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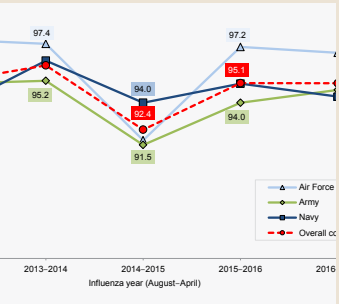

Measles, Mumps, Rubella, and Varicella Among Service Members and Other Beneficiaries of the Military Health System, 2010–2016

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Measles, mumps, rubella, and varicella (MMR/V) are highly communicable infectious diseases whose causative agents are spread through contact with contaminated surfaces or airborne droplets. Individuals at highest risk for MMR/V infections include infants, unvaccinated or inadequately vaccinated persons, individuals living in communities with low vaccination rates or in crowded and unsanitary conditions, and persons with compromised immune systems. During 2010–2016, there were 11 confirmed measles cases and 76 confirmed mumps cases among all Military Health System (MHS) beneficiaries. Only one of the confirmed cases of measles was in a service member. There were seven confirmed rubella cases among all MHS beneficiaries. Among service members, there were 62 confirmed cases of varicella during the surveillance period. The number of confirmed cases of varicella among service members dropped from 28 cases in 2010 and 27 cases in 2011 to seven confirmed cases in 2012. There were no confirmed cases of varicella among active and reserve component service members during 2013–2016. Recent trends in MMR/V in both military and civilian populations in the U.S. highlight the importance of primary and booster vaccinations.

Measles, mumps, rubella, and varicella (MMR/V) were common in the U.S. before the introduction of licensed vaccines: measles (1963), mumps (1967), rubella (1969), and varicella (1995).[1] Since then, these vaccines have been important components of routine pediatric preventive care. Individuals at highest risk for MMR/V infections include infants (because they are too young to be vaccinated), unvaccinated or inadequately vaccinated persons, individuals living in communities with low vaccination rates or in crowded and unsanitary conditions, and persons with compromised immune systems.[2]

Although the numbers of cases of these four diseases declined dramatically after vaccine implementation, outbreaks of these diseases occur sporadically in the U.S. Between 1 January 2017 and 9 September 2017, a total of 119 cases of measles were reported from 15 states. In 2016, a total of 70 cases of measles were reported from 16 states.[3] In 2015, a total of 188 measles cases were reported from 24 states and the District of Columbia.[3] A record number of measles cases were reported in the U.S. in 2014, with 667 cases from 27 states reported to the Centers for Disease Control and Prevention (CDC).[3] The number of measles cases reported in 2014 represents the greatest number of cases since the documentation of measles elimination in the U.S. in 2000.[4] The majority of these cases occurred among individuals who were unvaccinated.[4]

Mumps outbreaks continue to occur in the U.S., even among vaccinated individuals and in areas with high vaccination rates.[5] Two doses of the measles, mumps, rubella (MMR) vaccine are 88% effective at protecting against mumps.[6] When mumps infection does occur among vaccinated individuals, the illness is usually less severe; moreover, mumps outbreaks tend to be of limited size and duration in communities with high vaccination rates.[5,7] Most cases occur in settings where people have close and protracted contact with infected individuals such as at schools, colleges, camps, and isolated religious communities.[7] In 2016, there were approximately 6,366 mumps cases reported to CDC, the majority of which were associated with outbreaks in college settings.[7]

In the U.S., rubella and the associated congenital rubella syndrome were documented as eliminated in 2004.[8] Elimination in this context means that the disease is no longer spread year-round in the U.S. or the Americas region.[8] Although rubella has been eliminated in the U.S., it remains endemic in many other parts of the world. Each year during 2009–2016, fewer than 10 people in the U.S. were reported as rubella cases.[9] All people who were reported as cases of rubella infection since 2012 had evidence that they acquired the infection when they were living or traveling outside the U.S.[10]

Data on the number of chickenpox (varicella) outbreaks that occur each year in the U.S. are unavailable. Although chickenpox outbreaks are not notifiable at the national level, states are encouraged to report them to CDC annually.[11] States are also encouraged to conduct ongoing varicella surveillance to monitor vaccine impact on morbidity. Thirty-six states were carrying out case-based varicella surveillance as of 2010.[11] Based on passive surveillance data from six states, the number of varicella outbreaks decreased by 78% from 147 in 2005 to 33 in 2012.[12] Available data also indicate that outbreaks during this period decreased in size (number of varicella cases per outbreak) and duration.[12]

In the U.S., school requirements have been shown to be a highly effective strategy for achieving and maintaining high varicella

vaccination coverage among school-aged children.[13] The single-dose varicella vaccination program begun in 1996 was associated with significant decreases in disease burden from varicella.[14] However, outbreaks of varicella remained a problem even among school populations with high single-dose coverage.[15] In 2007, a universal two-dose varicella childhood vaccine schedule with a catch-up vaccination for susceptible (i.e., only one dose of varicella vaccine) children, adolescents, and adults was recommended to improve protection and further decrease varicella cases and outbreaks.[15] Since these more recent recommendations were implemented, additional declines in varicella-related outpatient visits and hospitalizations have been documented.[16]

Because of the public health and military operational consequences of MMR/V, evidence of immunity to these viruses is required for service members. Certain military environments such as barracks and ships are conducive to person-to-person spread of diseases such as MMR/V. Furthermore, many service members are sent to overseas locations where the likelihood of exposure to these viruses is elevated.

In February 2015, the *MSMR* reported the numbers, trends, and demographics of measles and mumps diagnoses among service members and other Military Health System (MHS) beneficiaries.[17] The current analysis updates and expands on this earlier work by also summarizing the numbers, trends, and demographics of rubella and varicella diagnoses.

METHODS

The surveillance period was 1 January 2010 through 31 December 2016. The military surveillance population included active and reserve component members of the U.S. Army, Navy, Air Force, and Marine Corps who served at any time during the surveillance period. The non-military surveillance population included other beneficiaries (i.e., retired service members, family members, and other dependents of service members and retirees, and other authorized government employees and their family members) of the MHS who accessed care through either a military medical facility/provider or a civilian facility/provider (if paid for by the MHS). It is Department of Defense policy that cases of measles, mumps, rubella, and varicella (as well as many other diseases of public importance) be reported electronically through military health channels for surveillance purposes.[18] Conditions covered by this policy are referred to as reportable medical events (RMEs). All data used to ascertain cases for this analysis were derived from the electronic records of the Defense Medical Surveillance System (DMSS).

For this analysis, a "confirmed" case was defined as an individual identified through an RME of measles, mumps, rubella, or varicella that was described as confirmed by meeting specified laboratory or epidemiologic criteria.[18-20] Because reporting policy for RMEs of varicella was limited to active duty service members prior to 2017, results pertaining to confirmed varicella cases are limited to those reported among members of the active and reserve components.[18]

A "possible" case was defined as: 1) an RME of measles, mumps, rubella, or varicella without laboratory or epidemiologic confirmation; or 2) a record of an inpatient or outpatient medical encounter with a diagnosis of measles (ICD-9: 055; ICD-10: B05), mumps (ICD-9: 072; ICD-10: B26), rubella (ICD-9: 056; ICD-10: B06), or varicella (ICD-9: 052; ICD-10:B01) in the primary diagnostic position **(Tables 1–4)**. "Possible" measles, mumps, and rubella cases were also required to have an associated symptom code listed in another diagnostic position. Encounters were excluded if there was either: 1) a record of measles, mumps, rubella, or varicella vaccine administration or a positive test for serologic immunity to measles, mumps, rubella, or varicella within 7 days before or after the encounter date; or 2) an ICD-9 diagnosis, procedure or Current Procedural Terminology (CPT) code indicating measles, mumps, rubella, or varicella vaccination recorded for the same encounter as the diagnosis of measles, mumps, rubella, or varicella **(Tables 1–4)**.

RESULTS

Confirmed cases

Measles: During the surveillance period, there were a total of 11 confirmed cases of measles among all MHS beneficiaries **(Table 5, Figure 1)**. The only confirmed case of measles in a service member was in an active component Air Force member diagnosed in April 2014 in California. The remaining 10 confirmed cases were among non-service member beneficiaries **(Table 5)**. The majority (80.0%) of the confirmed non-service member cases were female. More confirmed cases were reported in 2014 (n=4) than in any other year of the surveillance period **(Figure 1)**. All four cases in 2014 were among beneficiaries diagnosed in California **(data not shown)**. Of all 11 cases reported during the 7-year surveillance period, five (45.5%) were among children younger than 5 years old; of these children, three were younger than 1 year old and two were 1 year old **(Figure 2)**.

Mumps: There were 76 confirmed cases of mumps among all beneficiaries during the surveillance period **(Table 5, Figure 3)**. Approximately three-fifths (59.2%) of the confirmed mumps cases were among males. Twenty-five cases (32.9%) were among active component and three cases were among reserve component service members. Of the 28 confirmed mumps cases in service members, 10 cases were among Army members, nine among Navy, eight among Air Force, and one among Marine Corps members **(Table 5)**. The remaining 48 cases of mumps were among non-service member beneficiaries. There were more confirmed cases in 2010 (n=23) than in any other year of the surveillance period **(Figure 3)**. Overall, the single month with the highest number of confirmed mumps cases was March 2010 (n=5) **(data not shown)**. The locations with the most cases were California (n=8), Virginia (n=6), and Japan (n=6) **(data not shown)**. The age groups with the most confirmed cases were children aged 1–5 years (n=17; 22.4%), and adults aged 26–30 years (n=11; 14.5%) **(Figure 4)**.

Rubella: During the surveillance period, there were seven confirmed rubella cases among all MHS beneficiaries **(Table 5, Figure 5)**. The vast majority (85.7%) of confirmed rubella cases were among females. There

TABLE 1. ICD-9/ICD-10 codes used for classification as a "possible" measles case

ICD-9			ICD-10	
Measles condition	**Symptoms**[a]	**Exclusions**[b]	**Measles condition**	**Symptoms**[a]
055 (measles)	Fever: 780.6, 780.60, 780.61, 778.4	*Diagnosis:* V04.2 (need for vaccine, measles alone)	—	Fever: R50, R50.8, R50.81, R50.9, P81.8, P81.9
055.0 (post-measles encephalitis)	Rash: 782.1, 057.9	V04.8 (need for vaccine, other viral diseases)	B05.0 (measles complicated by encephalitis)	Rash: R21, B09
055.79 (measles with other specified complication;other)	Acute URI: 460.**–466.**	V04.89 (need for vaccine, other viral diseases)	B05.1 (measles complicated by meningitis)	Acute URI: J00, J01.** (excluding 5th digit = 1), J02.9, J03.9, J03.90, J04, J04.0, J04.1, J04.10, J04.11, J04.3, J04.30, J04.31, J05.**, J06.0, J06.9
055.1 (post-measles pneumonia)	Viral pneumonia: 480, 480.8, 480.9, 483.8,485, 486	V05.8 (need for vaccine, other specified disease)	B05.2 (measles complicated by pneumonia)	Viral pneumonia: J12.89, J12.9, J16.8, J18.0, J18.9
055.79 (above)	Malaise/fatigue: 780.7, 780.79	V06.4 (need for vaccine, measles-mumps-rubella [MMR])	B05.4 (measles with intestinal complications)	Malaise/fatigue: R53, R53.1, R53.8, R53.81, R53.83
055.7 (measles with other specified complication)	Cough: 786.2	*Procedure:* 99.45 (measles vaccine)	B05.8 (measles with other complications)	Cough: R05
055.79 (above)	Conjunctivitis: 372.0*, 372.3*, 077.9, 077.99, 771.6	98.48 (measles-mumps-rubella [MMR] vaccine)	B05.89 (other measles complications)	Conjunctivitis: H10.0**–H10.3**, H10.8, H10.89, H10.9
055.8 (measles with unspecified complication)		*CPT codes:* 90705 (measles virus vaccine)	B05.9 (measles without complications)	
055.9 (measles without mention of complication)		90707 (measles-mumps-rubella [MMR] vaccine)		
		90708 (measles and rubella vaccine)		
		90709 (rubella and mumps vaccine)		
		90710 (measles-mumps-rubella-varicella [MMRV] vaccine)		

CPT, Current Procedural Terminology; URI, upper respiratory infection

[a]An asterisk (*) indicates any digit/character in this position.

