 6.6% among males but showed a consistent decline across surveillance periods among females (15.0%, 7.9%, and 4.2%, respectively). Musculoskeletal disorders peaked at 24.3% in the middle surveillance period for males but peaked at 23.4% in the first period for females. The "all other" category (the proportion of total encounters for all major burden categories ranked 6th through 25th for each surveillance period) was also slightly larger among females than among males across all periods (males: 23.2%, 24.8%, and 16.1%; females: 25.4%, 31.8%, and 23.2%, respectively).

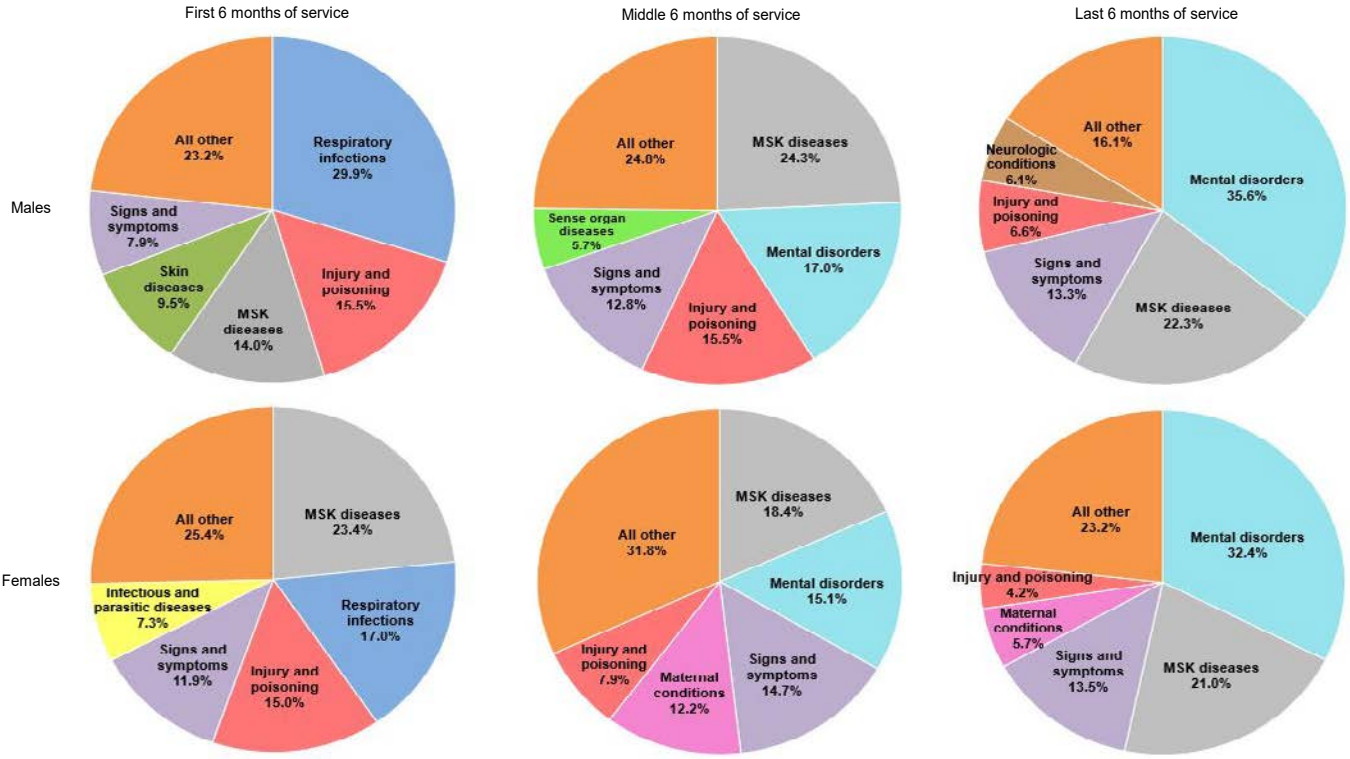
Tables 2a and **2b** show the 10 top-ranking diagnoses exhibiting upward, downward, or bimodal trends across the three surveillance periods, by IR differences, among males and females, respectively. For upward trends, mental health disorders were the most common type of diagnosis in the 10 top-ranking diagnoses for both sexes, and musculoskeletal conditions were more common in females than males. However, it should be noted that the substantial increase in the incidence rates of adjustment reaction over time was largely driven by diagnoses of posttraumatic stress disorder (ICD-9: 309.81), which increased from 1.1% to 17.9% of the total 309.* diagnoses among males and from 3.1% to 16.4% among females from the first to last period **(data not shown)**. The downward-trending top 10 list comprised mostly respiratory infections/diseases, and injuries/poisonings were more common in females than males. Lastly, for bimodal trends, musculoskeletal conditions were the most common conditions for both sexes in their top 10 lists.

EDITORIAL COMMENT

This report examines the diagnostic trends across three time points in the careers of service members separating from the active component between 1 October 2014 and 30 September 2015. Several comparisons can be made to previous studies on overall disease burdens and common diagnoses in recruits and retiring service members.

Crowded living conditions[25] and the stressful environment of military training,[26-29] make recruit populations particularly susceptible to respiratory infections.[30] Therefore, the observed encounter burden of respiratory infections in the first 6 months of service and the downward trend in related three-digit ICD-9 codes across surveillance periods is consistent with expectations and prior findings. Additionally, the commonality of musculoskeletal conditions, including "other and unspecified disorders of joint" (ICD-9: 719), "other disorders of soft tissues" (ICD-9: 729), and "disorders of muscle ligament and fascia" (ICD-9: 728), in both the first 6 months and last 6 months of service (bimodal trend) is not surprising. Two factors are likely contributing to this finding. First, in the initial 6 months of service, recruits during basic training are particularly prone to injuries and musculoskeletal conditions[31-34]; this increased risk is especially evident for females,[34-36] which might also explain the greater proportionate encounter burden for injuries/poisonings and musculoskeletal disorders among females during the first 6 months (38.4%) versus among males (29.5%). During the last 6 months of service, ACSMs are encouraged to report chronic conditions during separation/ retirement physicals as documentation of service-connected conditions increases their likelihood of both obtaining disability compensation[14] through the Department of Veterans Affairs (VA) and accessing VA healthcare.[37] Conversely, during the middle 6 months of service, other than being older and having more time in service than the first 6 months of service, there are not any strong risk factors or VA entitlement incentives for seeking care or reporting these conditions.

FIGURE. Proportion of total outpatient and inpatient encounters in three surveillance periods,[a] by sex, by burden of disease major category,[23,24] active component, U.S. Armed Forces, 30 September 2000 through 30 September 2015



[a]First, middle, and last 6 months of service for all active component service members separating with at least 48 months of continuous service at the time of separation and without any deployment days in the surveillance periods or breaks in service

Mental health disorders dramatically increased in total encounter burden and were the most common diagnoses exhibiting upward trends in incidence across the careers of those separating from the U.S. Armed Forces. The types of mental health disorders exhibiting upward trends in this study for both sexes—"adjustment reaction" (ICD-9: 309), "anxiety, dissociative, and somatoform disorders" (ICD-9: 300), and "depressive disorder, not elsewhere classified" (ICD-9: 311)—also were among the most common incident mental health disorder categories including adjustment disorders, depressive disorders, and anxiety disorders among all service members during this time period.[38] These upward trends in incidence seem counter to trends observed in the civilian population in which most mental health disorders occur during childhood or adolescence.[39] However, most (94.2%) of the surveillance population in this study were aged 17–34 years, so this finding might not be surprising, especially as most of the more common disorders diagnosed during military service (e.g., mood disorders, other anxiety disorders, and substance use disorders)[38] are diagnosed after age 18.[39] Additionally, military service has many unique stressors,[40-51] particularly combat and trauma exposure,[40-42,44,47-49] which might explain these trends.

Two *MSMR* studies published in 2010 both found a pronounced increase in the incidence rates of illness and injury-related diagnoses within 6 months of retirement, compared to 12–18 months before retirement.[15,16] However, mental health conditions were neither among the 18 most frequent illnesses/injuries diagnosed among retirees[16] nor in the top 25 diagnoses by incident rate differences when comparing retirees versus "pre-retirees" or retirees versus "retirement eligible."[15] These are striking differences compared to this study's finding of a growing proportionate encounter burden across time in service and upward trends in mental health–related ICD codes for separating service members. There are several potential reasons for this difference. First, this study did not distinguish between voluntarily separating service members and those being medically separated. Many mental health conditions, especially those lasting longer than a year, requiring treatment, and/or impacting duty, do not meet retention standards,[11-13] and mental health disorders have been found to be the leading category of discharge diagnoses in men and the second leading category in women.[52] Service members reaching retirement are likely among the healthiest overall service members across time, and this could be the reason for the observed differences between the two populations.

