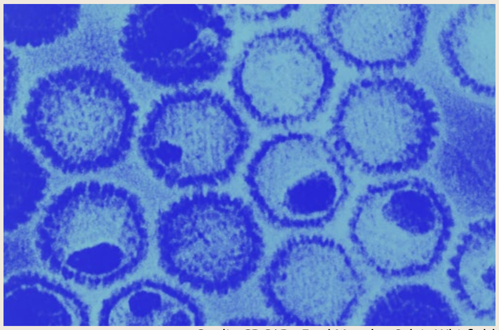
MSMR

MEDICAL SURVEILLANCE MONTHLY REPORT

May 2022 | Vol. 29 | No. 5

Credit: CDC/James Archer



Credit: CDC/ Dr. Fred Murphy; Sylvia Whitfield

Credit: iStock/ErikKarits

IN THIS ISSUE:

A PUBLICATION OF THE ARMED FORCES HEALTH SURVEILLANCE DIVISION

www.health.mil/MSMR

Update: Sexually Transmitted Infections, Active Component, U.S. Armed Forces, 2013–2021

This report summarizes incidence rates of the 5 most common sexually transmitted infections (STIs) among active component service members of the U.S. Armed Forces during 2013–2021. Infections with chlamydia were the most common, followed in decreasing order of frequency by infections with genital human papillomavirus (HPV), gonorrhea, genital herpes simplex virus (HSV), and syphilis. Compared to men, women had higher rates of all STIs except for syphilis. In general, compared to their respective counterparts, younger service members, non-Hispanic Black service members, those who were single and other/unknown marital status, and enlisted service members had higher incidence rates of STIs. Although rates of chlamydia and gonorrhea increased among both male and female service members during the latter half of the surveillance period, there was a notable decrease in the rates of chlamydia in both sexes from 2019 through 2021, and the rates of gonorrhea decreased slightly for both men and women during 2018–2021. Rates of syphilis generally increased during the first half of the surveillance period, decreased in 2020, then increased in 2021. Rates of genital HSV declined during the period from 2016 through 2021 for both male and female service members. The rates of genital HPV decreased steadily between 2012 and 2021 in men and declined between 2015 and 2021 among women. Similarities to and differences from the findings of the last *MSMR* update on STIs are discussed.

WHAT ARE THE NEW FINDINGS?

The incidence of chlamydia and gonorrhea generally increased among male and female service members in the latter half of the surveillance period; however, the rates decreased in 2020 and 2021. The incidence of genital HPV and HSV continued to decrease. The incidence of syphilis decreased among male and female service members in 2020, but increased in 2021.

WHAT IS THE IMPACT ON READINESS AND FORCE HEALTH PROTECTION?

STIs can adversely impact service members' availability and ability to perform their duties and can result in serious medical sequelae if untreated. Establishing standards for screening, testing, treatment, and reporting would likely improve efforts to detect STI-related health threats. Continued behavioral risk-reduction interventions are needed to counter STIs among military service members.

Sexually transmitted infections (STIs) are relevant to the U.S. military because of their relatively high incidence, adverse impact on service members' availability and ability to perform their duties, and potential for serious medical sequelae if untreated.[1] Two of the most common bacterial STIs are caused by *Chlamydia trachomatis* (chlamydia) and *Neisseria gonorrhoeae* (gonorrhea). Rates of chlamydia and gonorrhea have been steadily increasing in the general U.S. population among both men and women since 2000; between 2010 and 2019, chlamydia and gonorrhea rates increased 30.5% and 88.0%, respectively.[2] A March 2021 *MSMR* report documented more than 228,000 incident infections of chlamydia and more than 35,000 incident infections of gonorrhea among active component U.S. military members between 2012 and 2020, with increasing incidence rates of these conditions among both male and female service members in the latter half of the surveillance period, mirroring trends in the general U.S. population.[3]

Another important bacterial STI is syphilis, which is caused by the bacterium *Treponema pallidum*. Rates of primary and secondary syphilis in the U.S. have risen steadily from a historic low in 2001 and increased 167.1% from 4.5 cases per 100,000 persons in 2010 to 11.9 cases per 100,000 persons in 2019.[2] This upward trend is mirrored in the active component of the U.S. Armed Forces, in which the incidence of syphilis (of any type) increased steadily between 2012 and 2018, with most of the increase after 2014 occurring among men.[3] Although these 3 relatively common bacterial STIs are curable with antibiotics, there is continued concern regarding the threat of multidrug resistance.[4–6]

Common viral STIs in the U.S. include infections caused by human papillomavirus (HPV) and genital herpes simplex virus (HSV). HPVs are DNA viruses that infect basal epithelial (skin or mucosal) cells. HPV genotypes 6 and 11 are responsible for approximately 90% of all genital wart infections,[7] while genotypes 16 and 18 cause most HPV-related cancers.[8] HSV can cause genital or oral herpes infections that are characterized by the appearance of 1 or more vesicles that can break and leave painful ulcers. Most genital herpes infections are caused by type 2 (HSV-2); however, type 1 (HSV-1), which is most often associated with oral herpes infection, is estimated to be responsible for nearly 60% of new genital herpes infections.[9] Neither HPV nor HSV viral infections are curable with antibiotics; however, suppression of recurrent herpes manifestations is attainable using antiviral medication, and there is a vaccine to prevent infection with 4 of the most common HPV serotypes as well as 5 additional cancer-causing types.[7] From 2012 through 2020, the overall incidence rates of genital HPV and HSV in the active component were 51.9 and 24.0 cases per 10,000 person-years (p-yrs), respectively.[3]

The current analysis updates the findings of previous *MSMR* articles on STIs among active component service members.[1,3] Specifically, this report summarizes incident cases and incidence rates of 5 of the most common STIs during 2013–2021 and describes their distributions by demographic and military characteristics.

METHODS

The surveillance period was 1 January 2013 through 31 December 2021. The surveillance population consisted of all active component service members of the U.S. Army, Navy, Air Force, or Marine Corps who served at any time during the period. Diagnoses of STIs were ascertained from medical administrative data and reports of notifiable medical events routinely provided to the Armed Forces Health Surveillance Division (AFHSD) and maintained in the Defense Medical Surveillance System (DMSS) for surveillance purposes. STI cases were also derived from positive laboratory test results recorded in the Health Level 7 (HL7) chemistry and microbiology databases maintained by the Navy and Marine Corps Public Health Center at the EpiData Center.

For each service member, the number of days in active military service was ascertained and then aggregated into a total for all service members during each calendar year. The resultant annual totals were expressed as person-years of service and used as the denominators for the calculation of annual incidence rates. Person-time that was not considered to be time at risk for each STI was excluded (i.e., the 30 days following each incident chlamydia or gonorrhea infection and all person-time following the first diagnosis, medical event report, or positive laboratory test of genital HSV, genital HPV, or syphilis).