[b]There are no measles-specific ICD-10 exclusion diagnosis or exclusion procedure codes.

were two confirmed cases of rubella among service members, both active component Navy members; one case was diagnosed in May 2012 in Virginia and the other in October 2015 in Japan. The remaining five confirmed rubella cases were among non-service member beneficiaries **(Table 5)**. Six of the seven confirmed cases (85.7%) reported during the surveillance period were among adults; one case was in a child younger than 1 year old **(Figure 6)**. Two confirmed cases were reported in 2012 and 2014, whereas only single confirmed cases were reported in 2011, 2015, and 2016 **(Figure 5)**. No confirmed rubella cases were reported in either 2010 or 2013.

Varicella: Among members of the active and reserve components, there were 62 confirmed cases of varicella during the surveillance period **(Table 5, Figure 7)**. Close to four-fifths (77.4%) of confirmed varicella cases were among male service members. Twenty-four of the 62 cases were among Air Force members, 17 among Army members, 15 among Navy, and six among Marine Corps members **(Table 5)**. There were more confirmed cases in 2010 (n=28) and 2011 (n=27) than in any other year of the surveillance period **(Figure 7)**. Overall, the months with the greatest number of confirmed

TABLE 2. ICD-9/ICD-10 codes used for classification as a "possible" mumps case

ICD-9			ICD-10	
Mumps condition	**Symptoms**[a]	**Exclusions**[b]	**Mumps condition**	**Symptoms**[a]
072 (mumps) 072.1 (mumps orchitis) 072.2 (mumps meningitis) 072.3 (mumps pancreatitis) 072.7 (mumps with other specified conditions) 072.71 (mumps hepatitis) 072.79 (mumps with other specified conditions; other) 072.72 (mumps poly-neuropathy) 072.79 (above) 072.8 (mumps with unspecified complication) 072.9 (mumps without mention of complication)	Sialoadenitis; parotitis: 527.2 Lymphadenopathy/acute lymphadenitis: 785.6, 683 Hypertrophy of salivary gland: 527.1 Sialolithiasis: 527.5 Swelling, mass, or lump in head/neck: 784.2 Swelling, mass, or lump in head/neck: 784.2 Jaw pain: 784.92 Fever: 780.6, 780.60, 780.61, 778.4 Malaise/fatigue: 780.7, 780.79 Headache: 784.0 Anorexia: 783.0 Odynophagia/dysphagia: 787.2* Generalized pain/myalgia: 780.96, 729.1 Orchitis/epididymitis: 604.** Abdominal pain: 789.0* Otalgia (ear ache): 388.7* Acute pharyngitis: 462 Atypical face pain: 350.2	*Diagnosis:* V04.8 (need for vaccine, other viral diseases) V04.89 (need for vaccine, other viral diseases) V05.8 (need for vaccine, other specified disease) V05.8 (need for vaccine, other specified disease) V06.4 (need for vaccine, measles-mumps-rubella [MMR]) *Procedure:* 99.46 (mumps vaccine) 98.48 (measles-mumps-rubella [MMR] vaccine) *CPT codes:* 90704 (mumps virus vaccine) 90707 (measles-mumps-rubella [MMR] vaccine) 90709 (rubella and mumps vaccine) 90710 (measles-mumps-rubella-varicella [MMRV] vaccine)	B26 (mumps) B26.0 (mumps orchitis) B26.1 (mumps meningitis) B26.3 (mumps pancreatitis) B26.8 (mumps with other complications) B26.81 (mumps hepatitis) B26.82 (mumps myocarditis) B26.83 (mumps nephritis) B26.84 (mumps polyneuropathy) B26.85 (mumps arthritis) B26.89 (other mumps complications) B26.9 (mumps without complication)	Salioadenitis: K11.2, K11.20, K11.21 Lymphadenopahty/acute lymphadenitis: R59*, L04.0, L04.9 Hypertrophy of salivary gland: K11.1 Sialolithiasis: K11.5 Swelling, mass, or lump in head/neck: R22.0, R22.1 Jaw pain: R68.84 Fever: R50.8, R50.81, R50.9, P81.8, P81.9 Malaise/fatigue: R53, R53.1, R53.8, R53.81, R53.83 Headache: R51 Anorexia: R63.0 Odynophagia/dysphagia: R13, R13.1* Generalized pain/myalgia: R52, M79.1 Orchitis/epididymitis: N45.* Abdominal pain: R10.1*, R10.2, R10.3*, R10.84, R10.9 Otalgia (ear ache): H92.0* Acute pharyngitis: J02.9 Atypical face pain: G50.1

CPT, Current Procedural Terminology

[a]An asterisk (*) indicates any digit/character in this position.

[b]There are no mumps-specific ICD-10 exclusion diagnosis or exclusion procedure codes.

varicella cases were July 2011 (n=6) and April 2010 (n=5) **(data not shown)**. There were no confirmed cases of varicella among active and reserve component service members during 2013–2016. The locations with the most reported cases were Florida (n=6), Georgia (n=6), Japan (n=5), and California (n=5) **(data not shown)**. Among active and reserve component service members, the age group with the most confirmed cases was 21–25 years (n=15; 24.2%) **(Figure 8)**.

Possible cases

Measles: During the 7-year surveillance period, there were 46 possible cases of measles among all MHS beneficiaries **(Table 5)**. Three of the possible cases were among active component service members. The remaining 43 possible cases were among non-service member beneficiaries. The greatest number of possible cases was among children aged 5 years or younger (n=20; 43.5%) **(data not shown)**.

TABLE 3. ICD-9/ICD-10 codes used for classification as a "possible" rubella case

ICD-9			ICD-10	
Rubella condition	**Symptoms**[a]	**Exclusions**[b]	**Rubella condition**	**Symptoms**[a]
056 (rubella)	Fever: 780.6, 780.60, 780.61, 778.4	*Diagnosis:* V04.3 (need for vaccine, rubella alone)	B06 (rubella [German measles])	Fever: R50, R50.8, R50.81, R50.9, P81.8, P81.9
056.0 (rubella with neurological complications)	Rash: 782.1, 057.9	V04.8 (need for vaccine, other viral diseases)	B06.0 (rubella with neurological complications)	Rash: R21, B09
056.00 (rubella with unspecified neurological complication)	Arthralgia: 719.4	V04.89 (need for vaccine, other viral diseases)	B06.00 (rubella with neurological complication, unspecified)	Arthralgia: M25.**
056.01 (encephalomyelitis due to rubella)	Arthritis: 716.4–716.9	V05.8 (need for vaccine, other specified disease)	B06.01 (rubella encephalitis)	Arthritis: M13.1*
056.09 (rubella with other neurological complications)	Lymphadenopathy: 785.6	V06.4 (need for vaccine, measles-mumps-rubella [MMR])	B06.09 (other neurological complications of rubella)	Lymphadenopathy: R59*
056.7 (rubella with other specified complications)	Conjunctivitis: 372.0*, 372.3*, 077.9, 077.99, 771.6	*Procedure:* 99.47 (rubella vaccine)	B06.8 (rubella with other complications)	Conjunctivitis: H10.0**–H10.3**, H10.8, H10.89, H10.9
056.71 (arthritis due to rubella)		98.48 (measles-mumps-rubella [MMR] vaccine)	B06.82 (rubella arthritis)	
056.79 (rubella with other specified complications)		*CPT codes:* 90706 (rubella vaccine)	B06.81 (rubella pneumonia)	
		90707 (measles-mumps-rubella [MMR] vaccine)	B06.89 (other rubella complications)	
		90708 (measles and rubella vaccine)		
056.8 (rubella with unspecified complications)		90709 (rubella and mumps vaccine)	B06.89 (above)	
056.9 (rubella without complication)		90710 (measles-mumps-rubella-varicella [MMRV] vaccine)	B06.9 (rubella without complication)	

CPT, Current Procedural Terminology

[a]An asterisk (*) indicates any digit/character in this position.

[b]There are no rubella-specific ICD-10 exclusion diagnosis or exclusion procedure codes.

Mumps: Overall, there were 254 possible cases of mumps among all MHS beneficiaries during the surveillance period **(Table 5)**. Of these, 35 possible cases were among active component service members and 10 were among reserve component service members. The remaining 209 possible cases were among non-service member beneficiaries. The age group with the greatest number of possible mumps cases was children aged 5 years and younger (n=41; 16.1%) **(data not shown)**.

Rubella: During the surveillance period, there were 32 possible cases of rubella among all MHS beneficiaries **(Table 5)**. All 32 possible cases were among non-service member beneficiaries. The greatest number of possible rubella cases was among children aged 5 years and younger (n=23; 71.9%) **(data not shown)**.

Varicella: There were 16,583 possible cases of varicella during the surveillance period among all MHS beneficiaries **(Table 5)**. Of these, 604 (3.6%) possible cases were among active component service members and 240 (1.4%) were among reserve component service members. The remaining 15,739 possible cases were among non-service member beneficiaries. The age groups with the most possible cases were children aged 5 years and younger (n=7,553; 45.5%) and children aged 6–10 years (n=2,571; 15.5%) **(data not shown)**.

EDITORIAL COMMENT

Department of Defense policy and practices for MMR/V protection for new accessions have evolved over time. In regards to measles, mumps, and rubella,

TABLE 4. ICD-9/ICD-10 codes used for classification as a "possible" varicella case

ICD-9		ICD-10
Varicella condition	**Exclusions**	**Varicella condition**
052 (chickenpox)	*CPT codes:*	B01 (varicella [chickenpox])
052.0 (postvaricella encephalitis)	90716 (varicella vaccine)	B01.11 (varicella encephalitis and encephalomyelitis)
052.1 (varicella [hemorrhagic] pneumonitis)	90710 (measles-mumps-rubella-varicella [MMRV] vaccine)	B01.2 (varicella pneumonia)
052.2 (postvaricella myelitis)		B01.12 (varicella myelitis)
052.7 (chickenpox with other specified complications)		B01.0 (varicella meningitis)
		B01.81 (varicella keratitis)
052.8 (chickenpox with unspecified complication)		B01.89 (other varicella complications)
052.9 (chickenpox without mention of complication)		B01.9 (varicella without complication)

CPT, Current Procedural Terminology

TABLE 5. Confirmed and possible cases of measles, mumps, rubella, and varicella among Military Health System beneficiaries, January 2010–December 2016

	Measles		Mumps		Rubella		Varicella	
	Confirmed	Possible	Confirmed	Possible	Confirmed	Possible	Confirmed[a]	Possible
Total	11	46	76	254	7	32	62	16,583
Active component	1	3	25	35	2	0	57	604
Reserve component	0	0	3	10	0	0	5	240
All other beneficiaries	10	43	48	209	5	32	-	15,739
Sex								
Male	3	21	45	129	1	15	48	8,052
Female	8	23	30	124	6	17	14	8,528
Unknown	0	2	1	1	0	0	0	3
Service[b]								
Army	0	1	10	17	0	0	17	425
Navy	0	0	9	12	2	0	15	174
Air Force	1	0	8	11	0	0	24	168
Marine Corps	0	2	1	5	0	0	6	77

[a]Confirmed cases of varicella limited to active and reserve component service members

[b]Among active and reserve components

antibody titers are obtained on all basic trainees and other accessions, followed by vaccination against those diseases for which they screen seronegative.[21] Because monovalent vaccines are unavailable in the U.S., a seronegative screen for any one of the MMR/V antibodies leads to vaccine administration. Department of Defense immunization policy recommends presuming mumps immunity for those who are seropositive for measles and rubella.[21] However, compared to measles and rubella, the immunity induced by the mumps component of the MMR vaccine is the least effective and has been shown to wane the fastest.[22] Measles also can occur in vaccinated individuals due to primary vaccine failure or waning immunity.[3]

During 2010–2016, only one confirmed measles case was reported among service members. The report of the case (as an RME) noted that the individual had only one dose of MMR vaccine on record; public health follow-up of the case included identifying and vaccinating close contacts of the case who had only one MMR vaccination on record. The vast majority of the confirmed cases of measles identified for this report were among non-service member beneficiaries. Children aged 5 years or younger accounted for close to half (n=5; 45.5%) of all confirmed measles cases. This finding and those of published reports of recent outbreaks suggest that some children who have not received two doses of either MMR or MMRV vaccine are susceptible to infection when exposed to the measles virus.[24,25]

During the 7-year surveillance period, there were seven times (n=76) as many confirmed cases of mumps as there were of measles. This finding is not unexpected given that the efficacy of the mumps vaccine (88% [range: 66%–95%] with two doses; 78% [range: 49%–92%] with one dose) is lower than that of the measles component of the vaccine.[25,26] Furthermore, a relatively high number of confirmed cases of mumps occurred among 26- to-30-year-olds. This observation is consistent with evidence of waning immunity against mumps in adults who had received the vaccine in the more distant past.[27-29]

In this analysis, California was the location associated with the greatest number of confirmed measles and mumps cases among MHS beneficiaries. It is unknown whether these cases were associated with outbreaks within military or civilian communities.