The findings of this report should be interpreted in light of several important limitations. First, because this study did not focus on a single disease or subset of diseases, it would not have been feasible to

TABLE 2a. Top 10 diagnoses exhibiting upward,[a] downward,[b] or bimodal trends[c] across three surveillance periods[d] in separating service members' careers, by incidence rate (IR) differences, males only, U.S. Armed Forces, 30 September 2000 through 30 September 2015

Trend	ICD-9 code	Disease burden category	Diagnosis	IR per 1,000 persons					
				First	No. of incident cases	Middle	No. of incident cases	Last	No. of incident cases
Upward	724	Musculoskeletal diseases	Other and unspecified disorders of back	32.7	1,244	39.3	1,253	80.2	1,909
	799	Signs and symptoms	Other ill-defined and unknown causes of morbidity and mortality	28.5	1,084	50	1,506	75.3	1,605
	309	Mental disorders	Adjustment reaction	7.1	271	21.9	772	52.1	1,521
	327	Neurologic conditions	Organic sleep disorders	0.1	3	4.3	163	44.2	1,538
	300	Mental disorders	Anxiety, dissociative and somatoform disorders	2.7	101	11.7	429	41.2	1,306
	311	Mental disorders	Depressive disorder, not elsewhere classified	1.9	72	8.8	326	27.8	930
	338	Neurologic conditions	Pain, not elsewhere classified	0.8	29	8.2	308	23.4	784
	388	Sense organ diseases	Other disorders of ear	5.2	197	6	222	27.5	959
	796	Signs and symptoms	Other nonspecific abnormal findings	6.9	261	13.9	500	25.4	822
	307	Mental disorders	Special symptoms or syndromes not elsewhere classified	3.4	131	6.1	226	21.8	751
Downward	465	Respiratory infections	Acute upper respiratory infections of multiple or unspecified sites	281.7	10,729	28.5	661	26.7	533
	460	Respiratory infections	Acute nasopharyngitis (common cold)	108.5	4,132	6.4	210	5.9	184
	462	Respiratory infections	Acute pharyngitis	77.9	2,966	20.5	645	17.6	495
	079	Infectious and parasitic diseases	Viral and chlamydial infection in conditions classified elsewhere and of unspecified site	69	2,628	13.3	440	10.7	330
	466	Respiratory infections	Acute bronchitis and bronchiolitis	51.5	1,962	5.7	201	4.6	156
	844	Injury and poisoning	Sprains and strains of knee and leg	48.8	1,857	16.3	541	10.4	316
	682	Skin diseases	Other cellulitis and abscess	44.2	1,683	11	379	9.3	303
	845	Injury and poisoning	Sprains and strains of ankle and foot	48.9	1,862	20.2	656	15	437
	490	Respiratory diseases	Bronchitis, not specified as acute or chronic	35.3	1,345	4.8	172	4.8	165
	704	Skin diseases	Diseases of hair and hair follicles	36.1	1,376	8.6	305	7.6	255
Bimodal	367	Sense organ diseases	Disorders of refraction and accommodation	257.3	9,800	47.1	985	66.2	1,095
	719	Musculoskeletal diseases	Other and unspecified disorders of joint	125.4	4,778	65.9	1,675	106.2	1,780
	780	Signs and symptoms	General symptoms	54.4	2,071	30.5	975	78.5	1,924
	372	Sense organ diseases	Disorders of conjunctiva	72.4	2,758	10.5	351	12.7	399
	729	Musculoskeletal diseases	Other disorders of soft tissues	73.3	2,791	30.3	943	44.7	1,116
	486	Respiratory infections	Pneumonia, organism unspecified	59.3	2,260	2.6	91	3.1	107
	786	Signs and symptoms	Symptoms involving respiratory system and other chest symptoms	50.4	1,919	26.4	856	53.4	1,414
	726	Injury and poisoning	Peripheral enthesopathies and allied syndromes	40.5	1,541	17.8	602	32.7	961
	784	Headache	Symptoms involving head and neck	36.4	1,385	16.5	557	31.2	927
	728	Musculoskeletal diseases	Disorders of muscle ligament and fascia	33.2	1,265	15.6	540	30.5	925

[a]Diagnoses showing any increase in the IR between both the first & middle and middle & last surveillance periods, ranked by the total difference between the last & first period, from largest to smallest
[b]Diagnoses showing any decrease in the IR between both the first & middle and middle & last surveillance periods, ranked by the total difference between the last & first period, from largest to smallest
[c]Diagnoses showing any decrease in the IR between the first & middle surveillance period and any increase between the middle & last period, ranked by the sum of the absolute value of the difference between the first & middle period and the middle & last period, from largest to smallest
[d]First, middle, and last 6 months of service for each separating service member

TABLE 2b. Top 10 diagnoses exhibiting upward,[a] downward,[b] or bimodal trends[c] across three surveillance periods[d] in separating service members' careers, by incidence rate (IR) differences, females only, U.S. Armed Forces, 30 September 2000 through 30 September 2015

Trend	ICD-9 code	Disease burden category	Diagnosis	IR per 1,000 persons					
				First	No. of incident cases	Middle	No. of incident cases	Last	No. of incident cases
Upward	309	Mental disorders	Adjustment reaction	18.0	131	44.6	263	76.3	324
	300	Mental disorders	Anxiety, dissociative and somatoform disorders	9.1	66	33.3	213	65.8	320
	799	Signs and symptoms	Other ill-defined and unknown causes of morbidity and mortality	64.4	468	89.9	391	111.5	279
	724	Musculoskeletal diseases	Other and unspecified disorders of back	62.2	452	80.6	394	105.5	325
	311	Mental disorders	Depressive disorder, not elsewhere classified	6.6	48	27	175	47.2	249
	338	Neurologic conditions	Pain, not elsewhere classified	2.1	15	17	119	37.9	223
	346	Headache	Migraine	9.8	71	22.4	145	42.5	235
	723	Musculoskeletal diseases	Other disorders of cervical region	8.3	60	19.9	133	39	221
	739	Musculoskeletal diseases	Nonallopathic lesions not elsewhere classified	4.3	31	19.2	129	32	187
	327	Neurologic conditions	Organic sleep disorders	0.6	4	5.2	37	24.8	167
Downward	465	Respiratory infections	Acute upper respiratory infections of multiple or unspecified sites	292.5	2,127	58.7	203	53.3	136
	460	Respiratory infections	Acute nasopharyngitis [common cold]	155.1	1,128	19.2	106	13.6	68
	079	Infectious and parasitic diseases	Viral and chlamydial infection in conditions classified elsewhere and of unspecified site	128.0	931	42	214	25.1	107
	844	Injury and poisoning	Sprains and strains of knee and leg	90.9	661	14.4	84	11.8	63
	462	Respiratory infections	Acute pharyngitis	104.8	762	45.7	227	37.6	149
	845	Injury and poisoning	Sprains and strains of ankle and foot	75.8	551	19	112	13.5	71
	625	Genitourinary diseases	Pain and other symptoms associated with female genital organs	100.5	731	48.2	246	40.2	158
	919	Injury and poisoning	Superficial injury of other multiple and unspecified sites	62.6	455	5.9	39	2.8	18
	795	Signs and symptoms	Other and nonspecific abnormal histological and immunological findings	71.5	520	39.2	211	25.9	122
	490	Respiratory diseases	Bronchitis, not specified as acute or chronic	43.3	315	11	71	8.4	51
Bimodal	719	Musculoskeletal diseases	Other and unspecified disorders of joint	269.2	1,957	74.7	264	120.5	262
	367	Sense organ diseases	Disorders of refraction and accommodation	283.9	2,064	84.3	244	104.3	200
	269	Nutritional disorders	Other nutritional deficiencies	170.7	1,241	2	12	3.2	19
	729	Musculoskeletal diseases	Other disorders of soft tissues	178.4	1,297	50.4	237	72.4	244
	726	Injury and poisoning	Peripheral enthesopathies and allied syndromes	82.4	599	28.3	164	40.6	197
	786	Signs and symptoms	Symptoms involving respiratory system and other chest symptoms	85.3	620	44.4	229	69	265
	733	Musculoskeletal diseases	Other disorders of bone and cartilage	65.7	478	13.6	86	16.7	97
	728	Musculoskeletal diseases	Disorders of muscle ligament and fascia	51.4	374	27.2	163	51.9	250
	784	Headache	Symptoms involving head and neck	75.6	550	49.9	259	61.8	238
	477	Respiratory diseases	Allergic rhinitis	57.4	417	26.6	154	33.6	166

[a]Diagnoses showing any increase in the IR between both the first & middle and middle & last surveillance periods, ranked by the total difference between the last & first period, from largest to smallest
[b]Diagnoses showing any decrease in the IR between both the first & middle and middle & last surveillance periods, ranked by the total difference between the last & first period, from largest to smallest
[c]Diagnoses showing any decrease in the IR between the first & middle surveillance period and any increase between the middle & last period, ranked by the sum of the absolute value of the difference between the first & middle period and the middle & last period, from largest to smallest
[d]First, middle, and last 6 months of service for each separating service member

apply or develop case definitions for every possible diagnosis. However, for many conditions, a single ICD-9 code may not represent a true or final diagnosis, and many encounters might have been screening encounters or have been coded incorrectly. These possibilities represent a source of misclassification bias. Second, "trends" were defined in absolute terms (i.e., any change between periods), rather than by relative or minimum percent changes, and defining "trends" differently likely would have produced a different set of results.