An incident case of chlamydia was defined by any of the following: 1) a case-defining diagnosis **(Table 1)** in the first or second diagnostic position of a record of an outpatient or in-theater medical encounter, 2) a confirmed notifiable disease report for chlamydia, or 3) a positive laboratory test for chlamydia (any specimen source or test type). An incident case of gonorrhea was similarly defined by 1) a case-defining diagnosis in the first or second diagnostic position of a record of an inpatient or outpatient or in-theater encounter, 2) a confirmed notifiable disease report for gonorrhea, or 3) a positive laboratory test for gonorrhea (any specimen source or test type). For both chlamydia and gonorrhea, an individual could be counted as having a subsequent case only if there were more than 30 days between the dates on which the case-defining diagnoses were recorded.

Incident cases of HSV were identified by 1) the presence of the requisite International Classification of Diseases, 9th or 10th Revision (ICD-9 or ICD-10, respectively) codes in either the first or second diagnostic positions of a record of an outpatient or in-theater encounter or 2) a positive laboratory test from a genital specimen source. Antibody tests were excluded because they do not allow for distinction between genital and oral infections. Incident cases of HPV were similarly identified by 1) the presence of the requisite ICD-9 or ICD-10 codes in either the first or second diagnostic positions of a record of an outpatient or in-theater encounter or 2) a positive laboratory test from any specimen source or test type. Outpatient encounters for HPV with evidence of an immunization for HPV within 7 days before or after the encounter date were excluded, as were outpatient encounters with a procedural or Current Procedural Terminology (CPT) code indicating HPV vaccination, as such encounters were potentially related to the vaccination administration. An individual could be counted as an incident case of HSV or HPV only once during the surveillance period. Individuals who had diagnoses of HSV or HPV infection before the surveillance period were excluded from the analysis.

An incident case of syphilis was defined by 1) a qualifying ICD-9 or ICD-10 code in the first, second, or third diagnostic position of a hospitalization, 2) at least 2 outpatient or in-theater encounters within 30 days of each other with a qualifying ICD-9 or ICD-10 code in the first or second position, 3) a confirmed notifiable disease report for any type of syphilis, or 4) a record of a positive polymerase chain reaction or treponemal laboratory test. Stages of syphilis (primary, secondary, late, latent) could not be distinguished because the HL7 laboratory data do not allow for differentiation of stages and because there is a high degree of misclassification associated with the use of ICD diagnosis codes for stage determination.[10,11] An individual could be considered an incident case of syphilis only once during the surveillance period; those with evidence of prior syphilis infection were excluded from the analysis.

Incidence rates were calculated as incident cases of a given STI per 10,000 p-yrs of active component service. Percent change in incidence was calculated using unrounded rates.

RESULTS

Between 2013 and 2021, the number of incident chlamydia infections among active component service members was greater than the sum of the other 4 STIs combined and 4.2 times the total number of genital HPV infections—the next most frequently

TABLE 1. ICD-9 and ICD-10 diagnostic codes used to identify cases of STIs in electronic health care records

STI	ICD-9[a]	ICD-10[a]
Genital HPV	078.11, 079.4, 795.05, 795.09, 795.15, 795.19, 796.75, 796.79	A63.0, R85.81, R85.82, R87.81, R87.810, R87.811, R87.82, R87.820, R87.821, B97.7
Chlamydia	099.41, 099.5*	A56.*
Genital HSV	054.1*	A60.*
Gonorrhea	098.*	A54.*
Syphilis	091.*, 092.*, 093.*–096.*, 097.0, 097.1, 097.9	A51.* (excluding A51.31), A52.*, A53.0, A53.9

[a]An asterisk (*) indicates that any subsequent digit/character is included.
ICD, International Classification of Diseases; STIs, sexually transmitted infections; HPV, human papillomavirus; HSV, herpes simplex virus.

TABLE 2. Incident counts and incidence rates of STIs, active component, U.S. Armed Forces, 2013–2021

	Chlamydia		Gonorrhea		Syphilis		Genital HSV		Genital HPV	
	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]	No.	Rate[a]
Total	233,886	197.6	37,592	31.7	5,862	5.0	27,238	23.3	55,040	48.3
Sex										
Male	147,569	148.5	29,698	29.9	5,128	5.2	14,775	15.0	21,324	21.9
Female	86,317	453.8	7,894	41.4	734	3.9	12,463	68.0	33,716	204.6
Age group (years)										
<20	32,090	381.5	3,866	45.8	584	6.9	1,988	23.6	938	11.1
20–24	136,585	363.5	20,180	53.6	2,278	6.1	11,512	30.8	20,950	56.3
25–29	45,111	162.5	8,345	30.0	1,529	5.5	7,043	25.7	14,685	55.0
30–34	13,456	70.8	3,284	17.3	798	4.2	3,611	19.4	10,863	61.4
35–39	4,688	34.3	1,255	9.2	353	2.6	1,852	14.0	4,661	36.9
40+	1,956	16.4	662	5.5	320	2.7	1,232	10.6	2,943	26.0
Race/ethnicity group										
Non-Hispanic White	91,208	134.8	9,959	14.7	1,947	2.9	12,212	18.3	27,026	41.3
Non-Hispanic Black	77,000	403.7	19,505	102.0	2,064	10.8	8,167	44.0	11,868	65.4
Hispanic	42,465	234.1	5,033	27.7	1,189	6.6	4,322	24.1	9,299	53.2
Asian/Pacific Islander	7,501	157.1	943	19.7	244	5.1	656	13.8	2,117	45.7
Other/unknown	15,712	180.0	2,152	24.6	418	4.8	1,881	21.8	4,730	56.6
Education level										
High school or less	203,060	268.5	31,801	42.0	4,308	5.7	19,366	25.8	34,225	46.4
Some college	14,783	100.7	2,743	18.7	652	4.4	3,398	23.8	7,633	56.2
Bachelor's or advanced degree	13,640	53.4	2,671	10.5	826	3.2	4,064	16.2	11,894	49.2
Other/unknown	2,403	95.7	377	15.0	76	3.0	410	16.5	1,288	52.9
Marital status										
Single, never married	162,658	324.1	25,171	50.0	3,722	7.4	14,409	28.9	27,121	55.1
Married	57,280	91.4	10,233	16.3	1,794	2.9	10,091	16.4	22,066	36.8
Other/unknown	13,948	253.1	2,188	39.6	346	6.3	2,738	52.0	5,853	119.6
Service										
Army	98,065	225.4	18,909	43.4	2,178	5.0	11,712	27.3	19,833	47.2
Navy	55,537	189.3	8,943	30.4	2,143	7.3	6,498	22.5	15,312	54.3
Air Force	46,013	159.4	5,426	18.8	990	3.4	6,049	21.3	14,713	53.7
Marine Corps	34,271	205.6	4,314	25.8	551	3.3	2,979	18.0	5,182	31.6
Rank/grade										
Junior enlisted (E1–E4)	175,663	343.8	26,551	51.8	3,659	7.2	14,815	29.1	26,564	52.5
Senior enlisted (E5–E9)	48,962	105.6	9,397	20.3	1,737	3.8	9,388	20.7	19,588	45.1
Junior officer (O1–O3)	7,931	67.9	1,259	10.8	304	2.6	2,138	18.5	6,517	58.0
Senior officer (O4–O10)	778	10.3	259	3.4	128	1.7	640	8.6	1,905	26.6
Warrant officer (W01–W05)	552	32.8	126	7.5	34	2.0	257	15.8	466	29.6
Military occupation										
Combat-specific[b]	27,214	164.3	4,637	28.0	509	3.1	2,785	17.0	4,447	27.4
Motor transport	10,828	312.1	2,049	58.9	322	9.3	975	28.4	2,045	60.6
Pilot/air crew	2,325	53.4	284	6.5	75	1.7	535	12.4	1,253	29.9
Repair/engineering	66,719	190.6	10,380	29.6	1,406	4.0	7,258	21.0	13,707	40.3
Communications/intelligence	57,895	226.5	10,375	40.5	1,382	5.4	7,520	30.0	15,168	62.8
Health care	17,617	168.8	2,740	26.2	547	5.2	2,984	29.2	8,023	82.2
Other	51,288	223.0	7,127	30.9	1,621	7.0	5,181	22.8	10,397	46.6