FIGURE 1. Confirmed cases of measles among Military Health System beneficiaries, by year, January 2010–December 2016

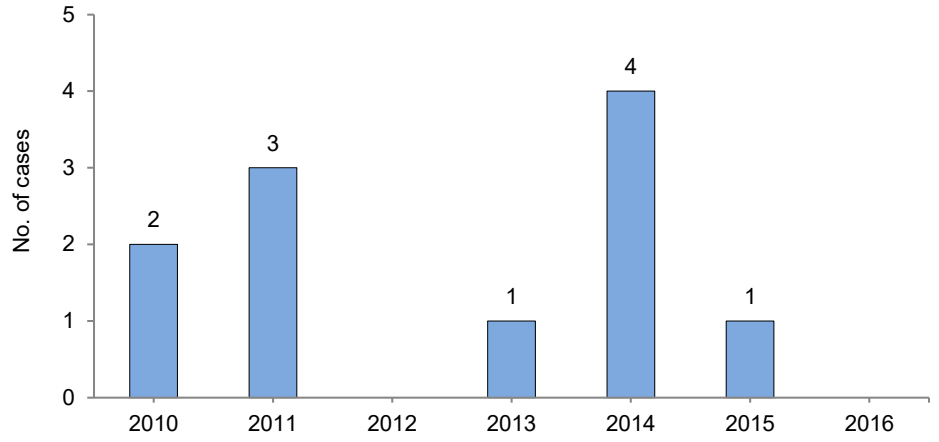


FIGURE 2. Age distribution of confirmed cases of measles among Military Health System beneficiaries, January 2010–December 2016

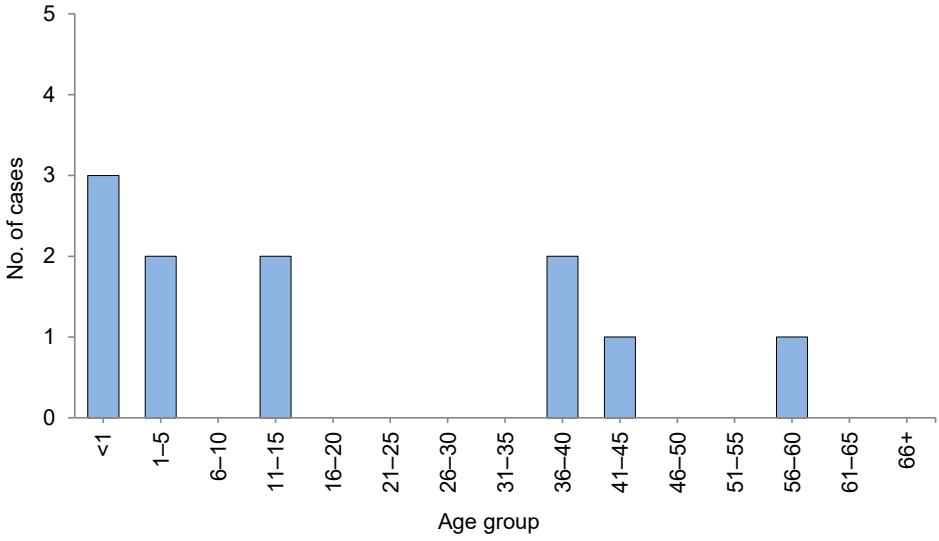
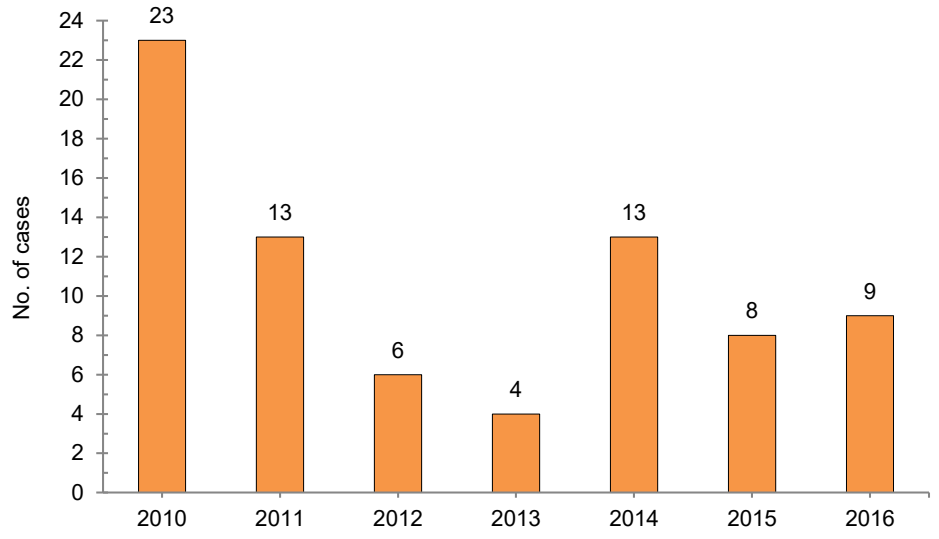


FIGURE 3. Confirmed cases of mumps among Military Health System beneficiaries, by year, January 2010–December 2016



The low number of confirmed rubella cases reported during the surveillance period is expected given the efficacy of the rubella component of the MMR vaccine and the low number of cases reported in the general U.S. population during this time.

Across the Services, the varicella vaccine is administered to susceptible trainees and other accessions within the first 2 weeks of initial entry training.[38] Serologic screening is the preferred means of determining those susceptible to varicella infection and in need of immunization. Those individuals without a personal history of chickenpox, documentation of two prior varicella vaccinations, or documentation of immunity based on serologic testing are considered susceptible.[30] Susceptible adults require two doses of varicella vaccine given 4–8 weeks apart.[30] In 2017, the reporting policy for RMEs for varicella was changed to include all beneficiaries and is no longer restricted to only active and reserve component service members.[18]

In the current analysis, the number of confirmed cases of varicella among active and reserve component service members dropped from 28 cases in 2010 and 27 cases in 2011 to seven confirmed cases in 2012. There were no confirmed cases of varicella among active and reserve component service members during 2013–2016.

As expected, this analysis identified many more possible cases of MMR/V than confirmed cases. In the MHS, these diagnoses require RME notifications. The published guidelines emphasize that the proper identification, treatment, control, and follow-up of cases requires prompt, accurate reporting of probable, suspected, or confirmed cases of these infections.[18] In addition, the guidelines discourage delaying the submission of RME reports while awaiting laboratory confirmation and call for the submission of additional reports once the diagnosis has been confirmed.[18] In the context of these guidelines, this analysis searched the database of RMEs for cases that were identified as "confirmed." RMEs that characterized the diagnoses as either "probable" or "suspected" and were never amended as "confirmed" were treated as "possible" cases. Such cases were grouped with cases identified from records of inpatient and outpatient records (as described in

FIGURE 4. Age distribution of confirmed cases of mumps among Military Health System beneficiaries, January 2010–December 2016

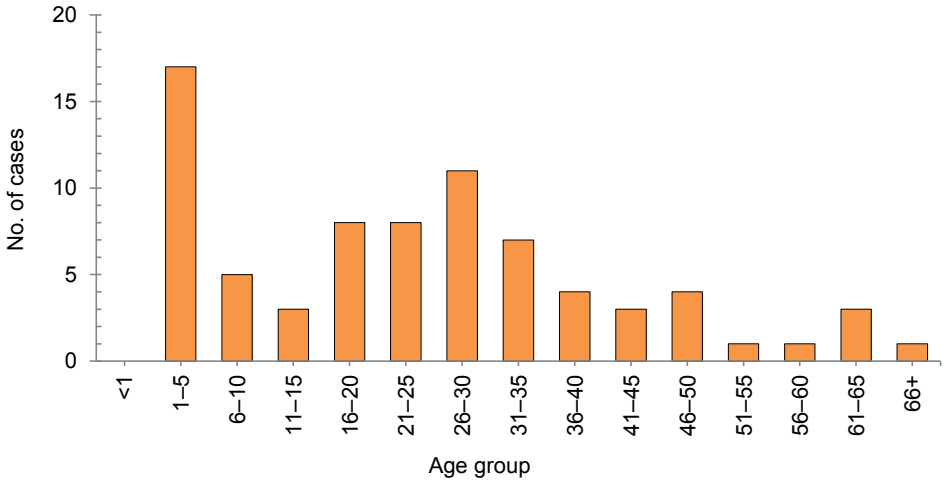


FIGURE 5. Confirmed cases of rubella among Military Health System beneficiaries, by year, January 2010–December 2016

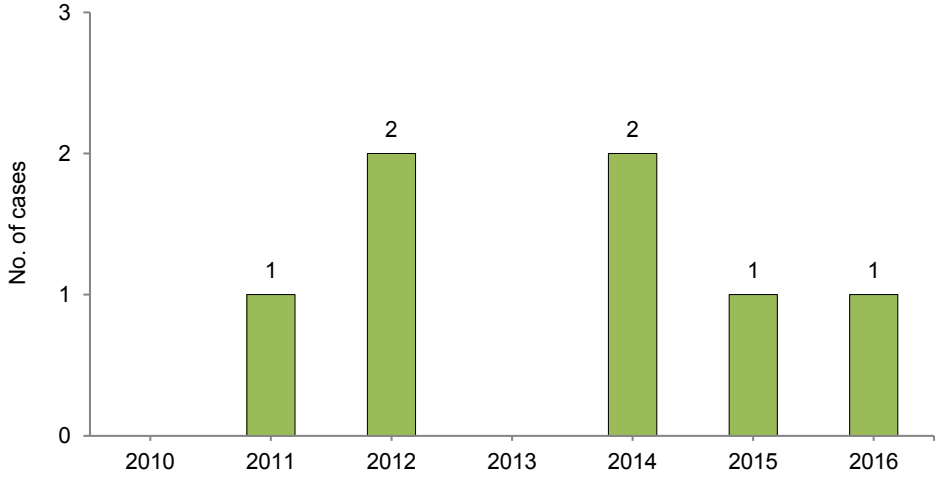
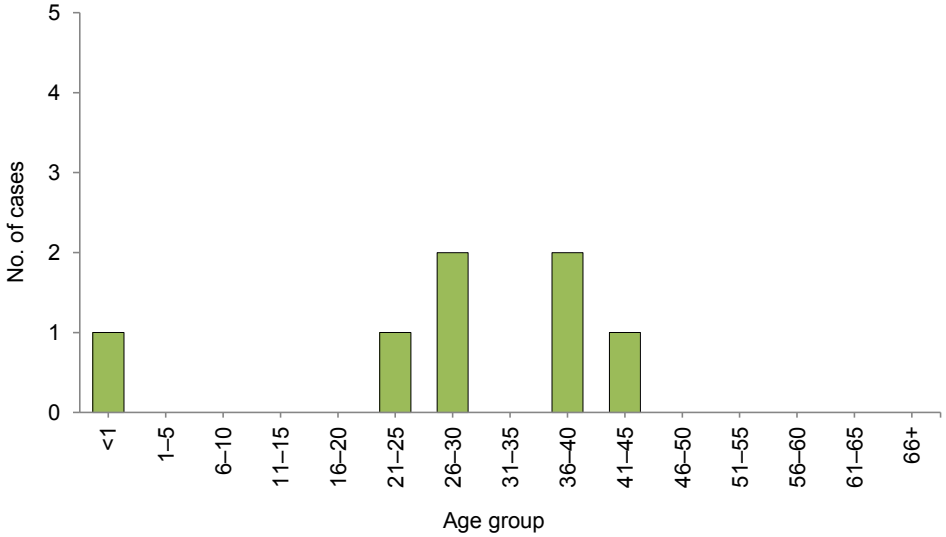


FIGURE 6. Age distribution of confirmed cases of rubella among Military Health System beneficiaries, January 2010–December 2016



the Methods section). Consequently, "possible" cases may include both "true" cases for which there were no follow-up RMEs indicating confirmation; and "true" cases for which diagnoses were documented in inpatient or outpatient records but no RMEs were ever submitted by local military public health officials. Civilian healthcare providers who diagnose and confirm cases of any of these four viral infections outside of the MHS would not be expected to submit RME reports; however, the diagnoses are captured in the DMSS if such care is underwritten by the MHS. The scenarios/situations described above may result in the underestimation of the actual incidence of cases of measles, mumps, rubella, and varicella among MHS beneficiaries.