Another limitation is that the study population consisted only of those service members separating in a specific 1-year window. Those separating in 1 year might be different in terms of demographic characteristics and health from those separating in another year. For instance, the time frame chosen for this study, October 2014 through September 2015, is 5–7 years following one of the worst recessions in U.S. history and the drawdown of forces in Iraq and Afghanistan. The individuals who chose to leave military service during this study's surveillance window might be considerably different from those who left during other time periods; thus, findings from this study may not be generalizable to previous or future separating service members. Additionally, the surveillance periods were only 6 months in length. Although the length of this period might not be of particular concern for males because of their larger sample size, this short time frame might not have captured a representative picture of disease in the relatively smaller sample of females. Findings were stratified only by sex while many other potential confounders likely exist such as age, race/ethnicity, branch of service, military rank/grade, and military occupation. Lastly, service members who were deployed during any of the surveillance windows were excluded to allow for equal surveillance opportunity across the three time periods. However, this exclusion may have introduced selection bias given that service members who deploy tend to be "healthier" than those who do not deploy.[53]

This study appears to be one of the first to examine diagnostic trends over specified time points during the careers of individual service members, and several trends were identified that could offer opportunities for preventive interventions. Compared to prior studies, separating service members seem to be different from those retiring with respect to the incidence of medical conditions prior to leaving service. Voluntarily separating service members without disability have more difficulty accessing VA healthcare than retiring individuals or those who are medically separated.[37] If further studies show a significant burden of disease among voluntarily separating service members who are not accessing VA healthcare, this finding could warrant a review of the transition and compensation process when separating service members move from active duty to civilian life.

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Acknowledgments: The authors thank COL (Dr.) P. Ann Loveless for her project guidance and mentorship; CDR (Dr.) Shawn Clausen, Dr. Margaret Venuto, and Dr. D. William White for their thoughtful insights; Dr. Saixia Ying for fulfilling this project's data request; and Ms. Amaris Thurston for her administrative support.

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Diagnoses of Eating Disorders, Active Component Service Members, U.S. Armed Forces, 2013–2017

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During 2013–2017, a total of 1,788 active component service members received incident diagnoses of one of the eating disorders: anorexia nervosa (AN), bulimia nervosa (BN) or "other/unspecified eating disorder" (OUED). The crude overall incidence rate of any eating disorder was 2.7 cases per 10,000 person-years. Of the case-defining diagnoses, OUED and BN accounted for 46.4% and 41.8% of the total incident cases, respectively. The overall incidence rate of any eating disorder among women was more than 11 times that among men. Overall rates were highest among service members in the youngest age groups (29 years or younger). Crude annual incidence rates of total eating disorders increased steadily between 2013 and 2016, after which rates decreased slightly. Results of the current study suggest that service members likely experience eating disorders at rates that are comparable to rates in the general population, and that rates of these disorders are potentially rising among service members. These findings underscore the need for appropriate prevention and treatment efforts in this population.

Eating disorders are characterized by significant and persistent disturbances of eating that are associated with increased psychopathology, serious physical health problems, impaired psychosocial functioning, and reduced quality of life.[1-3] Moreover, eating disorders represent a considerable economic burden in terms of work productivity loss, healthcare resource utilization, and healthcare costs.[4,5] The *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10) includes four broad categories of eating disorder types: anorexia nervosa (AN), bulimia nervosa (BN), "other eating disorders," and "eating disorders, unspecified." Both the types of conditions included in these categories and the diagnostic criteria for the specific disorders have changed over time. The diagnostic criteria for these conditions draw on the American Psychiatric Association *Diagnostic and Statistical Manual of Mental Disorders (DSM-V)* classification and are summarized in **Table 1**.[6] Eating disorders are not associated with loss of appetite, are non-organic in origin (i.e., not caused by a known physical illness), and are not directly attributable to other mental disorders.[6]

The prevalence of eating disorders is generally elevated among young females[7,8] and in high-income countries,[9,10] possibly attributable to sociocultural and economic factors. In the U.S., eating disorders affect members of all race/ethnicity groups.[2,11] Estimates of the prevalence of these disorders in the general population vary widely, depending on study methods and populations.[12] In a nationally representative U.S. sample, lifetime prevalence estimates of AN and BN were 0.9% and 1.5% among women, and 0.3% and 0.5%, respectively, among men.[2]

Published studies of the prevalence of eating disorders among U.S. military members have used a variety of assessment methods and have yielded a range of estimates.[13-23] Studies of U.S. military populations that diagnosed eating disorders using clinical interviews reported prevalence estimates that are generally comparable to or higher than those obtained from studies of the U.S. general population, with approximately 5%–8% of service women and 0.1% of service men diagnosed with an eating disorder.[15,16,22] Studies that employed validated eating disorder screening instruments in military populations have described prevalence estimates for AN, BN, and eating disorder not otherwise specified (EDNOS) of 1.1%, 8.1%–12.5%, and 36.0%–62.8% among women, respectively, and 2.5%, 6.8%, and 40.8% among men.[13,14,18] Lower estimates were obtained from a study of U.S. service members based on eating disorder diagnoses recorded during hospitalizations and outpatient healthcare encounters (AN, BN, and EDNOS: 0.25%, 0.79%, and 0.72%, respectively, among women, and 0.01%, 0.02%, and 0.03% among men).[21]

By current Department of Defense (DoD) policy, a diagnosis of AN, BN, or an unspecified eating disorder lasting longer than 3 months and occurring after age 13 is medically disqualifying for accession into military service.[24] Moreover, service members affected by eating disorders that are unresponsive to treatment and/or interfere with the satisfactory performance of their military duties may be referred to a medical evaluation board and may possibly be separated from service.[25]

Among military populations, several factors could increase risk of developing an eating disorder. Military members are subject to strict service-specific regulations regarding physical fitness and weight requirements and their lifestyles are regimented.[26] It is well recognized that factors that increase emphasis on weight and

shape elevate the risk of eating disorders among both women and men.[27] Service members' exposure to potentially traumatic experiences and their relatively high rates of mental health disorders also may put them at increased risk of developing eating disorders.[28,29] In addition, given the increase in the annual prevalence of diagnoses of clinical overweight among U.S. active component service members during 2011–2015,[30] eating-disordered behaviors may develop as service men and women attempt to lose or control their weight. Finally, the changing demographics in the military (women are a rapidly growing segment of U.S. military populations) further highlight the need for continued investigation of eating disorders among service member populations.

In 2014, the *MSMR* reported the overall and annual incidence rates of AN, BN, and EDNOS among active component service members during 2004–2013.[31] That report documented that, throughout the 10-year period, annual incidence rates declined slightly for each disorder and for all three types combined. The current report updates this earlier work by describing the incidence of diagnoses of AN, BN, and "other/unspecified eating disorders" among active component service members during 2013–2017.

METHODS

The surveillance period was 1 January 2013 through 31 December 2017. The surveillance population consisted of active component service members of the U.S. Army, Navy, Air Force, or Marine Corps who served at any time during the surveillance period. All data used to determine incident eating disorder–specific diagnoses were obtained from electronic records routinely maintained in the Defense Medical Surveillance System (DMSS). These records document both hospitalizations and ambulatory encounters of active component service members of the U.S. Armed Forces in fixed (i.e., not deployed or at sea) medical facilities of the Military Health System (MHS) and civilian treatment facilities in the purchased care system.

In the current study, an incident case of one of the three eating disorders of interest (AN, BN, or other/unspecified eating disorders [OUEDs]) was defined by the presence of any qualifying ICD-9 or ICD-10 diagnosis code in the 1st or 2nd diagnostic position of a hospitalization record or in the 1st diagnostic position of a record of an outpatient medical encounter.[32] Case-defining diagnoses were AN (ICD-9: 307.1; ICD-10: F50.0*), BN (ICD-9: 307.51; ICD-10: F50.2), and OUED (ICD-9: 307.50, 307.59; ICD-10: F50.8, F50.81, F50.89, F50.9) **(Table 1)**.[32] The incidence date was considered the date of the first hospitalization or outpatient medical encounter that included a case-defining diagnosis of an eating disorder.

For summary purposes, each affected service member could be counted as a case of only one of the three types of eating disorders once during the surveillance period. To this end, if a service member received more than one eating disorder–specific diagnosis, AN and BN were prioritized over OUED. If an individual received diagnoses of both AN and BN, the diagnosis recorded first was prioritized over subsequent diagnoses. Individuals were classified as OUED cases only if they were not diagnosed with either AN or BN. Service members with case-defining diagnoses before the start of the surveillance period were excluded from the incidence analysis because they were not considered at risk of incident (i.e., first-ever) diagnoses of eating disorders.