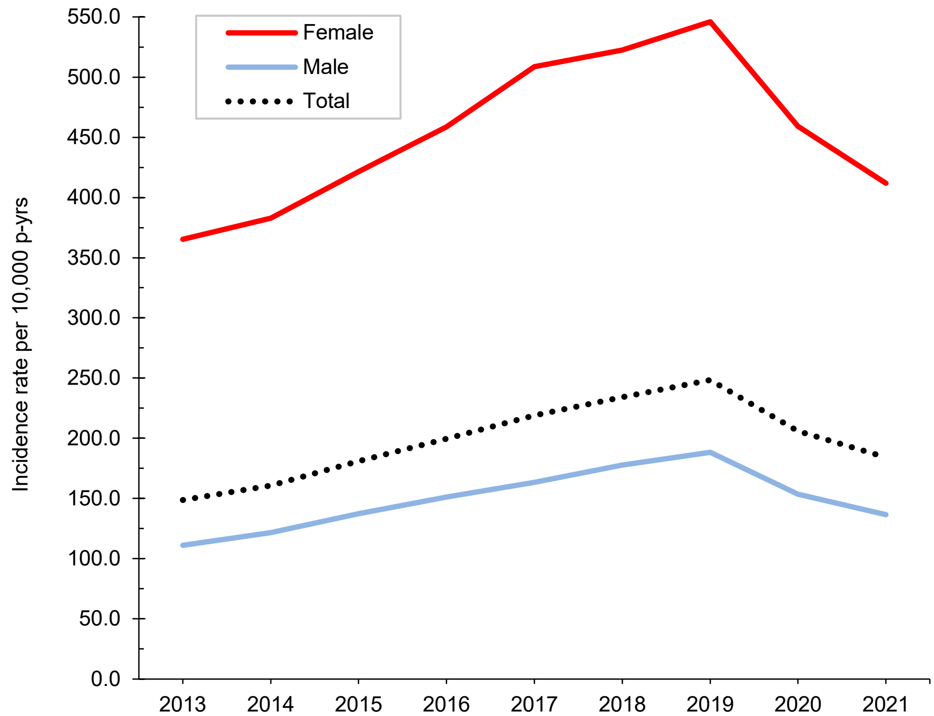
[a]Incidence rate per 10,000 person-years.
[b]Infantry/artillery/combat engineering/armor.
STIs, sexually transmitted infections; HSV, herpes simplex virus; HPV, human papillomavirus; No., number.

identified STI during this period **(Table 2)**. With the exception of syphilis, the crude overall incidence rates of all STIs were markedly higher among female than male service members. For chlamydia, gonorrhea, and syphilis, overall incidence rates were highest among those aged 24 years or younger and decreased with advancing age. However, overall rates of genital HSV were highest among those aged 20–24 years and overall rates of HPV were highest in those aged 30–34. Overall rates of all STIs were highest among non-Hispanic Black service members compared to those in other race/ethnicity groups. For chlamydia, gonorrhea, and genital HSV infections, overall rates were highest among members of the Army. The overall incidence rate of syphilis was highest among Navy members, and the overall rate of genital HPV infections was highest among Navy and Air Force members. Compared to their respective counterparts, enlisted service members and those with lower levels of educational achievement tended to have higher overall rates of all STIs. Married service members had the lowest overall incidence rates of all 5 STIs compared to service members who were single and never married or those of other/unknown marital status. Overall rates of chlamydia, gonorrhea, and syphilis were highest among those working in motor transport. In contrast, overall genital HPV infection rates were highest among those in health care occupations, and the highest rates of genital HSV infections were among those working in communications/intelligence, health care, or motor transport **(Table 2)**. Patterns of incidence rates over time for each specific STI are described in the subsections below.

Chlamydia

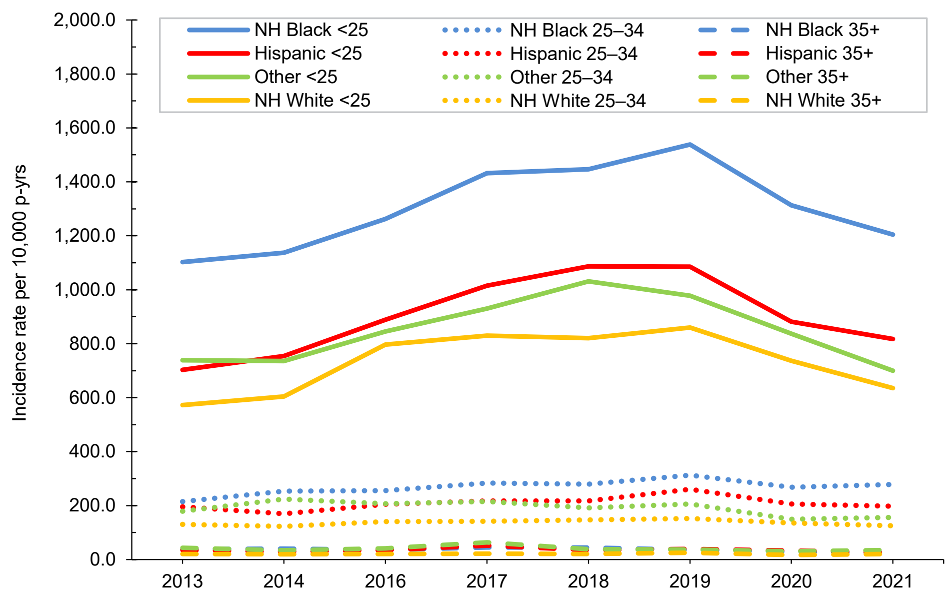
During the surveillance period, annual incidence rates of chlamydia among female service members were generally 3 times the rates among male service members. Annual rates among all active component members increased 67.0% between 2013 and 2019, with rates among both female and male service members peaking in 2019 (546.0 per 10,000 p-yrs and 188.3 per 10,000 p-yrs, respectively) **(Figure 1)**. In both sexes, this increase was primarily attributed to service members in the youngest age groups (less than 25 years among female service members; less than 30 years among male service members) **(data not shown)**.