Conversely, other circumstances may tend to result in overestimation of the number of incident cases. For example, diagnoses of MMR/V recorded in electronic health records may represent misdiagnoses, tentative (rule-out) diagnoses that are not confirmed, and/or miscoding of medical encounters for vaccinations or laboratory testing. Because of this inherent uncertainty, counts of confirmed cases were the main focus of this report.

Recent trends in MMR/V in both military and civilian populations in the U.S. highlight the importance of primary and booster vaccinations. Current recommendations for the MMR vaccine include two doses, the first between ages 12 and 15 months and the second between ages 4 and 6 years.[30] Adults with only one dose or who lack laboratory evidence for measles, mumps, and/or rubella immunity are encouraged to receive the vaccine, particularly for those who work in healthcare settings.[30] Current recommendations for varicella vaccination correspond to the MMR vaccination schedule (two doses, the first between ages 12 and 15 months and the second between ages 4 and 6 years) with a catch-up vaccination for susceptible children, adolescents, and adults.[30] Because they are required to have evidence of immunity for MMR/V, it is not surprising that service members account for a relatively small proportion of all cases of these diseases in the MHS.

FIGURE 7. Confirmed cases of varicella, by year, active and reserve components, U.S. Armed Forces, January 2010–December 2016

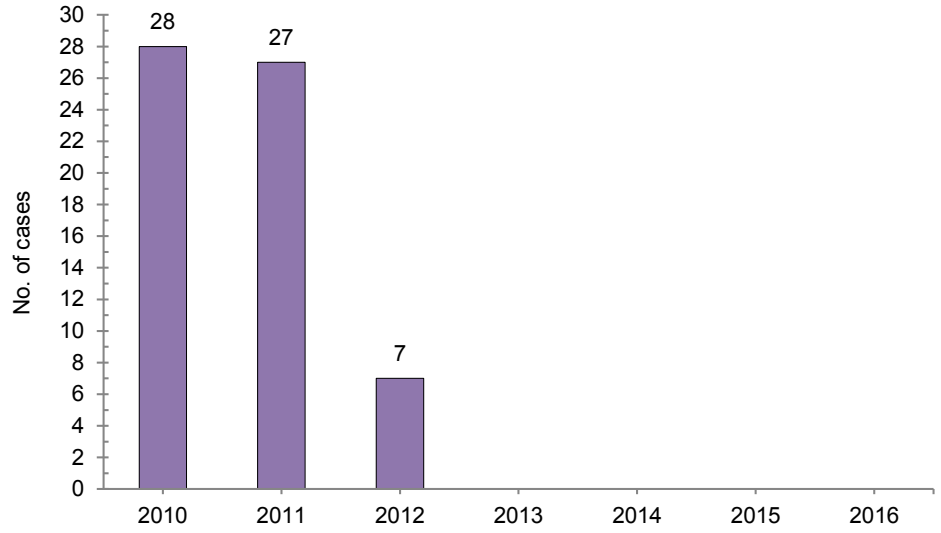
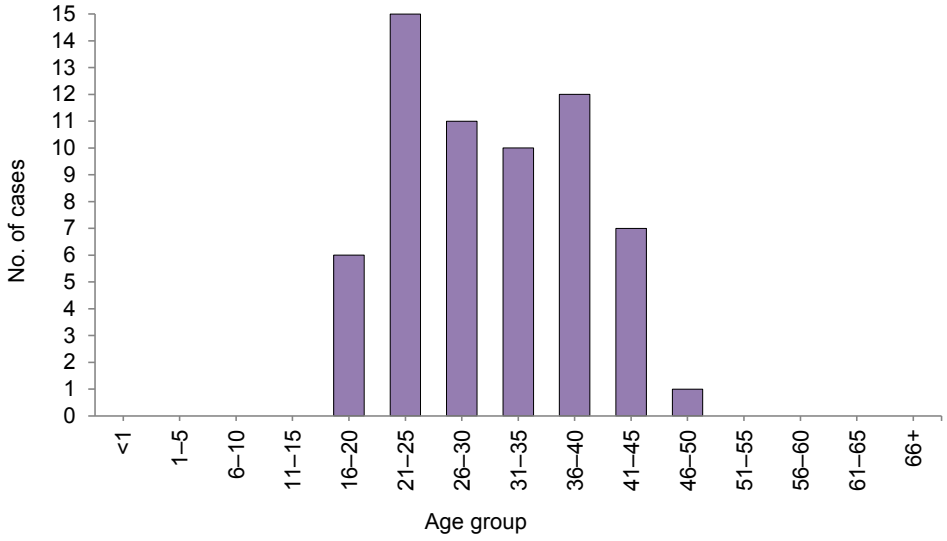


FIGURE 8. Age distribution of confirmed cases of varicella, active and reserve components, U.S. Armed Forces, January 2010–December 2016



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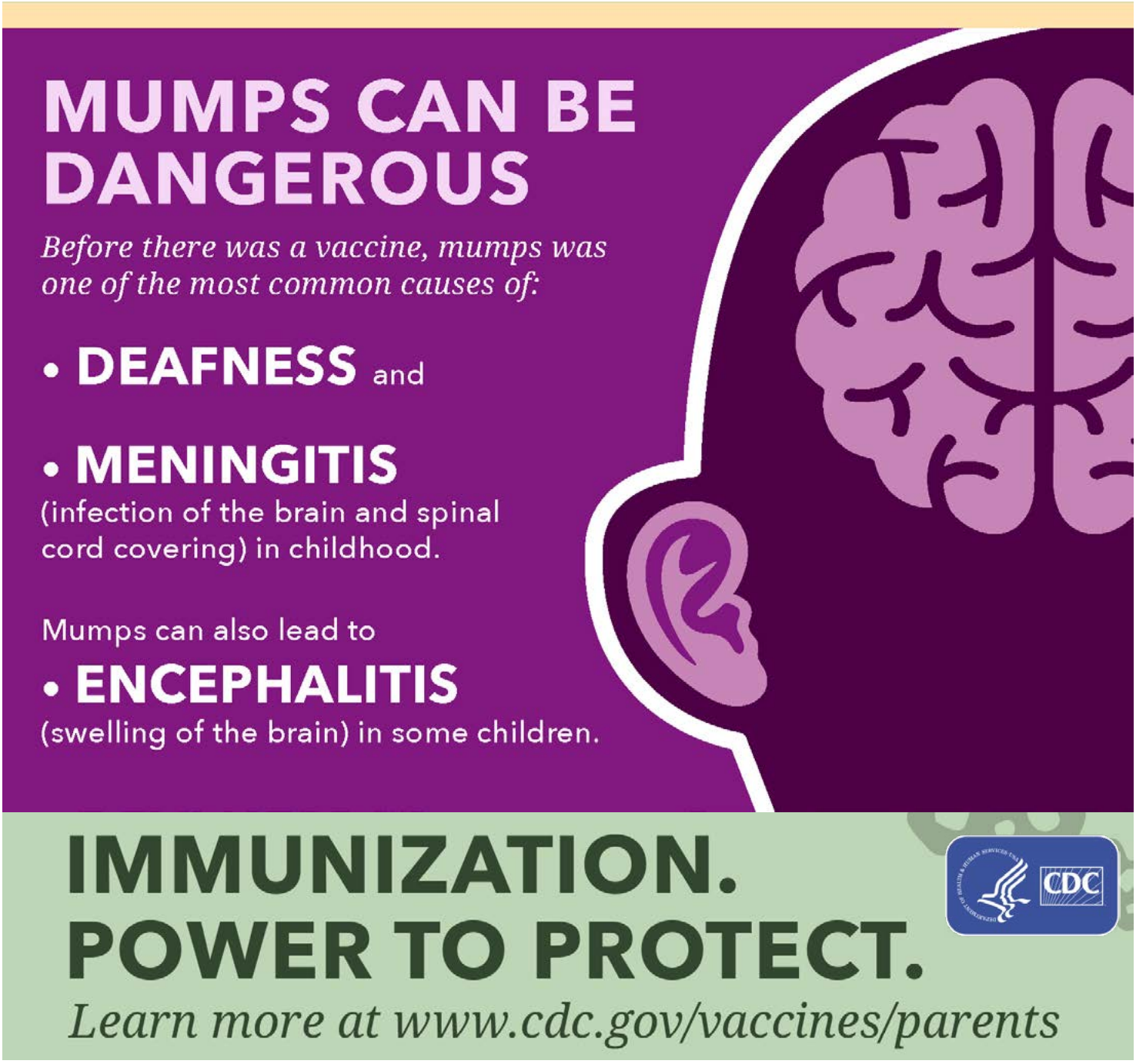


Update: Cold Weather Injuries, Active and Reserve Components, U.S. Armed Forces, July 2012–June 2017

Francis L. O'Donnell, MD, MPH (COL, USA, Ret.); Shauna Stahlman, PhD, MPH; Alexis A. Oetting, MPH

From July 2016 through June 2017, a total of 387 members of the active (n=328) and reserve (n=59) components had at least one medical encounter with a primary diagnosis of cold injury. Among active component service members, the total number of cold injuries in the 2016–2017 cold season was the lowest since 1999 and the overall incidence rate was lower than in any of the previous four cold seasons. Frostbite was the most common type of cold injury. During the five cold seasons in the surveillance period (2012–2017), rates tended to be higher among service members who were in the youngest age groups, female, non-Hispanic black, or in the Army. The numbers of cold injuries associated with overseas deployments have fallen precipitously in the past three cold seasons and included just 10 cases in the most recent year.

Since 2004, the *MSMR* has published an annual update on the incidence of cold weather injuries that affected U.S. military members during the five most recent cold seasons.[1] The content of this 2017 report addresses the occurrence of such injuries during the cold seasons from July 2012 through June 2017. The timing of the annual updates is intended to call attention to the recurring risks of such injuries as winter approaches in the Northern Hemisphere, where most members of the U.S. Armed Forces are assigned.