Prevalence of the diagnoses of each of the three types of eating disorder was estimated for each year in the 5-year surveillance period. The numerator for prevalence calculations consisted of those individuals identified as incident cases of an eating disorder in a given year or in a previous year and who also had a healthcare encounter for any eating disorder type during that year. The denominator for prevalence calculations consisted of the total number of active component service members who served at least 1 day of the given year. Prevalence estimates were calculated for each of the three eating disorders of interest (AN, BN, and OUED) as the number of prevalent cases per 10,000 active component service members.

RESULTS

During the 5-year surveillance period, a total of 1,788 active component service members received incident diagnoses of eating disorders, for a crude overall incidence rate of 2.7 cases per 10,000 person-years (p-yrs) **(Table 2)**. Of the case-defining diagnoses, OUED and BN accounted for 46.4% and 41.8% of the total incident cases, respectively. Less than one-eighth (11.9%) of the total incident cases of eating disorder were attributable to AN. In regard to all eating disorders, more than two-thirds (67.5%) of incident cases affected females, and the overall incidence rate among women (11.9 cases per 10,000 p-yrs) was more than 11 times that among men (1.0 per 10,000 p-yrs) **(Table 2)**. Crude overall incidence rates of AN, BN, and OUED among women were 15.7, 15.5, and 8.3 times the rates among men, respectively.

The distributions of incident diagnoses of the three types of eating disorders by demographic characteristics are presented in **Table 3**. For both sexes, overall incidence rates were highest among service members in the youngest age groups (29 years or younger) and rates decreased with increasing age. Compared to their respective female counterparts, overall rates were highest among non-Hispanic white service women (15.8 cases per 10,000 p-yrs), Marine Corps members (20.4 cases per 10,000 p-yrs), junior enlisted or junior officers (16.0 and 11.4 cases per 10,000 p-yrs, respectively), and those in combat-specific occupations (17.2 cases per 10,000 p-yrs). Of note, the overall incidence rate of all eating disorders among female Marine Corps members was nearly twice that among female Army members. Among men, overall rates were highest among Hispanic service members, those of other/unknown race/ethnicity and non-Hispanic white service members (1.3, 1.3, and 1.1 cases per 10,000 p-yrs, respectively), compared to those in other race/ethnicity groups **(Table 3)**. Relative to their respective male counterparts, rates of diagnoses of all eating disorders for men were highest among Army or Marine Corps members (1.2 and 1.1 cases per 10,000 p-yrs, respectively), enlisted service members (1.2 and 1.1 cases per 10,000

TABLE 1. Summary of diagnostic criteria for anorexia nervosa, bulimia nervosa, and other/unspecified eating disorders[a]

Eating disorder	ICD-9 code	ICD-10 code
Anorexia nervosa (AN)	307.1	F50.0*
Persistent restriction of energy intake leading to significantly low body weight (in context of what is minimally expected for age, sex, developmental trajectory, and physical health)		
Intense fear of gaining weight/becoming fat or persistent behavior that interferes with weight gain (even though significantly low weight)		
Disturbance in the way one's body weight or shape is experienced, undue influence of body shape and weight on self-evaluation, or persistent lack of recognition of the seriousness of the current low body weight		
AN, unspecified		F50.00
Restricting type: Restriction of food intake; use of fasting, diet pills, exercise; no binge eating or purging		F50.01
Binge-eating/purging type: Binge eating and purging behavior to lose weight		F50.02
Bulimia nervosa (BN)	307.51	F50.2
Recurrent episodes of binge eating. An episode of binge eating is characterized by both: • Eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than most people would eat during a similar time period and under similar circumstances. • A sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating)		
Recurrent inappropriate compensatory behavior to prevent weight gain (e.g.,self-induced vomiting, misuse of laxatives, diuretics, or other medications, fasting, or excessive exercise) is present.		
The binge eating and inappropriate compensatory behaviors both occur, on average, at least once a week for 3 months.		
Self-evaluation is unduly influenced by body shape and weight.		
The disturbance does not occur exclusively during episodes of anorexia nervosa.		
Other/unspecified eating disorders (OUED)	307.50, 307.59	F50.8, F50.81, F50.89, F50.9
Other eating disorders[b]		F50.81
Binge eating disorder[c] is defined as recurring episodes of eating significantly more food in a short period of time (e.g., 2-hour period) than most people would eat under similar circumstances, with episodes marked by feelings of lack of control over eating during the epidsode. The binge-eating episodes are associated with three or more of the following: • Eating much more rapidly than normal • Eating until feeling uncomfortably full • Eating large amounts of food when not feeling physically hungry • Eating alone because of feeling embarrassed by how much one is eating • Feeling disgusted with oneself, depressed, or very guilty afterwards		
Marked distress regarding binge eating is present. The binge eating occurs, on average, at least once a week for 3 months. The binge eating is not associated with recurrent use of inappropriate compensatory behaviors and does not occur exclusively during the course of AN, BN, or Avoidant/Restrictive Food Intake Disorder.		
Other specified eating disorder[c] includes pica in adults, and psychogenic loss of appetite.		F50.89
Unspecified eating disorder: This category applies to behaviors that cause clinically significant distress/impairment of functioning, but do not meet the full criteria of any of the eating disorder criteria. This category may be used by clinicians when they choose not to specify why criteria are not met, including presentations where there may be insufficient information to make a more specific diagnosis (e.g., in emergency room settings). Includes atypical AN and atypical BN.		F50.9

[a]American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)*, Arlington, VA: American Psychiatric Association; 2013.
[b]ICD-10 code F50.8 (other eating disorders) was added to the ICD-10 coding system on 1 October 2015 and was changed to a parent code on 1 October 2016.
[c]F50.81 (binge eating disorders) and F50.89 (other specified eating disorder) were added to the ICD-10 coding system on 1 October 2016.

TABLE 2. Incident cases and incidence rates, eating disorders, active component, U.S. Armed Forces, 2013–2017

	All eating disorders, total		Anorexia nervosa		Bulimia nervosa		Other/unspecified eating disorders	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Female	1,207	11.9	157	1.6	552	5.5	498	4.9
Male	581	1.0	55	0.1	195	0.4	331	0.6
Total	1,788	2.7	212	0.3	747	1.1	829	1.3
Female:Male RR	11.4		15.7		15.5		8.3	
Female % (all cases)	67.5%		74.1%		73.9%		60.1%	

RR, rate ratio
[a]Rate per 10,000 person-years

TABLE 3. Incident cases and incidence rates, all eating disorders, active component, U.S. Armed Forces, 2013–2017

	Males		Females		Female:Male
	No.	Rate[a]	No.	Rate[a]	RR
Total	581	1.0	1,207	11.9	11.4
Age group (years)					
<21	67	1.0	201	14.6	15.1
21–24	173	1.2	429	16.1	13.1
25–29	148	1.1	315	12.6	11.1
30–34	85	0.9	141	8.7	9.2
35–39	59	0.9	72	6.9	7.4
40+	49	0.8	49	5.5	6.7
Race/ethnicity					
Non-Hispanic white	357	1.1	707	15.8	15.0
Non-Hispanic black	67	0.8	182	6.9	8.2
Hispanic	99	1.3	162	10.0	7.7
Asian/Pacific Islander	14	0.7	44	10.2	15.2
American Indian/Alaska Native	2	0.4	15	13.1	36.2
Other	42	1.3	97	11.5	8.8
Service					
Army	263	1.2	415	11.9	9.6
Navy	107	0.8	329	11.4	13.8
Air Force	115	0.9	315	10.4	11.5
Marine Corps	96	1.1	148	20.4	18.4
Rank					
Junior enlisted (E1–E4)	290	1.2	733	16.0	13.2
Senior enlisted (E5–E9)	236	1.1	292	8.2	7.6
Officers (O1–O3 [W1–W3])	37	0.6	152	11.4	18.0
Officers (O4–O10 [W4–W5])	18	0.5	30	4.8	10.2
Occupation					
Combat-specific[b]	72	0.8	34	17.2	21.8
Motor transport	13	0.8	30	9.6	11.7
Pilot/air crew	5	0.2	7	4.8	22.6
Repair/engineer	169	1.0	229	11.3	11.5
Communications/intelligence	134	1.2	377	11.4	9.3
Health care	91	2.3	269	13.7	5.9
Other/unknown	97	0.9	261	12.2	13.0

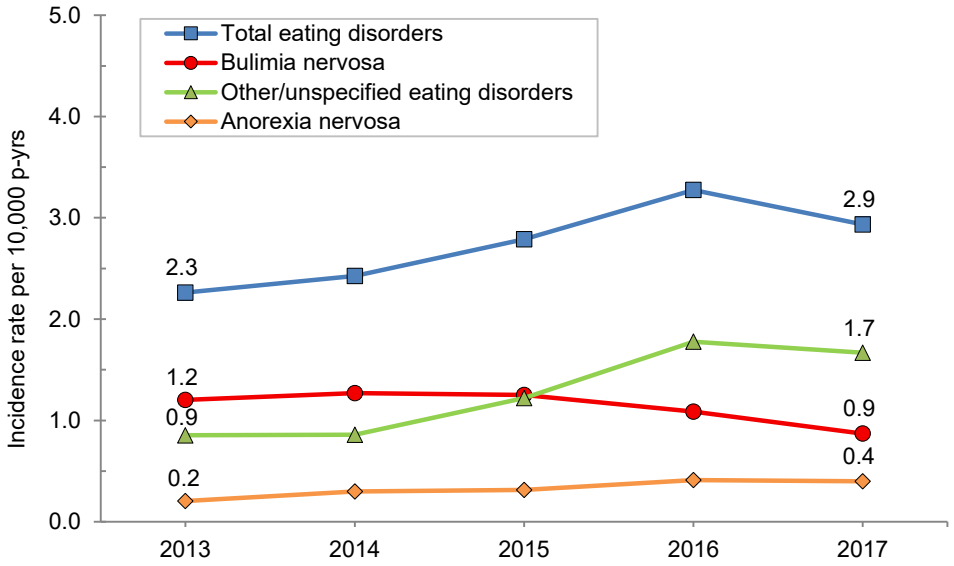
RR, rate ratio
[a]Rate per 10,000 person-years
[b]Infantry/artillery/combat engineering/armor

p-yrs for E1–E4 and E5–E9, respectively), and those in healthcare occupations (2.3 cases per 10,000 p-yrs).