FIGURE 1. Incidence rates of *Chlamydia trachomatis* infections, by sex, active component, U.S. Armed Forces, 2013–2021



P-yrs, person-years.

FIGURE 2. Incidence rates of *Chlamydia trachomatis* infections among female service members, by age group (years) and race/ethnicity group, active component, U.S. Armed Forces, 2013–2021



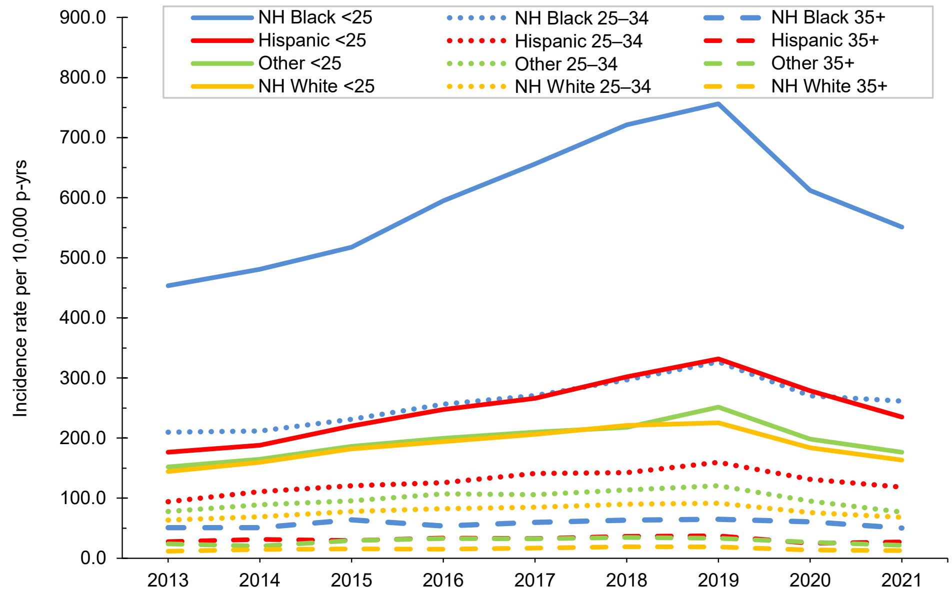
P-yrs, person-years; NH, non-Hispanic.

Among female service members in each race/ethnicity group, annual rates of chlamydia generally increased among those under 25 years old during 2013–2019 **(Figure 2)**. Among non-Hispanic Black, non-Hispanic White, and Hispanic female service members in this age group, annual rates of chlamydia increased between 2018 and 2019; in contrast, annual rates among female service members of other/unknown race/ethnicity decreased from 2018 through 2019. Then, between 2019 and 2020, annual rates decreased among female service members under 25 years old in all race/ethnicity groups. Rates remained relatively stable among female service members aged 25–34 years and among those aged 35 years or older **(Figure 2)**. Among male service members, annual rates of chlamydia increased consistently between 2013 and 2019 in all age and race/ethnicity groups under 35 years old. During 2013–2019, annual rates remained relatively stable among male service members aged 35 or older **(Figure 3)**. Between 2019 and 2021, rates decreased among male service members in all age and race/ethnicity groups, with the most pronounced decline among non-Hispanic Black male service members under 25 years old **(Figure 3)**.

Genital HPV

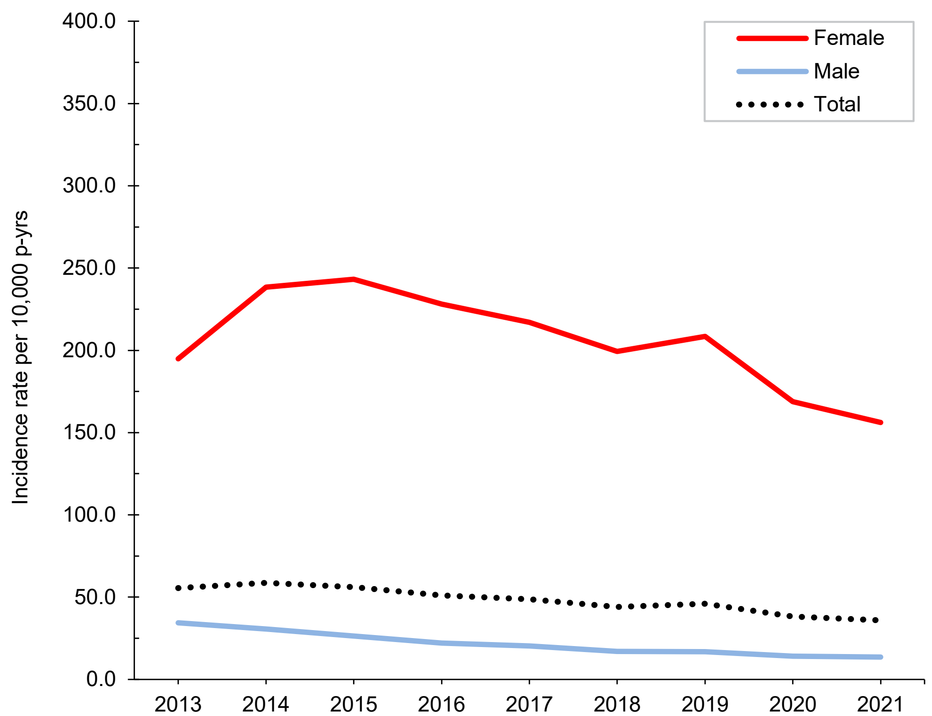
The crude annual incidence rates of genital HPV infections decreased 35.4% among all active component service members from the beginning to the end of the surveillance period, with the most marked decrease occurring among female service members **(Figure 4)**. Incidence rates of genital HPV infections among female service members increased to a high of 243.2 per 10,000 p-yrs in 2015 then declined by 35.8% to a low of 156.2 cases per 10,000 p-yrs in 2021 **(Figure 4)**. Rates among male service members decreased, from 34.4 per 10,000 p-yrs in 2013 to 13.6 per 10,000 p-yrs in 2021 (60.5%). Between 2015 and 2020, annual rates of genital HPV infections decreased among female service members in all age groups; however, annual rates increased in 2021 among female service members under age 20 and those aged 30–34 **(Figure 5)**. The decrease in the genital HPV infection rates among male service members overall during 2013–2020 was driven mainly by decreases in the rates in those aged 20–29 **(Figure 6)**. Between 2020 and 2021, annual genital HPV infection rates increased slightly among male service members aged 35–39 (7.5%) and more markedly among those aged 40 or older (38.6%).