For many years, the U.S. Armed Forces have developed and improved robust training, doctrine, procedures, and protective equipment and clothing to counter the threat from cold environments.[2-4] Although these measures are highly effective, cold injuries have continued to affect hundreds of service members each year because of exposure to cold and wet environments.[5] Such environmental conditions pose the threat of hypothermia, frostbite, and nonfreezing cold injury such as immersion injury. The human physiologic response to cold exposure is to preserve core body temperature, but this response may not be sufficient to prevent hypothermia if heat loss is prolonged. Moreover, the response includes constriction of the peripheral (superficial) vascular system, which may result in nonfreezing injuries or hasten the onset of actual freezing of tissues (frostbite). Traditional measures to counter the dangers associated with cold environments include minimizing loss of body heat and protecting superficial tissues through such means as protective clothing, shelter, physical activity, and nutrition. However, military training or mission requirements in cold and wet weather may place service members in situations where they may be unable to be physically active, find warm shelter, or change wet or damp clothing.[2,3] Military history has well documented the toll of cold weather injuries. Continuous surveillance of these injuries is essential to inform steps to reduce their impact as well as to remind leaders of the predictable threat of cold injuries. This update summarizes frequencies, rates, and correlates of risk of cold injuries among members of both active and reserve components of the U.S. Armed Forces during the past 5 years.

METHODS

The surveillance period was 1 July 2012 through 30 June 2017. The surveillance population included all individuals who served in an active or reserve component of the U.S. Armed Forces at any time during the surveillance period. For analysis purposes, "cold years" or "cold seasons" were defined as 1 July through 30 June intervals so that complete cold weather seasons could be represented in year-to-year summaries and comparisons.

For this analysis, the Defense Medical Surveillance System (DMSS) and the Theater Medical Data Store (which maintains electronic records of medical encounters of deployed service members) were searched for records of inpatient and outpatient care for the diagnoses of interest (frostbite, immersion injury, hypothermia, and "other specified/unspecified effects of reduced temperature"). A case was defined by the presence of an ICD-9 or ICD-10 code for one of the cold injuries in the first diagnostic position of a record of health care **(Table 1)**. It should be noted that the former category of "immersion foot" now encompasses "immersion foot and hand" because the ICD-10 coding system provides a specific code for such injuries of the hand. Cases of cold injuries were also sought in the DMSS records of cases identified via electronic notifications of so-called reportable medical events (RMEs). The DoD guidelines for RMEs

TABLE 1. ICD-9/ICD-10 diagnostic codes for cold weather injuries

	ICD-9	ICD-10
Frostbite	991.0, 991.1, 991.2, 991.3	T33.***A, T34.***A
Immersion foot and hand	991.4	T69.0**A
Hypothermia	991.6	T68.XXXA
Other and unspecified	991.8, 991.9	T69.8XXA, T69.9XXA

*Wild card; codes with any characters in those positions should be included.

require the reporting of cases of frostbite, hypothermia, and immersion injuries, but not "other specified/unspecified effects of reduced temperature."[6] Cases of chilblains are not included in this report because the condition is common, infrequently diagnosed, usually mild in severity, and thought to have minimal medical, public health, or military impacts.

To estimate the number of unique individuals who suffered a cold injury each cold season, and to avoid counting follow-up healthcare encounters after single episodes of cold injury, only one cold injury per individual per cold season was included. A slightly different approach was taken for summaries of the incidence of the different types of cold injury diagnoses. In counting types of diagnoses, one of each type of cold injury per individual per cold season was included. For example, if an individual was diagnosed with immersion foot at one point during a cold season and then with frostbite later during the same cold season, each of those different types of injury would be counted in the tally of injuries. If a service member had multiple medical encounters for cold injuries on the same day, only one encounter was used for analysis (hospitalizations were prioritized over reportable events which were prioritized over ambulatory visits). Annual incidence rates of cold injuries (per 100,000 person-years [p-yrs] of service) were estimated for active component service members only. However, this year's *MSMR* update on cold injuries did calculate, for the first time, rates for reservists (cases per 100,000 persons per year) using the total number of reserve component service members for each year of the surveillance period. Counts of persons were used for the denominator because person-years could not be calculated due to the unavailability of the start and end dates of active duty service periods of reserve component members. The numbers of cold injuries were summarized by the locations at which service members were treated for cold injuries as identified by the Defense Medical Information System Identifier (DMISID) recorded in the medical records of the cold injuries. Because cold injuries may be sustained during field training exercises, temporary duty, or other instances for which a service member may not be located at his/her usual duty station, DMISID was considered a proxy for the location where the cold injury occurred.

RESULTS

2016–2017 cold season

From July 2016 through June 2017, a total of 387 members of the active (n=328) and reserve (n=59) components had at least one medical encounter with a primary diagnosis of cold injury **(Table 2)**. The number of affected individuals in the active component was the lowest of the last 18 cold seasons for which the *MSMR* has reported such data, beginning with the 1999–2000 cold season **(data not shown)**. The overall incidence rate for all active component service members in 2016–2017 (25.8 per 100,000 p-yrs) was 15% lower than the rate (30.4 per 100,000 p-yrs) for the 2015–2016 cold season and was the lowest rate among the five seasons of the surveillance period. In 2016–2017, the service-specific incidence rate (41.0 per 100,000 p-yrs) for active component members of the Army was 18% lower than the lowest previous Army rate (2012–2013) during the surveillance period. For each of the other three services (Navy, Air Force, and Marine Corps), the active component rate for 2016–2017 was not the lowest during the period, but was only slightly higher than the lowest rate. Because the Army contributed 57.6% (n=189) of all cold injury diagnoses in the active component during the 2016–2017 cold season, the sharp decline in the Army rate drove the overall decline for all services combined **(Table 2, Figure 1)**. The 69 members of the Marine Corps diagnosed with a cold injury in 2016–2017 represented 21.0% of all affected active component service members. Navy service members (n=27) had the lowest service-specific rate of cold injuries during the 2016–2017 cold season (rate: 8.5 per 100,000 p-yrs) **(Table 2, Figure 1)**.

This update for 2016–2017 depicts the first estimation of annual rates of cold injuries for members of the reserve component. Army personnel (n=43) accounted for 72.9% of all reserve component service members (n=59) who suffered cold injuries during 2016–2017. As was true for the active component, service-specific rates in the reserve component were higher in the Army and Marine Corps than in the Air Force and Navy. For the 2016–2017 cold season, the overall rate of cold injuries for the reserve component and the rates for each of the services except the Air Force were lower than in any of the previous four seasons **(Table 2, Figure 2)**.

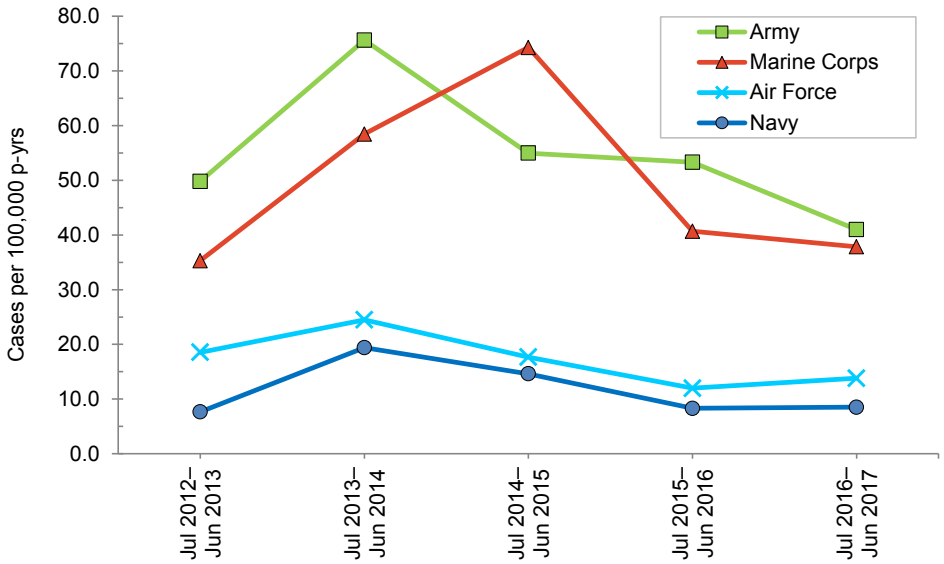
When all injuries were considered—not just the numbers of individuals affected— frostbite was the most common type of cold injury (n=177 or 53.0% of all cold injuries) among active component service members in 2016–2017. In the Air Force and Army respectively, 60.9% and 58.9% of all cold injuries were frostbite, whereas the proportions in the Marine Corps (42.9%) and Navy (25.0%) were much lower **(Tables 3a–3d)**. For the Navy, the 2016–2017 number and rate of frostbite injuries in active component service members were the lowest of the past 5 years. For all active component service members during 2016–2017, the proportions of all cold weather injuries that were hypothermia, immersion injuries, and other and unspecified cold injuries were 19.5%, 17.7%, and 9.9% respectively **(data not shown)**. The number of immersion injury cases in

TABLE 2. Counts and rates of individuals with any cold injury (one per person per year), by service and component, U.S. Armed Forces, July 2012–June 2017

	Army		Navy		Air Force		Marine Corps		All services	
Active component	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
All years (2012–2017)	1,380	55.3	187	11.7	276	17.4	464	49.3	2,307	34.8
Jul 2012–Jun 2013	268	49.8	24	7.6	61	18.6	69	35.3	422	30.7
Jul 2013–Jun 2014	394	75.6	62	19.4	80	24.5	113	58.4	649	47.7
Jul 2014–Jun 2015	273	55.0	47	14.6	55	17.7	138	74.3	513	39.0
Jul 2015–Jun 2016	256	53.3	27	8.3	37	12.0	75	40.7	395	30.4
Jul 2016–Jun 2017	189	41.0	27	8.5	43	13.8	69	37.8	328	25.8
Reserve component										
All years (2012–2017)[b]	294	26.1	10	3.0	45	11.6	61	25.8	410	19.6
Jul 2012–Jun 2013	49	21.4	1	1.4	11	13.9	15	31.2	76	17.8
Jul 2013–Jun 2014	94	41.5	4	5.8	7	9.0	14	29.4	119	28.3
Jul 2014–Jun 2015	61	27.3	3	4.6	13	16.8	15	31.8	92	22.2
Jul 2015–Jun 2016	47	20.8	2	3.1	6	7.9	9	19.4	64	15.5
Jul 2016–Jun 2017	43	19.2	0	0.0	8	10.5	8	17.3	59	14.3
Overall, active and reserve										
All years (2012–2017)	1,674		197		321		525		2,717	
Jul 2012–Jun 2013	317		25		72		84		498	
Jul 2013–Jun 2014	488		66		87		127		768	
Jul 2014–Jun 2015	334		50		68		153		605	
Jul 2015–Jun 2016	303		29		43		84		459	
Jul 2016–Jun 2017	232		27		51		77		387	

[a]For active component, rate is per 100,000 p-yrs. For reserve component, rate is per 100,000 persons.
[b]Average rate

FIGURE 1. Annual incidence rates of cold injuries (one per person per year), by service, active component, U.S. Armed Forces, July 2012–June 2017

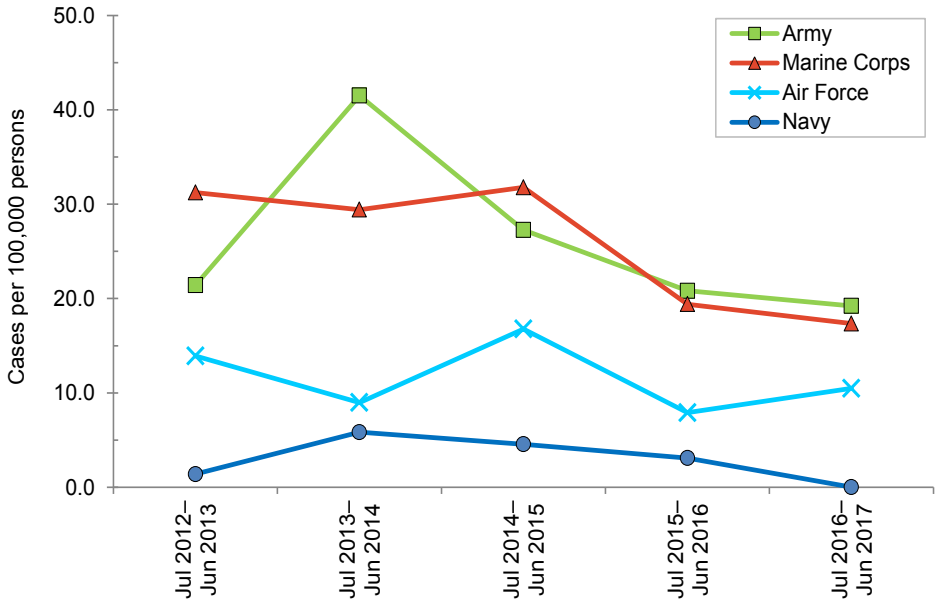


2016–2017 in the Marine Corps was the lowest of the 5-year surveillance period **(Table 3d)**.