Crude annual incidence rates of total eating disorders increased steadily from 2.3 cases per 10,000 p-yrs in 2013 to a peak of 3.3 cases per 10,000 p-yrs in 2016 (44.7% increase), after which rates decreased to 2.9 cases per 10,000 p-yrs in 2017 **(Figure 1)**. Annual rates of OUED remained stable during 2013–2014 at 0.9 cases per 10,000 p-yrs and then increased to a peak of 1.8 cases per 10,000 p-yrs in 2016. Crude rates of diagnoses of BN decreased slightly during the surveillance period, from 1.2 cases per 10,000 p-years in 2013 to 0.9 cases per 10,000 p-yrs in 2017. Annual rates of AN increased slightly from 0.2 cases per 10,000 p-years in 2013 to 0.4 cases per 10,000 p-yrs in 2017. Of note, the crude annual incidence rate of OUED converged with that of BN in 2015, after which annual rates of OUED exceeded those of BN **(Figure 1)**. The increasing trend in crude annual rates of total eating disorders during 2013–2016 was driven largely by increases in OUED among service members of both sexes during this period **(Figure 2, Figure 3)**. Among male service members, the annual rates of incident diagnoses of BN and AN were relatively stable during the 5-year surveillance period. Among service women, crude annual rates of BN declined during the period, with the greatest decrease occurring between 2015 and 2017. Rates of AN among service women increased slightly during the period **(Figure 3)**.

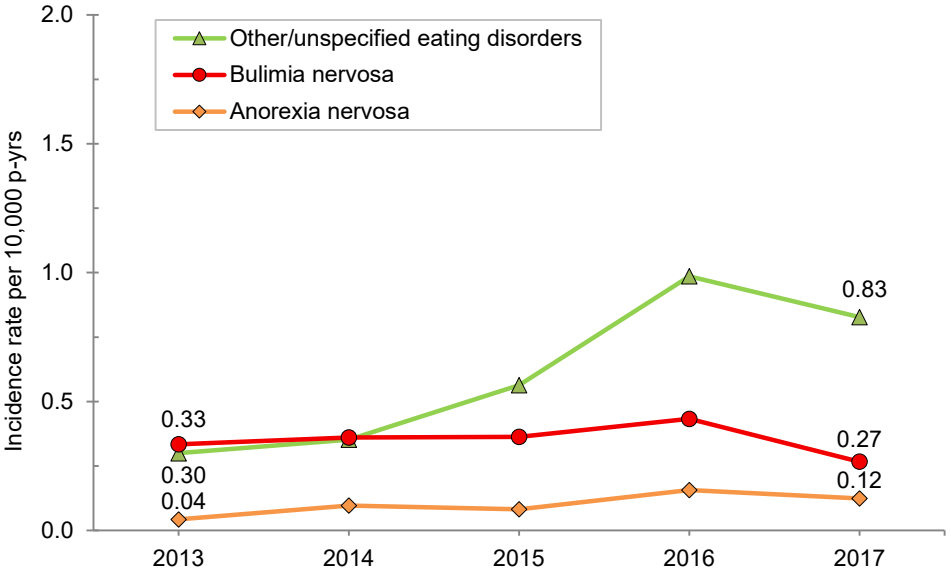
The general pattern of period prevalences of OUED, BN, and AN among active component service members by year during the surveillance period was broadly similar to that observed for the annual incidence rates of these eating disorder types **(Figure 4)**. The peak prevalences for women were as follows: AN, 3.7 cases per 10,000 active component service women in 2016; BN, 10.3 cases per 10,000 in 2014; and OUED, 13.2 cases per 10,000 in 2016. For men, the peak prevalences were as follows: AN, 0.22 cases per 10,000 active component service men in 2016 and 2017; BN, 0.64 cases per 10,000 in 2016; and OUED, 1.5 cases per 10,000 in 2016 **(data not shown)**.

FIGURE 1. Annual incidence rates of eating disorders, by type, active component, U.S. Armed Forces, 1 January 2013 through 30 June 2017



Note: ICD-10 code F50.8 (Other eating disorders) was added to the ICD-10 coding system on 1 October 2015 and was changed to a parent code on 1 October 2016. F50.81 (Binge eating disorders) and F50.89 (Other specified eating disorder) were added to the ICD-10 coding system on 1 October 2016. This likely affected the rates of "other eating disorders" around this time period.

FIGURE 2. Annual incidence rates of eating disorders, by type, active component males, U.S. Armed Forces, 1 January 2013 through 30 June 2017



Note: ICD-10 code F50.8 (Other eating disorders) was added to the ICD-10 coding system on 1 October 2015 and was changed to a parent code on 1 October 2016. F50.81 (Binge eating disorders) and F50.89 (Other specified eating disorder) were added to the ICD-10 coding system on 1 October 2016. This likely affected the rates of "other eating disorders" around this time period.

EDITORIAL COMMENT

Results of the current analysis indicate that crude annual incidence rates of total eating disorders increased by 44.7% between 2013 and 2016 followed by a slight decrease in 2017. Sex-stratified rates showed that the increasing trend in annual rates of total eating disorders during this period was driven largely by increases in OUED among service members of both sexes. Previous *MSMR* results showed that crude annual rates of BN were consistently higher than rates of EDNOS and AN.[31] However, in the current study, the crude annual rate of OUED (category most similar to EDNOS category) converged with that of BN in 2015. From that point through 2017, crude annual rates of OUED exceeded those of BN. The increase in OUED rates observed in the current analysis is likely due, at least in part, to adjustments to the classification of eating disorders made in the ICD-10 coding system.

In the previous *MSMR* report, all diagnoses used the ICD-9 classification system in which binge eating disorder (BED) was not specifically described but was included in the EDNOS category.[31] On 1 October 2015, code F50.8 (other eating disorders) was added to the ICD-10 coding system. Subsequently, on 1 October 2016, F50.8 was changed to a parent code and codes F50.81 (BED) and F50.89 (other specified eating disorder) were added to the coding system. Another important adjustment was to clarify the body weight criterion for AN. Previously, "minimal normal body weight" was defined as a body weight less than 85% of that expected. Currently, the criterion is "significantly low body weight" in the context of what is minimally expected for age, sex, developmental trajectory, and physical health **(Table 1)**.[6] In addition, the amenorrhea criterion under AN was removed.[6] For BN, the minimum frequency of binge eating episodes and inappropriate compensatory behavior was reduced from twice a week to once a week.[6]

Results of several U.S. studies indicate that BED is one of the most common eating disorders among both sexes.[2,33,34] In a U.S. nationally representative sample, lifetime prevalence estimates for BED were 3.5% among women and 2.0% among men.[2] The increase in crude annual incidence rates of OUED among both sexes and their peak in 2016 broadly coincides with the shift to the ICD-10 classification system. Results of some studies suggest that there have been increases in the prevalence of total eating disorders and of AN over time.[35,36] The reasons for this reported increase in prevalences is unclear, but the change in the diagnostic coding of BED and the relaxation of the criteria for AN

are generally cited as the major reasons for such increases in prevalence over time.[12,37]