FIGURE 3. Incidence rates of *Chlamydia trachomatis* infections among male service members, by age group (years) and race/ethnicity group, active component, U.S. Armed Forces, 2013–2021



P-yrs, person-years; NH, non-Hispanic.

FIGURE 4. Incidence rates of genital HPV infections, by sex, active component, U.S. Armed Forces, 2013–2021



HPV, human papillomavirus; p-yrs, person-years.

Gonorrhea

Between 2013 and 2021, the crude annual incidence rate of gonorrhea increased 41.8%; however, after increasing steadily from 2012 through 2019, the rate decreased slightly in 2020 and 2021 **(Figure 7)**. The annual rates among female service members declined between 2013 and 2015 then increased through 2019 before decreasing slightly in 2020 and 2021. After increasing between 2012 and 2019, the rate among male service members decreased slightly in 2020 and 2021 **(Figure 7)**. These trends in gonorrhea incidence were primarily driven by changes in rates among female service members under age 25 and among male service members under age 30 **(Figures 8, 9)**. For all groups except non-Hispanic Black service members, the annual rates of gonorrhea increased during the surveillance period through 2018, but then decreased slightly through 2021 **(data not shown)**. Among non-Hispanic Black service members, rates continued to increase in 2020 and then decreased slightly in 2021 **(data not shown)**.

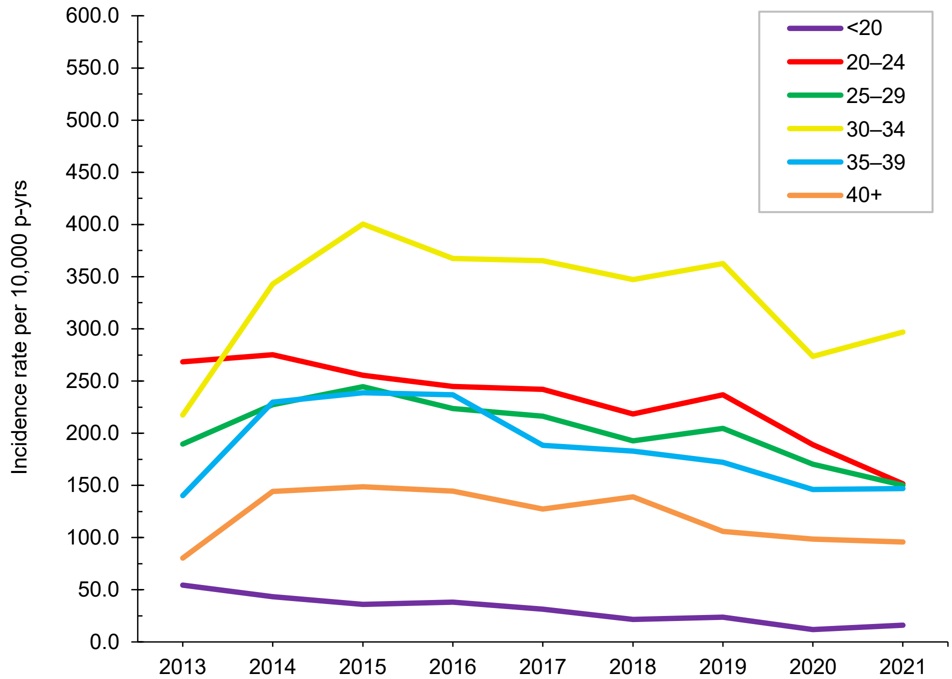
Genital HSV

Crude annual incidence rates of genital HSV infections decreased from 23.2 to 17.9 per 10,000 p-yrs over the course of the surveillance period (22.8%). Rates among female service members ranged from a high of 77.5 per 10,000 p-yrs in 2016 to a low of 50.8 per 10,000 p-yrs in 2021. Rates for male service members were also highest in 2016 (18.1 per 10,000 p-yrs) and reached their lowest points in 2020 and 2021 (11.2 per 10,000 p-yrs in both years) **(Figure 10)**. Over the course of the surveillance period, the incidence rates of genital HSV infections decreased among service members in all age and race/ethnicity groups **(data not shown)**. The rates decreased between 2018 and 2021 among female service members in all age groups except for those under 20 years old and those aged 25–29, among whom rates increased slightly in 2021. Annual rates decreased among male service members in all age groups from 2016 through 2020; in 2021, rates among male service members under age 24 and those aged 35–39 increased slightly **(data not shown)**.

Syphilis

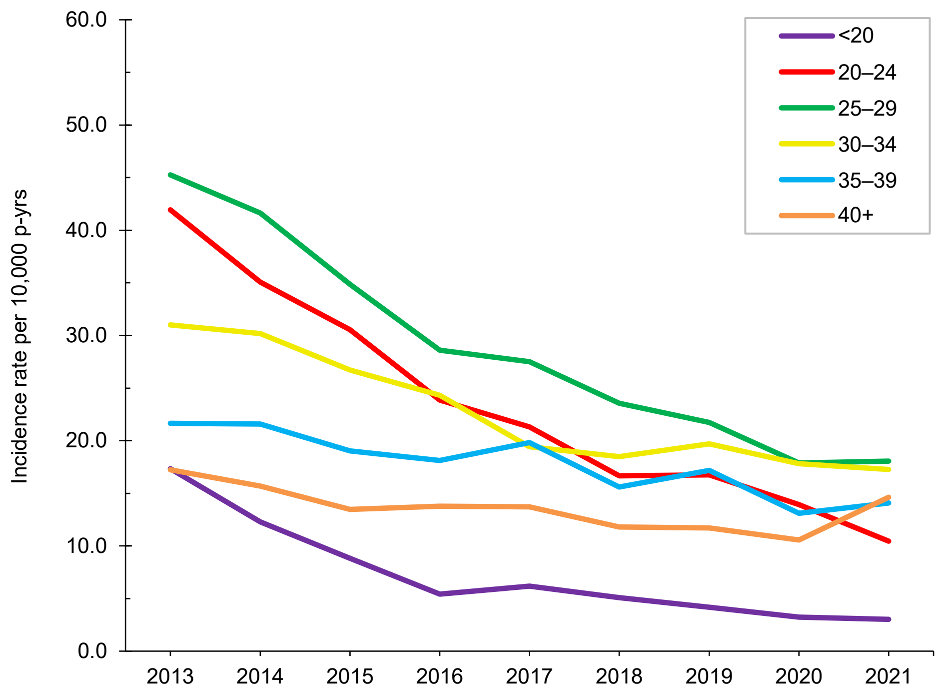
The crude incidence rate for syphilis in 2021 (6.1 per 10,000 p-yrs) was nearly 2 times that observed in 2013 (3.2 per 10,000 p-yrs), with the increase primarily driven by cases identified among male service members **(Figure 11)**. Rates of syphilis increased steadily among male service members until 2018, decreased in 2019 and 2020, and then increased in 2021. Among female service members, rates remained relatively stable from 2013 to 2018, increased in 2019, decreased in 2020, and then increased in 2021. The overall incidence rates of syphilis generally decreased with advancing age among both sexes **(data not shown)**. Among male service members, this pattern of decreasing overall incidence with increasing age was consistent among all race/ethnicity