Five cold seasons: July 2012–June 2017

During the 5-year surveillance period, overall rates of cold injuries in the active component were higher in females than in males mainly because of the striking difference between the rates for female (rate: 78.8 per 100,000 p-yrs) and male (rate: 53.9 per 100,000 p-yrs) service members in the Army. In the other three services, the rates of all cold injuries in females were actually less than the male rates. This observation contrasts with the finding last year for the period 2011–2016, when the 5-year rates for the other three services were slightly higher among females than among males. In all

FIGURE 2. Annual incidence rates of cold injuries (one per person per year), by service, reserve component, U.S. Armed Forces, July 2012–June 2017



the services during 2012–2017, females had lower rates of immersion injury than did males but higher rates of frostbite (except in the Air Force) **(Tables 3a–3d)**.

In all of the services, overall rates of cold injuries were higher among non-Hispanic black service members than among those of other race/ethnicity groups. In particular, within the Army and Marine Corps, and for all services combined, rates of cold injuries were twice as high in non-Hispanic black service members as in non-Hispanic white or "other" race/ethnicity groups **(Tables 3a–3d)**. The major underlying factor in these differences is that rates of frostbite among non-Hispanic black service members were triple those of the other race/ethnicity groups. Additionally, non-Hispanic black service members had incidence rates of cold injuries greater than the rates of other race/ethnicity groups in nearly every military occupational category during 2012–2017 **(data not shown)**.

Rates of cold injuries were highest among the youngest service members (less than 20 years old) and were lower with each succeeding older age group. Enlisted members of the Army, Navy, and Air Force had higher rates than officers, but the opposite was true in the Marine Corps **(Tables 3a–3d)**. In the Army and Air Force, rates of all cold injuries combined were highest among service members in infantry/artillery/combat engineering–related occupations **(Tables 3a, 3c, 3d)**.

During the 5-year surveillance period, the 2,717 service members who were affected by any cold injury included 2,307 from the active component and 410 from the reserve component. Of all affected reserve component members, 71.7% (n=294) were members of the Army **(Table 2)**. Overall, soldiers accounted for the majority (61.6%) of all cold injuries affecting active and reserve component service members **(Figure 3)**.

Of all active component service members who were diagnosed with a cold injury (n=2,307), 230 (10.0% of the total) were affected during basic training. The Army (n=122) and Marine Corps (n=99) accounted for 96.1% of all basic trainees who suffered a cold injury **(data not shown)**. Additionally, during the surveillance period, 60 service members diagnosed with cold injuries (2.6% of the total) were hospitalized, and most (93.3%) of the hospitalized cases were members of either the Army (n=32) or Marine Corps (n=24) **(data not shown)**.

Cold injuries during deployments

During the 5-year surveillance period, 105 cold injuries were diagnosed and treated in service members deployed outside of the U.S. Of these, 39 (37%) were immersion injuries; 33 (31%) were frostbite; 16 (15%) were hypothermia; and 17 (16%) were "unspecified" cold injuries. Of all 105 cold injuries during the surveillance period, 68% occurred in the first two cold seasons. There were 35 cold injuries during cold season 2012–2013 and 36 during 2013–2014, but only 13 during 2014–2015, 11 during 2015–2016, and 10 during 2016–2017 **(data not shown)**.

Cold injuries by location

During the 5-year surveillance period, 24 military locations had at least 30 incident cold injuries (one per person per year) among active and reserve component service members. The locations with the highest 5-year counts of incident injuries were Fort Wainwright, AK (n=175); Bavaria (Vilseck/Grafenwoehr), Germany (110); Marine Corps Recruit Depot Parris Island/Beaufort, SC (102); Fort Benning, GA (99); Fort Carson, CO (88); Marine Corps Base Quantico, VA (86); and Fort Bragg, NC (78). During the 2016–2017 cold season, the numbers of incident cases of cold injuries were higher than the counts for the previous 2015–2016 cold season at just seven of the 24 locations. The most noteworthy increase was found at the Army's Fort Wainwright, where there were 48 total cases diagnosed in 2016–2017, compared to just 16 the year before. **Figure 4** shows the numbers of cold injuries during 2016–2017 and the median numbers of cases for the previous 4 years for those locations that had at least 30 cases during the past 5 years. For 17 of the 24 installations, the numbers of cases in 2016–2017 were at or below the median counts for the previous 4 years.

TABLE 3a. Diagnoses of cold injuries (one per type per person per year), active component, U.S. Army, July 2012–June 2017

	Frostbite		Immersion foot and hand		Hypothermia		Unspecified		All cold injuries	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	710	28.4	210	8.4	210	8.4	303	12.1	1,433	57.4
Sex										
Male	563	26.2	195	9.1	178	8.3	221	10.3	1,157	53.9
Female	147	42.0	15	4.3	32	9.1	82	23.4	276	78.8
Race/ethnicity										
Non-Hispanic white	278	19.0	110	7.5	123	8.4	133	9.1	644	44.0
Non-Hispanic black	319	61.0	59	11.3	40	7.6	119	22.8	537	102.7
Other	113	22.1	41	8.0	47	9.2	51	10.0	252	49.2
Age										
<20	65	43.2	28	18.6	22	14.6	50	33.2	165	109.7
20–24	324	44.6	98	13.5	99	13.6	137	18.9	658	90.6
25–29	147	25.2	51	8.8	53	9.1	53	9.1	304	52.2
30–34	84	20.0	23	5.5	21	5.0	33	7.9	161	38.3
35–39	50	16.8	7	2.3	10	3.4	14	4.7	81	27.1
40–44	25	12.8	1	0.5	3	1.5	11	5.6	40	20.4
45+	15	12.1	2	1.6	2	1.6	5	4.0	24	19.3
Rank										
Enlisted	643	31.9	166	8.2	177	8.8	268	13.3	1,254	62.1
Officer	67	14.0	44	9.2	33	6.9	35	7.3	179	37.4
Occupation										
Infantry/artillery/combat engineer	244	38.5	108	17.0	93	14.7	91	14.4	536	84.6
Armor/motor transport	33	43.2	5	6.5	8	10.5	8	10.5	54	70.6
Repair/engineering	124	24.4	28	5.5	29	5.7	56	11.0	237	46.6
Communications/intelligence	172	27.9	36	5.8	45	7.3	73	11.8	326	52.9
Health care	39	15.1	7	2.7	9	3.5	27	10.5	82	31.8
Other	98	24.2	26	6.4	26	6.4	48	11.9	198	48.9
Cold year (Jul–Jun)										
2012–2013	149	27.7	46	8.6	29	5.4	56	10.4	280	52.0
2013–2014	209	40.1	50	9.6	55	10.6	97	18.6	411	78.9
2014–2015	136	27.4	19	3.8	55	11.1	75	15.1	285	57.4
2015–2016	104	21.6	68	14.2	37	7.7	58	12.1	267	55.6
2016–2017	112	24.3	27	5.9	34	7.4	17	3.7	190	41.2

[a]Rate per 100,000 person-years

EDITORIAL COMMENT

Overall incidence rates of cold injuries among U.S. service members declined during the most recent three winters after having peaked in winter 2013–2014. The number of cases in 2016–2017 was the lowest count in the past 18 years. For active component service members in the Army, the rate of all cold injuries in 2016–2017 was the lowest of any year of the 5-year surveillance period. The 2016–2017 rates for the active component of the three other services were slightly higher

TABLE 3b. Diagnoses of cold injuries (one per type per person per year), active component, U.S. Navy, July 2012–June 2017

	Frostbite		Immersion foot and hand		Hypothermia		Unspecified		All cold injuries	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	72	4.5	46	2.9	42	2.6	33	2.1	193	12.1
Sex										
Male	55	4.2	42	3.2	39	3.0	30	2.3	166	12.7
Female	17	5.9	4	1.4	3	1.0	3	1.0	27	9.4
Race/ethnicity										
Non-Hispanic white	35	4.3	17	2.1	24	2.9	17	2.1	93	11.4
Non-Hispanic black	13	5.3	8	3.3	10	4.1	6	2.5	37	15.2
Other	24	4.5	21	3.9	8	1.5	10	1.9	63	11.7
Age										
<20	21	24.0	5	5.7	3	3.4	4	4.6	33	37.7
20–24	15	3.0	23	4.6	16	3.2	13	2.6	67	13.5
25–29	18	4.4	10	2.5	14	3.5	8	2.0	50	12.4
30–34	9	3.5	5	1.9	3	1.2	2	0.8	19	7.3
35–39	5	2.7	2	1.1	5	2.7	3	1.6	15	8.2
40–44	2	1.9	1	1.0	0	0.0	3	2.9	6	5.8
45+	2	3.2	0	0.0	1	1.6	0	0.0	3	4.7
Rank										
Enlisted	66	5.0	44	3.3	38	2.9	30	2.3	178	13.4
Officer	6	2.2	2	0.7	4	1.5	3	1.1	15	5.6
Occupation										
Infantry/artillery/combat engineer	7	6.9	0	0.0	4	4.0	3	3.0	14	13.9
Armor/motor transport	6	9.5	6	9.5	7	11.0	2	3.2	21	33.1
Repair/engineering	21	3.0	23	3.3	11	1.6	13	1.9	68	9.8
Communications/intelligence	10	3.9	4	1.6	4	1.6	3	1.2	21	8.3
Health care	8	4.4	2	1.1	5	2.7	5	2.7	20	11.0
Other	20	6.6	11	3.6	11	3.6	7	2.3	49	16.1
Cold year (Jul–Jun)										
2012–2013	7	2.2	7	2.2	7	2.2	4	1.3	25	8.0
2013–2014	34	10.6	6	1.9	17	5.3	8	2.5	65	20.4
2014–2015	16	5.0	13	4.0	7	2.2	13	4.0	49	15.2
2015–2016	8	2.5	10	3.1	4	1.2	4	1.2	26	8.0
2016–2017	7	2.2	10	3.2	7	2.2	4	1.3	28	8.8

[a]Rate per 100,000 person-years

than the lowest annual rates during the surveillance period.