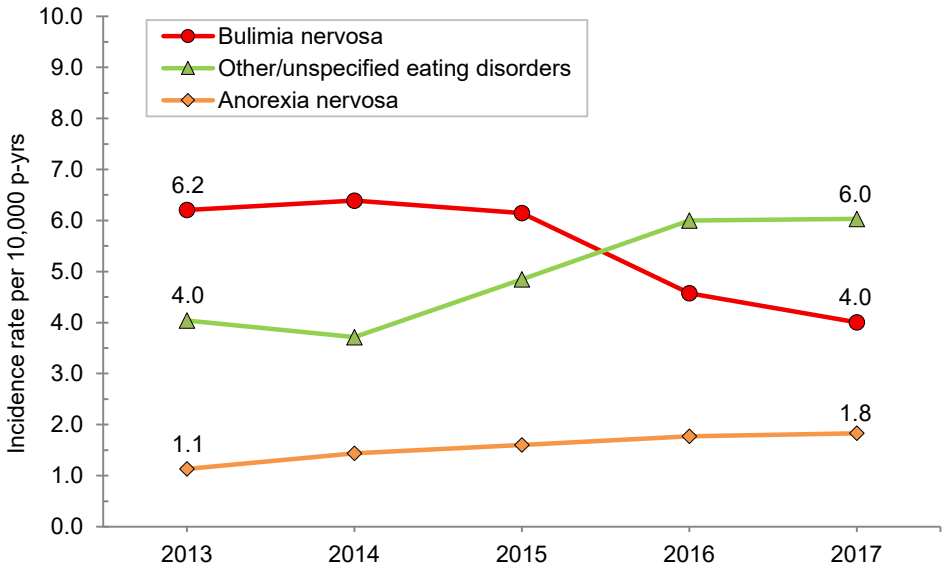
The overall incidence rate of AN diagnoses among women documented here (1.6 cases per 10,000 p-yrs) is comparable to the range of rates cited in Hsu's review (0.14 to 5.0 cases per 10,000 young women per year); however, prevalence estimates among female service members for AN and BN were much lower.[38] The estimates of prevalence yielded by the current analysis are otherwise consistent with the published literature with respect to age group and sex differences and the relative frequencies of the three diagnostic categories examined. Both the incidence rates and prevalence estimates in the current analysis are lower than many published estimates from military and civilian populations.[39] However, most of these studies used data from non-military populations and/or employed estimation methods different from those used here.

Given that DoD standards preclude entrance into military service for individuals with diagnosed eating disorders, it is plausible that the incidence and prevalence of these conditions among service members are lower than in the civilian population because eating disorders commonly have their onsets during adolescence (before the age of eligibility for military accession). Nevertheless, the current analysis documents that there are hundreds of new cases of eating disorders diagnosed each year among active component service members; there are likely many other service members whose conditions went medically undetected. The published literature documents that, at least in certain select populations, abnormal eating behaviors occur with surprising frequency among military personnel.[13-23] Barlett and Mitchell's systematic review summarizes the literature regarding eating disorders among military and veteran men and women.[39]

Subgroup-specific results of the current analysis are consistent with findings in the published literature on eating disorders. As expected, based on studies in the U.S. civilian and military populations, incidence rates among women were considerably higher than those among men. Female service members accounted for 68% of all diagnosed eating disorders, even though women account for only 15.9% of active component service members.[40] Similar to results found in representative samples of military service members,[21,23] overall incidence rates of total eating disorders were highest among non-Hispanic white service members, those in the youngest age groups (29 years or younger), and Marine Corps members.

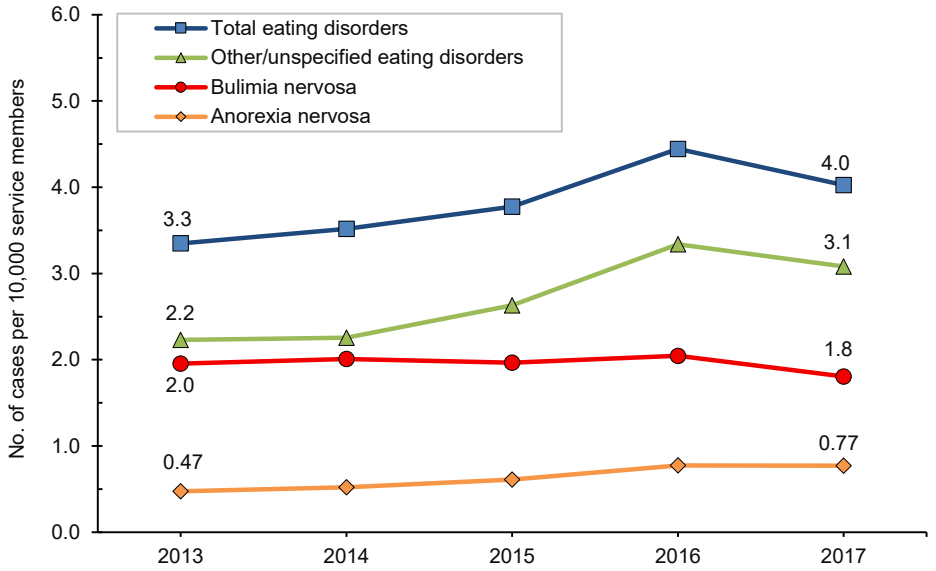
Results of the current study must be interpreted in the context of several analysis limitations. First, the reliance on

FIGURE 3. Annual incidence rates of eating disorders, by type, active component females, U.S. Armed Forces, 1 January 2013 through 30 June 2017



Note: ICD-10 code F50.8 (Other eating disorders) was added to the ICD-10 coding system on 1 October 2015 and was changed to a parent code on 1 October 2016. F50.81 (Binge eating disorders) and F50.89 (Other specified eating disorder) were added to the ICD-10 coding system on 1 October 2016. This likely affected the rates of "other eating disorders" around this time period.

FIGURE 4. Annual prevalence of eating disorders, by type, active component, U.S. Armed Forces, 1 January 2013 through 30 June 2017



Note: ICD-10 code F50.8 (Other eating disorders) was added to the ICD-10 coding system on 1 October 2015 and was changed to a parent code on 1 October 2016. F50.81 (Binge eating disorders) and F50.89 (Other specified eating disorder) were added to the ICD-10 coding system on 1 October 2016. This likely affected the rates of "other eating disorders" around this time period.

diagnoses from records of service members' medical encounters undoubtedly resulted in underestimates of the true incidence and prevalence of eating disorders among the surveillance population. Persons with eating disorders generally avoid seeking medical care, at least initially, either because they do not believe they have a medical problem or because they are embarrassed about their behaviors.[33] Individuals with BN or OUED (including BED) are better able to conceal their eating disorders because their body weights and appearances are not suggestive of disordered eating, and their binge eating and compensatory behaviors usually take place in private.[33] Service members with these disorders may not have the diagnoses documented in their medical records unless they seek assistance for or experience a serious complication of their conditions.

Another limitation of the current analysis is related to the implementation of MHS GENESIS, the new electronic health record for the MHS. During 2017, medical data from sites that were using MHS GENESIS are not available in DMSS. These sites include Naval Hospital Oak Harbor, Naval Hospital Bremerton, Air Force Medical Services Fairchild, and Madigan Army Medical Center. Therefore, medical encounter and person-time data for individuals seeking care at one of these facilities during 2017 were excluded from the analysis.

Among military personnel, there is reason to believe that some concealment of eating disorders is motivated by concerns that discovery and formal diagnosis may influence deployment, promotion,[41] or even retention.[19] Because of the emaciation that follows extreme weight loss in AN, service members with this eating disorder are more likely to be noticed by their families, friends, and/or military colleagues and persuaded to seek medical attention. Among active component service members, deterioration of not only physical appearance but also duty performance may serve as triggers for supervisors to refer persons with AN for medical evaluation.[19] However, because such medical scrutiny likely follows many months or a few years of weight loss, diagnoses of AN often are documented long after the onset of the disorder.

When AN persists, the debilitating effects have adverse impacts on the physical and mental health and social and occupational activities of those affected. In addition, AN that persists or recurs is life threatening. Manos et al. cite studies that estimate crude 10-year mortality rates of 3.3%–5.6% and 20-year rates of 15%–20%.[19] Recognition and treatment of AN is essential. In the U.S. Armed Forces, where periodic measurement of service members' height and weight is common, the detection of a body mass index (BMI) of less than 17.5 kg/m^2 should indicate the need for further evaluation.

Because service members affected by BN or OUED usually have BMIs that are in or near the normal range, their appearances may not be indicative of their abnormal eating behaviors. Potential complications of BN and OUED that may lead those affected to seek medical care include the consequences of overeating and vomiting as well as overuse of laxatives, diuretics, and enemas. An extended period of repeated, induced vomiting may result in erosion of dental enamel by the exposure of the teeth to stomach acid.[19] Although mortality is a much less frequent outcome of BN and OUED than AN, purging and metabolic abnormalities may be associated with potentially fatal events such as esophageal tears, gastric ruptures, and cardiac arrhythmias.[42] Because individuals with eating disorders are at elevated risk of psychiatric comorbidity,[1] it is important for military healthcare providers to be vigilant for eating disorder symptoms among service members affected by mental health disorders, especially among those in the accession phase of military service.[43]

Results of the current study suggest that service members likely experience eating disorders at rates that are comparable to rates in the general population, and that rates of these disorders are potentially rising among military members. These findings underscore the need for appropriate prevention and treatment efforts in this population. At stake are the health, well-being, and military operational effectiveness of affected service members and their units.