FIGURE 5. Incidence rates of genital HPV infections among female service members, by age group (years), active component, U.S. Armed Forces, 2013–2021



HPV, human papillomavirus; p-yrs, person-years.

FIGURE 6. Incidence rates of genital HPV infections among male service members, by age group (years), active component, U.S. Armed Forces, 2013–2021



HPV, human papillomavirus; p-yrs, person-years.

groups; there were not enough cases to evaluate associations between age and race/ethnicity group among female service members **(data not shown)**.

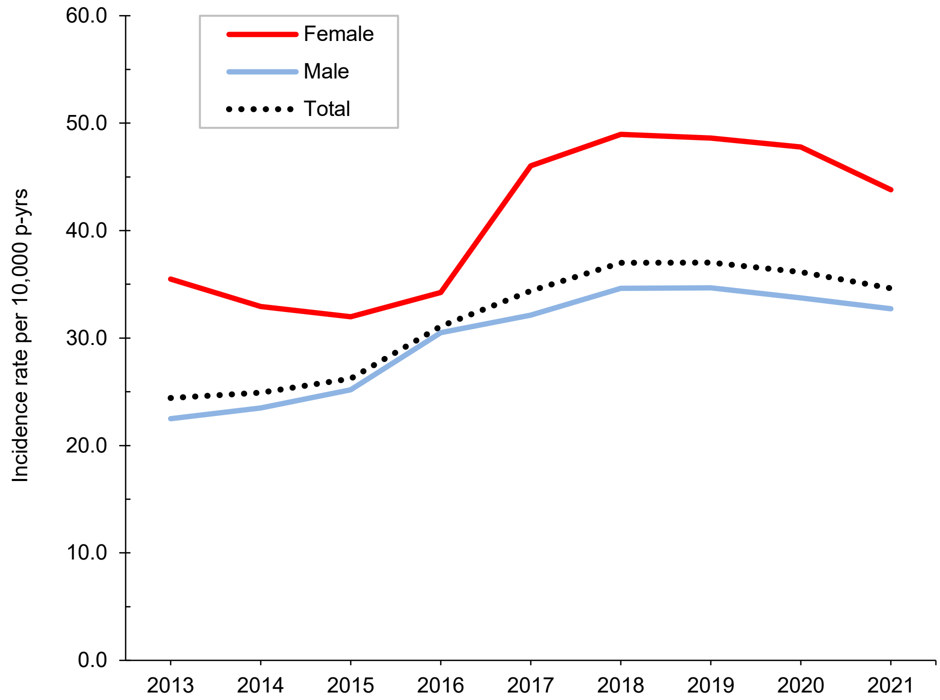
EDITORIAL COMMENT

The crude annual incidence rates of chlamydia, genital HPV, and genital HSV demonstrated decreases in more recent years during the surveillance period (since 2019, 2015, and 2016, respectively). Incidence rates of gonorrhea have remained relatively stable, while rates of syphilis generally increased during the surveillance period. From 2019 through 2021, rates of all STIs decreased in service members of both sexes, with the exception of syphilis; syphilis rates increased in both sexes between 2020 and 2021. Overall incidence rates of STIs were higher among women compared to men for genital HPV, genital HSV, gonorrhea, and chlamydia. Syphilis was the only STI in this analysis for which the incidence was, on average, higher among male compared to female service members.

Higher incidence rates of most STIs among females compared to males can likely be attributed to implementation of the services' screening programs for STIs among female service members as they enter active service and during the subsequent annual screenings for females younger than 26 years old. Because asymptomatic infection with chlamydia, gonorrhea, or HPV is common among sexually active females, widespread screening may result in sustained high numbers of infections diagnosed among young females.

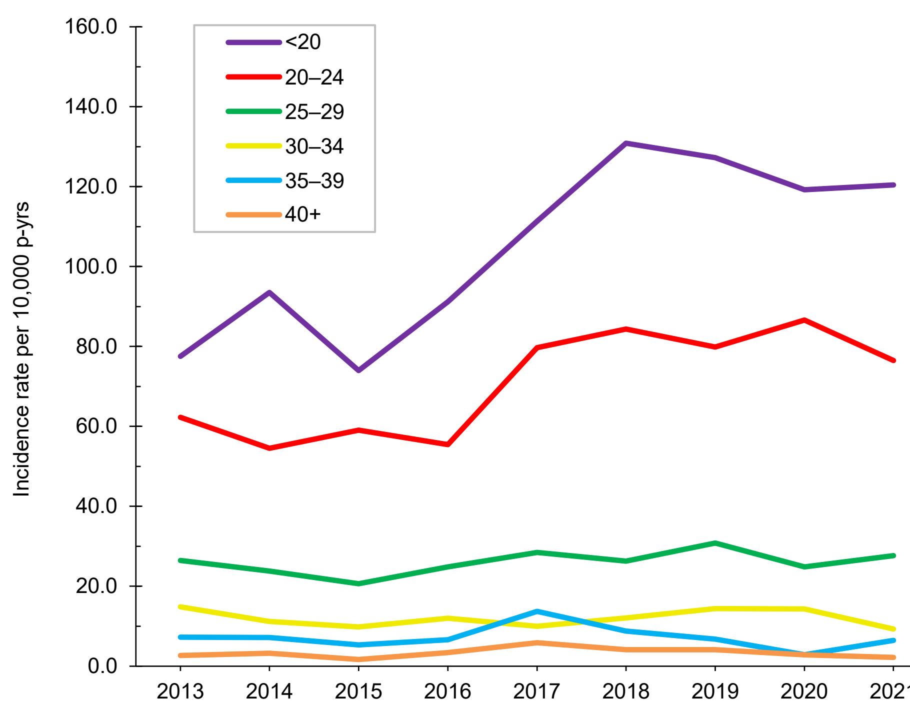
Although rates of chlamydia and gonorrhea increased among both male and female service members during 2018–2019, mirroring the increasing rates in the civilian population,[2] there were decreases in service members' rates of chlamydia and gonorrhea in both sexes from 2019 through 2021. In the U.S., rates of chlamydia have been increasing among both men and women since 2000, and rates of gonorrhea have been increasing among both sexes since 2013.[2] The increases in the rates of these STIs seen through 2018 in both the civilian and military populations could reflect

FIGURE 7. Incidence rates of gonorrhea infections, by sex, active component, U.S. Armed Forces, 2013–2021



P-yrs, person-years.