In 2016–2017, frostbite was the most common type of cold injury for active component service members in all the services except for the Navy, in which immersion injury was the most common. Factors associated with increased risk of cold injury in previous years were again noted during the most recent cold season. Rates of cold injuries were higher among non-Hispanic black service members, the youngest (less than 20 years old), females, and those who were enlisted. Increased rates of cold injuries affected all enlisted and

TABLE 3c. Diagnoses of cold injuries (one per type per person per year), active component, U.S. Air Force, July 2012–June 2017

	Frostbite		Immersion foot and hand		Hypothermia		Unspecified		All cold injuries	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	175	11.0	31	2.0	35	2.2	48	3.0	289	18.2
Sex										
Male	147	11.4	30	2.3	29	2.3	32	2.5	238	18.5
Female	28	9.2	1	0.3	6	2.0	16	5.3	51	16.8
Race/ethnicity										
Non-Hispanic white	99	9.6	26	2.5	23	2.2	28	2.7	176	17.1
Non-Hispanic black	37	17.4	2	0.9	5	2.4	13	6.1	57	26.9
Other	39	11.3	3	0.9	7	2.0	7	2.0	56	16.3
Age										
<20	10	14.6	8	11.7	4	5.8	4	5.8	26	38.0
20–24	80	18.4	7	1.6	9	2.1	19	4.4	115	26.4
25–29	45	10.8	10	2.4	13	3.1	12	2.9	80	19.2
30–34	17	5.7	4	1.3	4	1.3	5	1.7	30	10.1
35–39	16	7.7	2	1.0	2	1.0	5	2.4	25	12.1
40–44	5	4.5	0	0.0	1	0.9	1	0.9	7	6.3
45+	2	3.8	0	0.0	2	3.8	2	3.8	6	11.4
Rank										
Enlisted	151	11.8	29	2.3	30	2.4	39	3.1	249	19.5
Officer	24	7.7	2	0.6	5	1.6	9	2.9	40	12.8
Occupation										
Infantry/artillery/combat engineer	6	55.0	0	0.0	0	0.0	0	0.0	6	55.0
Armor/motor transport	3	26.9	0	0.0	1	9.0	0	0.0	4	35.8
Repair/engineering	56	11.0	7	1.4	6	1.2	12	2.3	81	15.8
Communications/intelligence	35	9.4	3	0.8	3	0.8	11	3.0	52	14.0
Health care	9	5.9	1	0.7	3	2.0	4	2.6	17	11.1
Other	66	12.5	20	3.8	22	4.2	21	4.0	129	24.3
Cold year (Jul–Jun)										
2012–2013	34	10.3	8	2.4	9	2.7	13	4.0	64	19.5
2013–2014	52	15.9	9	2.8	8	2.5	13	4.0	82	25.1
2014–2015	42	13.5	4	1.3	4	1.3	8	2.6	58	18.6
2015–2016	19	6.2	4	1.3	8	2.6	8	2.6	39	12.6
2016–2017	28	9.0	6	1.9	6	1.9	6	1.9	46	14.8

[a]Rate per 100,000 person-years

most officer occupations among non-Hispanic black service members. In particular, rates of frostbite were appreciably higher in non-Hispanic blacks. The *MSMR* has previously noted the latter pattern in past years and there is literature that suggests that other factors such as physiologic differences or previous cold weather experience are possible explanations for increased susceptibility.[7]

The numbers of cold injuries associated with deployment have fallen precipitously in the past four cold seasons and the 10 cases in the most recent year are the fewest in the surveillance period. This reduction

TABLE 3d. Diagnoses of cold injuries (one per type per person per year), active component, U.S. Marine Corps, July 2012–June 2017

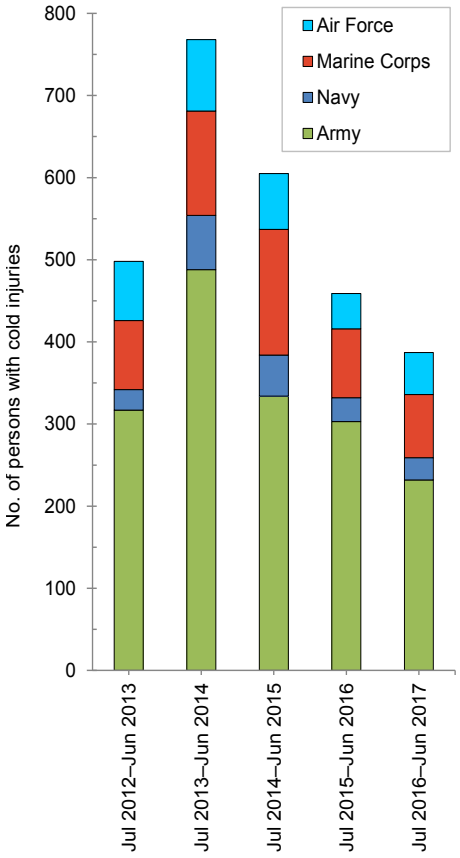
	Frostbite		Immersion foot and hand		Hypothermia		Unspecified		All cold injuries	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	139	14.8	150	15.9	106	11.3	83	8.8	478	50.8
Sex										
Male	123	14.1	148	17.0	100	11.5	74	8.5	445	51.2
Female	16	22.4	2	2.8	6	8.4	9	12.6	33	46.1
Race/ethnicity										
Non-Hispanic white	63	10.6	113	18.9	57	9.5	51	8.5	284	47.6
Non-Hispanic black	51	54.2	10	10.6	25	26.6	17	18.1	103	109.4
Other	25	10.0	27	10.8	24	9.6	15	6.0	91	36.4
Age										
<20	21	16.8	75	59.8	31	24.7	15	12.0	142	113.3
20–24	72	16.7	64	14.8	47	10.9	44	10.2	227	52.6
25–29	28	15.7	7	3.9	23	12.9	13	7.3	71	39.7
30–34	14	14.6	1	1.0	3	3.1	8	8.4	26	27.1
35–39	3	4.8	3	4.8	2	3.2	2	3.2	10	16.1
40–44	1	3.0	0	0.0	0	0.0	0	0.0	1	3.0
45+	0	0.0	0	0.0	0	0.0	1	7.0	1	7.0
Rank										
Enlisted	99	11.9	143	17.1	100	12.0	63	7.5	405	48.5
Officer	40	37.8	7	6.6	6	5.7	20	18.9	73	69.0
Occupation										
Infantry/artillery/combat engineer	49	23.8	14	6.8	16	7.8	17	8.3	96	46.6
Armor/motor transport	1	2.6	3	7.7	2	5.2	3	7.7	9	23.2
Repair/engineering	9	3.8	9	3.8	14	6.0	8	3.4	40	17.0
Communications/intelligence	28	13.5	2	1.0	9	4.4	12	5.8	51	24.7
Health care	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other	52	20.5	122	48.0	65	25.6	43	16.9	282	110.9
Cold year (Jul–Jun)										
2012–2013	19	9.7	20	10.2	15	7.7	20	10.2	74	37.9
2013–2014	53	27.4	20	10.3	20	10.3	24	12.4	117	60.5
2014–2015	17	9.2	76	40.9	23	12.4	25	13.5	141	75.9
2015–2016	20	10.8	18	9.8	30	16.3	8	4.3	76	41.2
2016–2017	30	16.5	16	8.8	18	9.9	6	3.3	70	38.4

[a]Rate per 100,000 person-years

in the number of cases is almost certainly a byproduct of the dramatic decline in the numbers of service members deployed to Iraq and Afghanistan and of changes in the nature of military operations there.

The Military Health System's adoption of the ICD-10 coding system (effective 1 October 2015) greatly increased the number of possible diagnostic codes for cold injuries. This increase was especially true for frostbite. The total of 222 ICD-10 codes for frostbite has the potential for enabling more anatomically specific analyses in the future that may point the way to priorities in preventive strategies.

FIGURE 3. Numbers of service members who had a cold injury (one per person per year), by service and cold season, active and reserve components, U.S. Armed Forces, July 2012–June 2017



Policies and procedures are in place to protect service members against cold weather injuries. Modern cold weather uniforms and equipment provide excellent protection against the cold when used correctly. However, in spite of these safeguards, a significant number of individuals within all military services continue to be affected by cold weather injuries each year. It is important that awareness, policies, and procedures continue to be emphasized to reduce the toll of such injuries. In addition, enhancements in protective technologies deserve continued research. It should be noted that this analysis of cold injuries was unable to distinguish between injuries sustained during official military duties (training or operations) and injuries associated with personal activities not related to official duties. To provide for all circumstances that pose the threat of cold weather injury, service members should know well the signs of cold injury and how to protect themselves against such injuries whether they are training, operating, fighting, or recreating under wet and freezing conditions.

The most current cold injury prevention materials are available at: http://phc.amedd.army.mil/topics/discond/cip/Pages/default.aspx.

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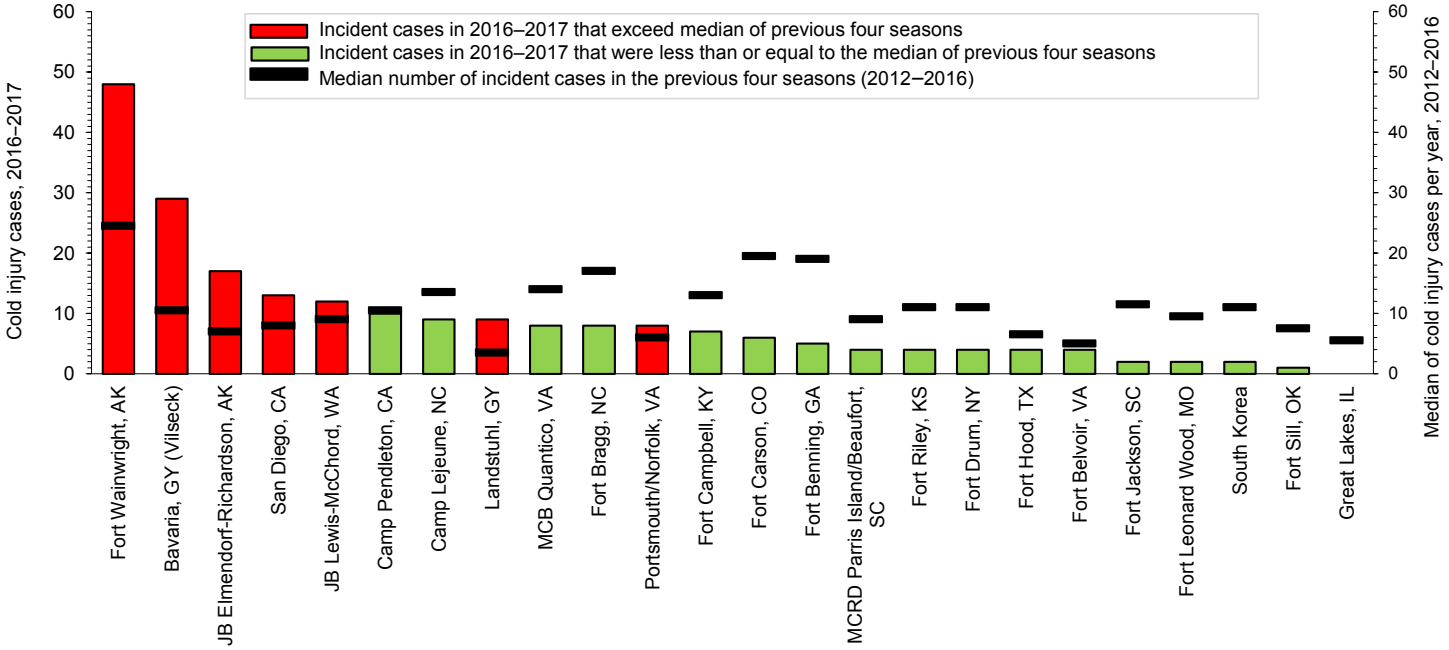
FIGURE 4. Annual number of cold injuries (cold season 2016–2017) and median number of cold injuries (cold seasons 2012–2016) at locations with at least 30 cold injuries during the surveillance period, active component, U.S. Armed Forces, July 2012–June 2017



Cold-Weather Casualties

**In cold weather you need to make an extra effort to stay healthy.
Go the extra mile to avoid serious illness.**

Clothing

- Remember the acronym **C-O-L-D** when wearing clothing in cold weather (**C**: Keep it **Clean**; **O**: avoid **Overheating**; **L**: wear clothing **Loose** and in **Layers**; **D**: keep clothing **Dry**).
- Change into dry clothing each day and whenever clothing becomes wet.
- Wash and dry feet and put on dry socks at least twice daily.

Eyes

- Use sunglasses with side protection in snow-covered areas.

Skin

- Keep your skin clean, covered and dry.
- Use gloves to handle all equipment and fuel products.
- Avoid cotton clothing - it holds moisture.
- No skin camouflage below 32 °F - it obscures detection of cold injuries.