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Brief Report

Department of Defense Midseason Vaccine Effectiveness Estimates for the 2017–2018 Influenza Season

Lisa Shoubaki, MPH; Angelia A. Eick-Cost, PhD, ScM; Anthony W. Hawksworth, BS; Zheng Hu, MS; LeeAnne Lynch, MPH; Christopher A. Myers, PhD; Susan Federinko, MD, MPH (Lt Col, USAF)

The 2017–2018 influenza season has been a topic of interest in the media and among the general public due to concerns about the protective nature of the 2017–2018 influenza vaccine. During the Southern Hemisphere's winter influenza season in mid-2017, Australia's overall influenza vaccine effectiveness (VE) was surprisingly low at 33% (95% CI, 17%–46%).[1] More specifically, Australia reported an influenza A(H3) VE of 10% (95% CI, -16%–31%), which was not statistically significantly different from zero.[1] These findings prompted concerns about the prospect of a similarly low VE during the subsequent influenza season in the Northern Hemisphere, as Australia and the U.S. selected identical vaccine strains. The Department of Defense (DoD) conducts VE analyses to determine the extent of matching between the recommended seasonal vaccine and the circulating strain. This article reports the results of DoD VE mid-season estimates determined by the Armed Forces Health Surveillance Branch (AFHSB) Air Force (AFHSB-AF) satellite at the U.S. Air Force School of Aerospace Medicine; Naval Health Research Center (NHRC); and the AFHSB.

METHODS

The AFHSB-AF satellite branch is a sentinel site-based program that requests weekly submissions of six to 10 specimens accompanied by a completed questionnaire from each site. Vaccination status was verified through immunization records obtained from the Air Force Complete Immunization Tracking Application, medical records from the Aeromedical Services Information Management System, or self-reported data from the questionnaire. Individuals were considered to be vaccinated if they were vaccinated at least 14 days prior to symptom onset. Those who were vaccinated less than 14 days prior to symptom onset were excluded from the study.

NHRC's population included civilians who sought care at outpatient clinics near the U.S.–Mexico border through the febrile respiratory illness program.Vaccination status was obtained through medical record reviews and self-report, if available.[2] NHRC classified cases and controls to have been vaccinated if symptom onset started 14–180 days after receiving the vaccine.[2]

AFHSB's VE study used data obtained via the Defense Medical Surveillance System and Navy and Marine Corps Public Health Center. The high vaccination rate is attributable to the fact that annual influenza vaccination is required for service members.[2]

All three VE estimates were derived using a test-negative case-control study design although each organization utilized different study populations (i.e., AFHSB-AF satellite, DoD dependent data; NHRC, civilians near the U.S.–Mexico border; AFHSB, active component service member data). All studies calculated crude and adjusted VE using odds ratios (ORs) and 95% CIs obtained from multivariable logistic regression models **(Table)**. Statistical data analyses were performed using SAS version 9.4 (2013, SAS Institute, Cary, NC). VE was calculated as (1−OR) × 100. AFHSB-AF's adjustment variables were age group, time period, and geographic region. NHRC's only adjustment variable was age group. AFHSB's adjustment variables were age group, sex, month of illness, and 5-year vaccination status. For summary purposes, vaccine effects were considered statistically significant if 95% CIs around point estimates of VE did not include zero.

Inactivated influenza vaccine was the only vaccine type analyzed, because the live, attenuated influenza vaccine was not recommended or used during the 2017–2018 season. Cases were laboratory-confirmed influenza positives and controls were influenza test negatives. Influenza positives from the AFHSB-AF satellite and NHRC were confirmed through reverse transcription polymerase chain reaction (RT-PCR) and/or viral culture, while AFHSB used RT-PCR and/or viral culture as well as positive rapid tests, excluding individuals with rapid test negatives.

RESULTS

From 1 October 2017 through 10 February 2018, the AFHSB-AF's VE study included 1,160 cases and 1,383 controls, with 36% and 47% having been vaccinated, respectively. Overall, the adjusted VE was 51% (95% CI, 41%–59%). The adjusted VE for influenza A(H3N2) was low at 37% (95% CI, 22%–49%) **(Figure)**. Influenza A(H1N1) pdm09 and influenza B had higher adjusted VE estimates of 79% (95% CI, 67%–86%) and 60% (95% CI, 49%–70%), respectively **(Figure)**. Adjusted VE estimates were similar among children (aged 2–17 years) and adults **(data not shown)**.

From 13 November 2017 through 8 January 2018, the NHRC's VE study included 201 cases and 114 controls, with 13% and 24% having been vaccinated, respectively. For the NHRC's study, the overall adjusted VE was 55% (95% CI,

TABLE. Department of Defense midseason influenza vaccine effectiveness (VE) estimates, 2017–2018

Population		Cases		Controls[a]					
	Influenza type	No. of cases	% vaccinated	No. of controls	% vaccinated	Crude VE (%)	95% CI	Adjusted VE (%)[b]	95% CI
Dependents (AFHSB-AF)									
	Overall	1,160	16	1,383	25	36	25–45	51	41–59
	Influenza A(H3N2)	610	12	1,383	32	21	5–35	37	22–49
	Influenza A(H1N1)	153	2	1,383	42	71	56–81	79	67–86
	Influenza B	390	8	1,383	36	39	23–52	60	49–70
Border civilians (NHRC)									
	Overall	201	13	114	24	52	13–74	55	17–75
	Influenza A(H3N2)	156	13	114	24	50	6–73	52	9–75
	Influenza B	41	12	114	24	55	-25–84	63	-5–87
Active component service members (AFHSB)									
	Overall	2,926	89	2,557	90	9	-8–24	19	3–33
	Influenza A	2,539	89	2,557	90	9	-9–24	19	2–33
	Influenza A(H3N2)	301	89	2,557	90	15	-25–42	27	-9–50
	Influenza B	383	89	2,557	90	12	-25–37	25	-8–48

CI, confidence interval; AFHSB-AF, Armed Forces Health Surveillance Branch-Air Force satellite cell; NHRC, Naval Health Research Center; AFHSB, Armed Forces Health Surveillance Branch

[a]All studies used unmatched, influenza test-negative controls.

[b]AFHSB-AF adjusted for age group, month of illness, and region; NHRC adjusted for age group; and AFHSB adjusted for sex, age group, month of illness, and 5-year prior vaccination status (Y/N).

17%–75%). For influenza A(H3N2), VE was 52% (95% CI, 9%–75%). For influenza B, VE was 63% but not statistically significant (95% CI, -5%–87%) **(Figure)**.

From 1 December 2017 through 10 February 2018, the AFHSB's study included 2,926 cases and 2,557 controls, with 89% and 90% having been vaccinated, respectively. After adjustment, VE for active component service members was statistically significant at 19% (95% CI, 3%–33%). For influenza A(H3N2) and influenza B, the adjusted VE estimates were 27% (95% CI, -9%–50%) and 25% (95% CI, -8%–48%), respectively **(Figure)**; neither adjusted VE estimate was statistically significant.

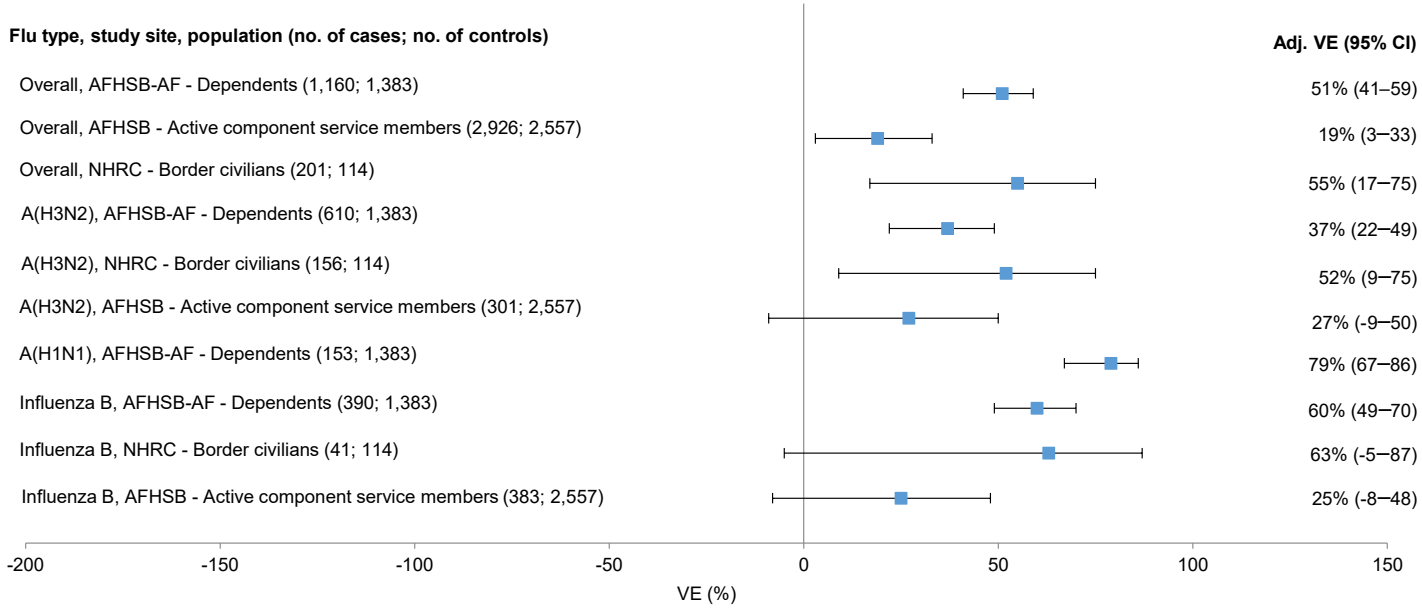
EDITORIAL COMMENT

Overall, adjusted VE estimates for DoD studies were moderately protective for the dependent population. The AFHSB-AF satellite's overall adjusted VE was statistically significant and conferred moderate to high protection; NHRC's adjusted VE was statistically significant overall and was moderately protective for influenza A(H3N2); and AFHSB's active component adjusted VE was statistically significant overall and provided some protection.