FIGURE 8. Incidence rates of gonorrhea infections among female service members, by age group (years), active component, U.S. Armed Forces, 2013–2021



P-yrs, person-years.

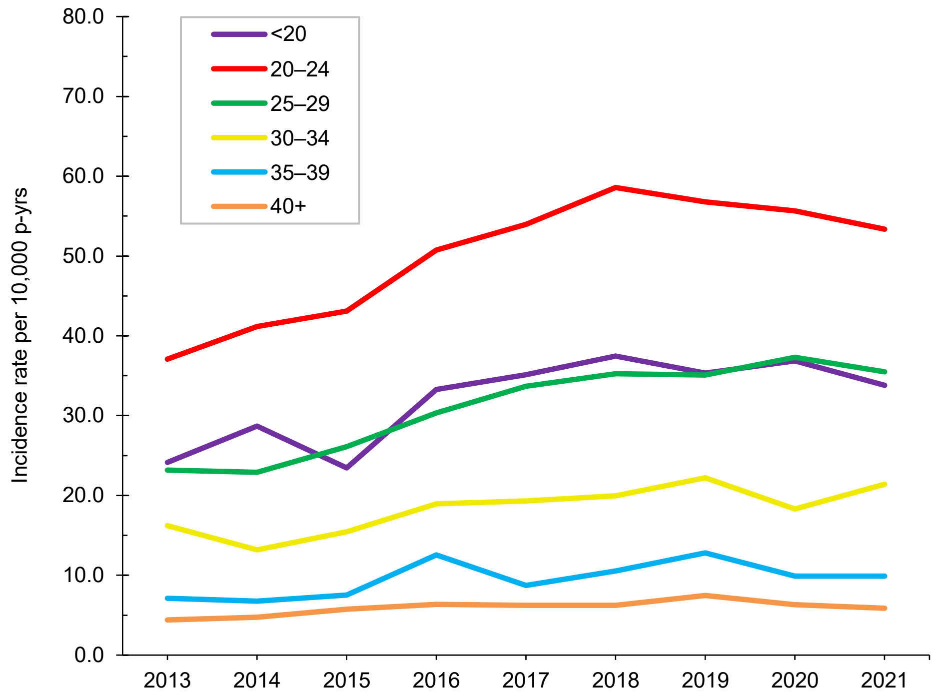
true increases in the incidence of infections as well as improved screening coverage in men, particularly extragenital screening in men who have sex with men.[12]

Analyses of provisional data from the Centers for Disease Control and Prevention's (CDC's) National Notifiable Disease Surveillance System (NNDSS) for 2019 and the first 50 weeks (week of 9 December) of 2020 revealed that the 2020 cumulative totals of reported chlamydia and syphilis (primary and secondary) cases were 14.0% and 0.9% lower, respectively, than their 2019 cumulative totals.[13] The cumulative total of 2020 reported gonorrhea cases represented a 7.1% increase over the 2019 cumulative total.[13] The decreases in civilian case counts of some STIs between 2019 and 2020 have so far been attributed mostly to COVID-19 pandemic-related declines in the testing and/or reporting of cases,[14] and it is possible that the COVID-19 pandemic had a similar effect on the military health system. It is important to note, however, that national civilian data for 2020 were preliminary at the time of this report.

No data on sexual risk behaviors were available in this study, but prior surveys of military personnel have indicated high levels of risk behaviors. The 2018 Department of Defense Health Related Behaviors Survey (HRBS) documented that 19.3% of active component respondents reported having 2 or more sex partners in the past year and that 34.9% reported sex with a new partner in the past year without using a condom; these percentages were almost double those reported from the 2011 survey.[15]

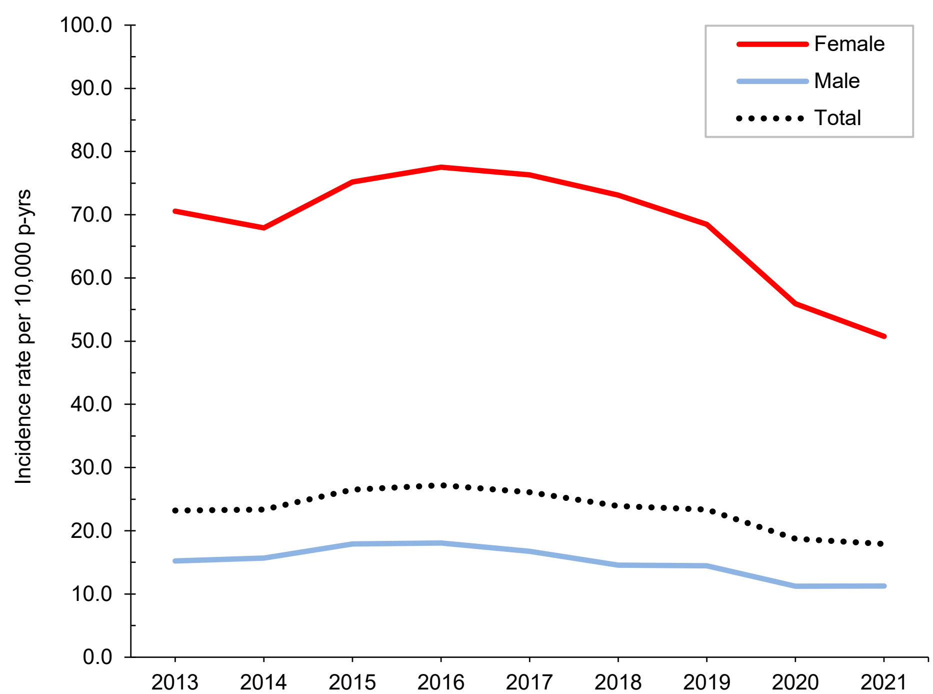
The general downward trend in incidence rates of genital HPV infections observed during the surveillance period may be related to the introduction of the HPV vaccine for women and girls in 2006 and for men in 2010. Among civilian women aged 14–24 years, cervical/vaginal prevalence of HPV types 6, 11, 16, and 18 decreased by approximately 6% from the period 2003–2006 to 2009–2012.[16] The HPV vaccine is currently not a mandatory vaccine for military service, but it is encouraged and offered to service members. Because the HPV vaccine (Gardasil) is approved for use among males and females beginning at age 9, it is possible that an increasing number of members