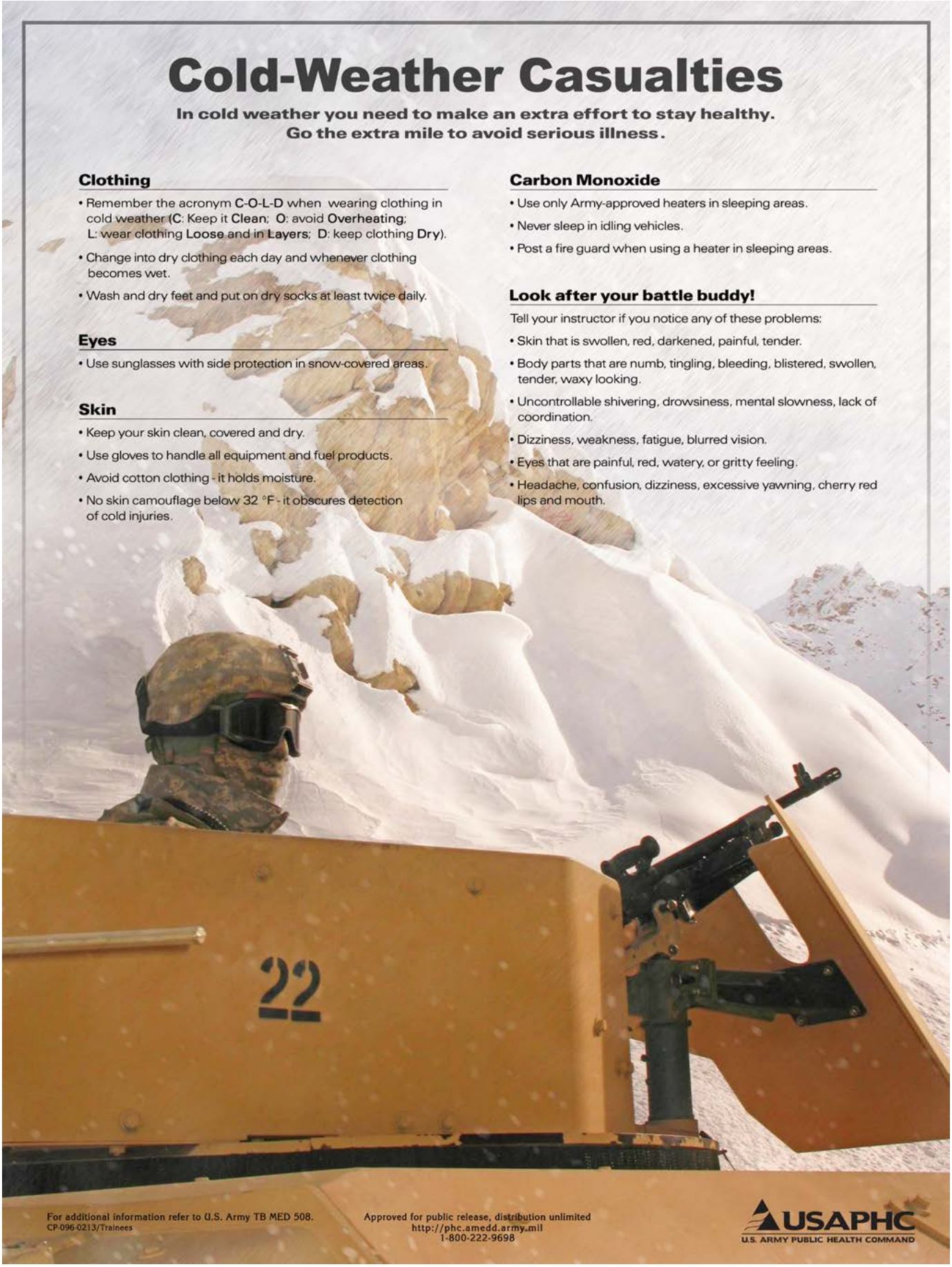
Carbon Monoxide

- Use only Army-approved heaters in sleeping areas.
- Never sleep in idling vehicles.
- Post a fire guard when using a heater in sleeping areas.

Look after your battle buddy!

Tell your instructor if you notice any of these problems:

- Skin that is swollen, red, darkened, painful, tender.
- Body parts that are numb, tingling, bleeding, blistered, swollen, tender, waxy looking.
- Uncontrollable shivering, drowsiness, mental slowness, lack of coordination.
- Dizziness, weakness, fatigue, blurred vision.
- Eyes that are painful, red, watery, or gritty feeling.
- Headache, confusion, dizziness, excessive yawning, cherry red lips and mouth.



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Surveillance Snapshot: Influenza Vaccine Effectiveness, U.S. European Command, as Estimated by the Department of Defense Global, Laboratory-Based Influenza Surveillance Program, 2016–2017 Influenza Season

Lisa A. Shoubaki, MPH; Laurie DeMarcus, MPH

TABLE. End-of-season U.S. European Command influenza vaccine effectiveness (VE) for all Department of Defense dependents, 2016–2017 influenza season

Population	Influenza type	No. cases	No. controls	Crude VE (95% CI)	Adjusted VE (95% CI)[a]
Dependents	Overall	94	217	58 (32%–75%)	59 (27%–77%)

[a]Adjusted for age group and specimen collection date

The Department of Defense (DoD) Global, Laboratory-Based, Influenza Surveillance Program performs influenza vaccine effectiveness (VE) studies each year. This report describes the first-ever Surveillance Program evaluation of VE for the U.S. European Command (EUCOM) region. Specimens submitted for testing were collected from patients who met the influenza-like illness (ILI) case definition, which required the presence of a fever (≥100.5°F) and symptoms of either cough or sore throat within 72 hours of symptom onset, or documentation of a physician's diagnosis of ILI. The EUCOM specimens were tested for influenza virus at the Landstuhl Regional Medical Center, Germany, through a reverse transcription polymerase chain reaction detection test.

This VE study employed a test-negative, case-control study design for DoD dependents. Cases were ILI patients whose specimens tested positive for an influenza virus and controls were ILI patients whose specimens tested negative for influenza. A multivariable logistic regression was performed to calculate adjusted odds ratios, accounting for age group and specimen collection date. VE was calculated as (1-OR) × 100.

Between 26 November 2016 and 2 April 2017, a total of 94 cases and 217 controls were identified among DoD dependents in EUCOM. The overall adjusted VE for all dependents against influenza, regardless of type, was 59% (95% CI: 27%–77%).

This adjusted VE estimate for EUCOM was higher than, but not statistically different from, the overall VE estimate for the continental U.S. region, which was 48% (95% CI: 44%–63%). Further investigation is needed to explain the differences between the two regions. The strain and clade structures of circulating influenza viruses were compared for both regions. Because of a low sample size for EUCOM, the strains A(H1N1)pdm09, B/Victoria, and B/Yamagata could not be evaluated and 3c.3a clades were not identified. A major limitation of this study was the relatively small number of cases, which prevented calculating VE estimates for specific types of influenza viruses such as types A(H3N2), A(H1N1)pdm09, and B.

Author affiliations: STS Systems Integration, LLC; Air Force Satellite of the Armed Forces Health Surveillance Branch, Defense Health Agency, Wright-Patterson Air Force Base, OH (Ms. Shoubaki, Ms. DeMarcus).

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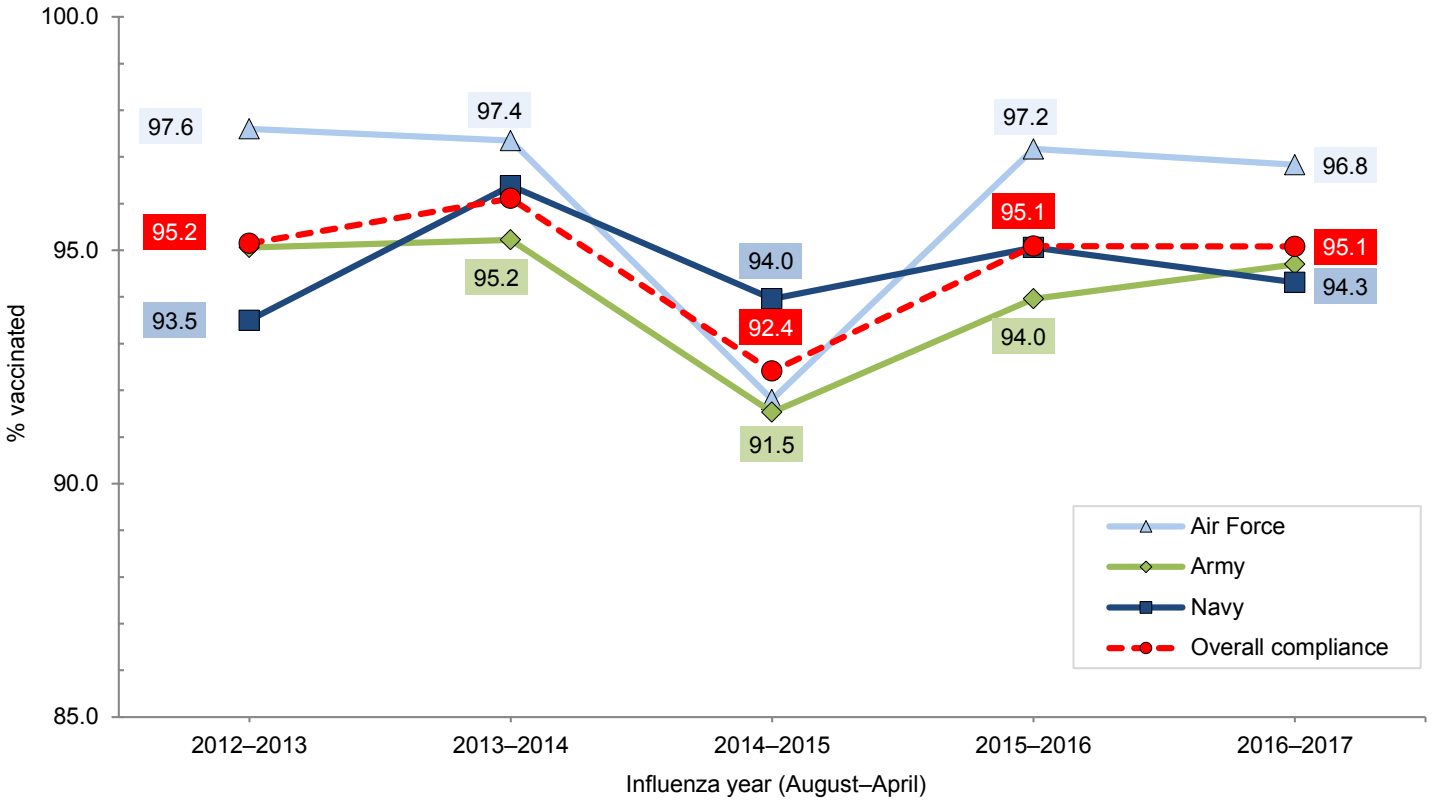
Surveillance Snapshot: Influenza Immunization Among U.S. Armed Forces Healthcare Workers, August 2012–April 2017

FIGURE. Percentage of healthcare specialists and officers with records of influenza vaccination, by influenza year (1 August through 30 April) and service, active component, U.S. Armed Forces, August 2012–April 2017



Data source: Immunization records from the Defense Enrollment Eligibility Reporting System (DEERS), which are archived in the Defense Medical Surveillance System (DMSS).

The U.S. Advisory Committee on Immunization Practices recommends that all healthcare personnel be vaccinated against influenza to protect themselves and their patients.[1] The Joint Commission's standard on infection control emphasizes that individuals who are infected with influenza virus are contagious to others before any signs or symptoms appear. The Joint Commission requires that healthcare organizations have influenza vaccination programs for practitioners and staff, and that they work toward the goal of 90% receipt of influenza vaccine. Within the Department of Defense, seasonal influenza immunization is mandatory for all uniformed personnel and for healthcare personnel who provide direct patient care, and is recommended for all others (excluding those who are medically exempt).[2-4] This snapshot covers a 5-year surveillance period (August 2012–April 2017) and depicts the documented percentage compliance with the influenza immunization requirement among active component healthcare personnel of the Army, Navy, and Air Force. During the 2016–2017 influenza season, each of the three services attained greater than 94% compliance among healthcare personnel **(Figure)**. For all services together, the compliance rate was 95.1%, nearly unchanged from the previous year.

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