All of the VE studies had limitations. For example, specimens were obtained from those seeking care at a medical treatment facility or meeting the influenza-like illness case definition; therefore, less severe cases that did not seek medical attention were not included in the analyses. Individuals included in the DoD studies were younger than the general population, so VE could not be analyzed for older, higher-risk populations. Active component members are a highly immunized population, which may have a negative impact on VE estimates due to methodologic validity (i.e., limited unvaccinated controls) and biologic effects (i.e., repeated vaccination). Lower sample size could have contributed to the reduction of statistical power in some DoD analyses.

The Centers for Disease Control and Prevention (CDC) reported lower VE at 36% (95% CI, 27%–44%), compared with all DoD studies with a dependent population. The CDC's adjusted VE for influenza A(H3N2) was low at 25% (95% CI, 13%–36%), 67% (95% CI, 54%–76%) for influenza A(H1N1)pdm09, and 42% (95% CI, 25%–56%) for influenza B.[3] Midseason results for the CDC did not closely match DoD midseason VE estimates. This difference in VE estimates may be due, at least in part, to differences in the types of influenza vaccine used in DoD and in civilian populations. More than half of the influenza vaccine purchased and administered by the DoD was derived from cell culture propagation rather than from egg propagation.[3] A rapid decline of VE for the vaccine component influenza A(H3N2) that was egg-propagated has been seen in the past few years.[4] Zost et al. reported that the current circulating influenza A(H3N2) viruses possess a new glycosylation site in antigenic site B of the hemagglutinin, and that the current egg-adapted A(H3N2) component of the vaccine does not have this mutation, which is hypothesized to

FIGURE. Department of Defense midseason influenza vaccine effectiveness (VE), 2017–2018



CI, confidence interval; AFHSB-AF, Armed Forces Health Surveillance Branch–Air Force Satellite; AFHSB, Armed Forces Health Surveillance Branch; NHRC, Naval Health Research Center

diminish antigenicity.[5] Additional research is needed to assess whether VE against circulating A(H3N2) viruses varies by vaccine propagation type.

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Acknowledgments: The authors thank the DoD Global Respiratory Pathogen Surveillance Program and its sentinel site partners, the Navy and Marine Corps Public Health Center, and the Centers for Disease Control and Prevention Border Infectious Disease Surveillance Program in San Diego and Imperial Counties, CA, which collected samples and case data from participating outpatient clinics.

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Report No. 18-XX was supported by Armed Forces Health Surveillance Branch under work unit no. 60805. The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government.

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Letter to the Editor

To the Editor: As both a former member of the Armed Forces Epidemiological Board and the Defense Health Board and as an investigator who has studied the prevalence of hepatitis C virus (HCV) among recruits, I was interested to read the brief report by Taylor and colleagues in the December 2017 issue of the *MSMR*.[1]

It was a little surprising to read the authors' statement that ". . . the prevalence among military recruits accessioning into the U.S. Air Force has not been described." May I respectfully remind the authors that in 2000, a manuscript titled "45-Year Follow-up of Hepatitis C Virus Infection in Healthy Young Adults" was published in the *Annals of Internal Medicine*? The manuscript reported studies of serum samples for hepatitis C antibody from more than 8,000 military recruits at the Fort Francis E. Warren Air Force Base obtained between 1948 and 1954.[2] Those authors described 0.2% of the tested recruits as having positive HCV studies by ELISA and by recombinant immunoblot assay. Because these sera were drawn upon entrance into the Air Force, one could not determine how many of this population subsequently contracted HCV either while on active duty or after their military career. However, of the 17 recruits in the latter report with a positive antibody test for HCV, only one (5.9%) had died of liver disease 42–45 years after the original phlebotomy. Such data are required from larger and more recent cohorts to complete this important natural history evaluation even if there are newer (and expensive) therapeutic approaches to individuals with hepatitis C infections.

The reported cohort represents an opportunity for the authors of the brief report to identify and to carry out a meaningful comparison between the two cohorts and also to plan/attempt long-term follow-up for their recently identified cohort as the resulting data would have both practical and public health implications for the Services, and especially for Veterans Administration healthcare programs. Data from identified cohorts of military personnel can provide important information for the future. This aspect was recently emphasized in a special supplement of *Military Medicine* in October 2015 and is important for more than only hepatitis infections.[3]

I hope that the authors can take these factors into consideration.

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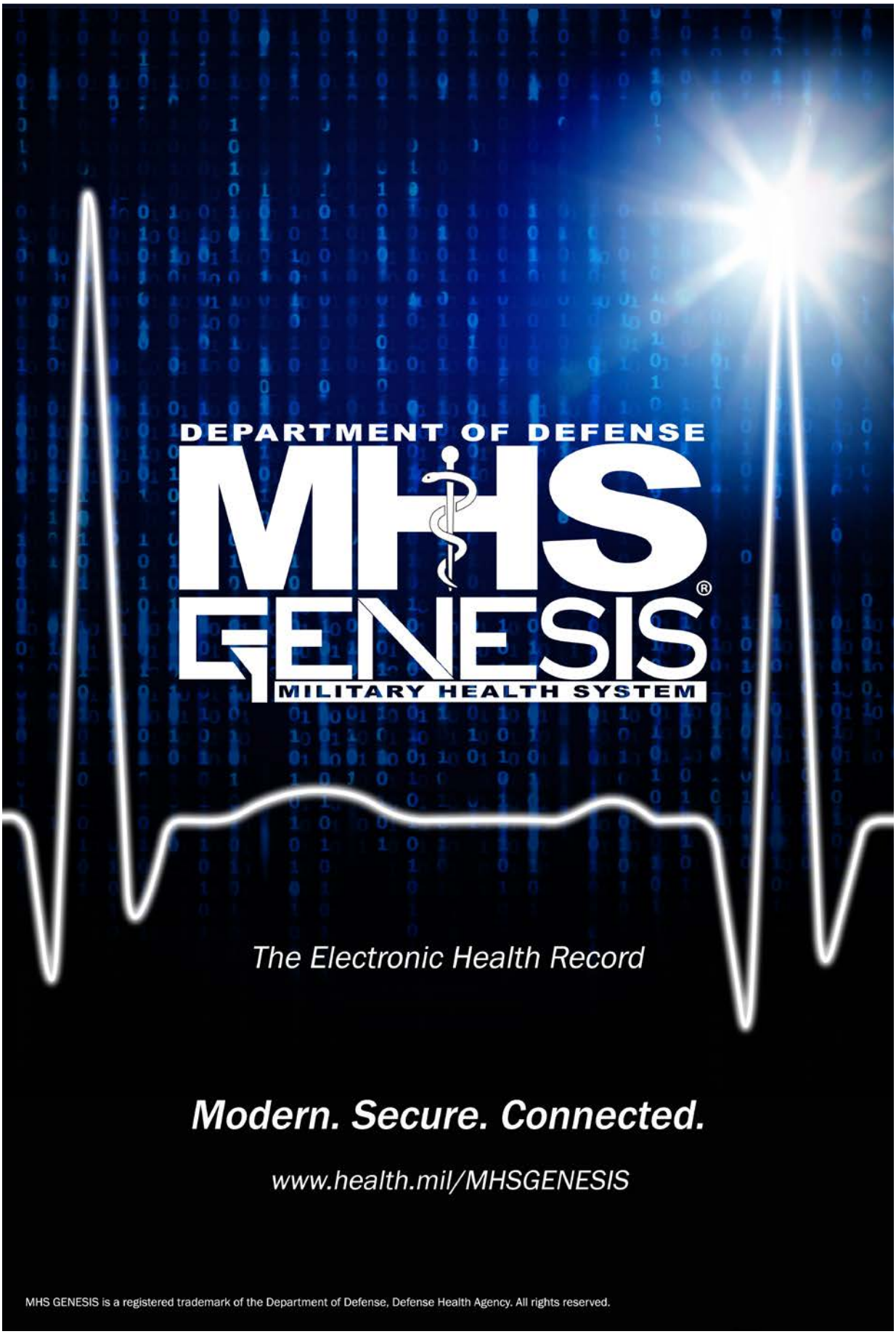
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ISSN 2158-0111 (print)
ISSN 2152-8217 (online)