FIGURE 9. Incidence rates of gonorrhea infections among male service members, by age group (years), active component, U.S. Armed Forces, 2013–2021



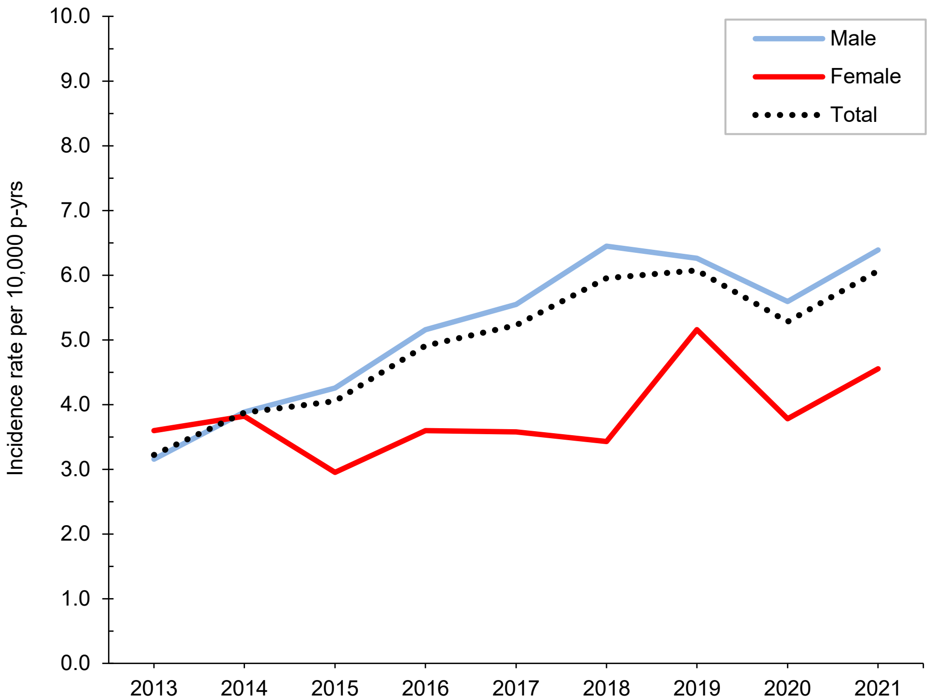
P-yrs, person-years.

FIGURE 10. Incidence rates of genital HSV infections, by sex, active component, U.S. Armed Forces, 2013–2021



P-yrs, person-years.

FIGURE 11. Incidence rates of syphilis infections, by sex, active component, U.S. Armed Forces, 2013–2021



P-yrs, person-years.

who entered military service during the surveillance period may have been vaccinated for HPV before entering service. This prior vaccination may account for the decrease in the annual rates of genital HPV infections during the surveillance period.

The trends in the incidence of HSV and syphilis in the U.S. military are also similar to what is observed in the civilian population. Data from the CDC's National Health and Nutrition Examination Survey indicate that the seroprevalence of both HSV-1 and HSV-2 has decreased in the U.S. population since 1999.[2] In contrast, the incidence of primary and secondary syphilis reported to the CDC has increased markedly (167.1%) between 2010 and 2019, with men accounting for the majority of cases.[2]

This report has several limitations that should be considered when interpreting the results. First, diagnoses of STIs may be incorrectly coded. For example, STI-specific "rule out" diagnoses or vaccinations (e.g., HPV vaccination) may be reported with STI-specific diagnostic codes, which would result in an overestimate of STI incidence. Cases of syphilis, genital HSV, and genital HPV infections based solely on laboratory test results are considered "suspect" because the laboratory test results cannot distinguish between active and chronic infections. However, because incident cases of these STIs were identified based on the first qualifying encounter or laboratory result, the likelihood is high that most such cases are acute and not chronic.

STI cases may not be captured if coded in the medical record using symptom codes (e.g., urethritis) rather than STI-specific codes. In addition, the counts of STI diagnoses reported here may underestimate the actual numbers of diagnoses because some affected service members may be diagnosed and treated through non-reimbursed, non-military care providers (e.g., county health departments or family planning centers) or in deployed settings (e.g., overseas training exercises, combat operations, or aboard ships). Laboratory tests that are performed in a purchased care setting, a shipboard facility, a battalion aid station, or an in-theater facility were not captured in the current analysis. Finally, medical data from sites that were using the new electronic health record for the Military Health System, MHS GENESIS, between July 2017 and October 2019 are not available in the DMSS. These sites include Naval Hospital Oak Harbor, Naval Hospital Bremerton, Air Force Medical Services Fairchild, and Madigan Army Medical Center. Therefore, medical encounter data for individuals seeking care at any of these facilities from July 2017 through October 2019 were not included in the current analysis.

For some STIs, the detection of prevalent infections may occur long after the time of initial infections. As a result, changes in incidence rates may reflect, at least in part, temporal changes in case ascertainment, such as a shift to more aggressive screening. The lack of standard practices across the services and their installations regarding screening, testing, treatment, and reporting complicate interpretations of differences between services, military and demographic subgroups, and locations. Establishing screening, testing, treatment, and reporting standards across the services and ensuring adherence to such standards would likely improve efforts to detect and characterize STI-related health threats. In addition, continued behavioral risk-reduction interventions are needed to counter STIs among military service members.

REFERENCES

1. Armed Forces Health Surveillance Center. Sexually transmitted infections, active component, U.S. Armed Forces, 2000–2012. *MSMR*. 2013;20(2):5–10.
2. Centers for Disease Control and Prevention. Sexually transmitted disease surveillance 2019. Accessed 14 March 2022. https://www.cdc.gov/std/statistics/2019/default.htm
3. Armed Forces Health Surveillance Division. Sexually transmitted infections, active component, U.S. Armed Forces, 2012–2020. *MSMR*. 2021;27(3):13–22.
4. Krupp K, Madhivanan P. Antibiotic resistance in prevalent bacterial and protozoan sexually transmitted infections. *Indian J Sex Transm Dis AIDS* 2015;36(1):3–8.
5. Growing antibiotic resistance forces updates to recommended treatment for sexually transmitted infections [news release]. Geneva, Switzerland: World Health Organization; 30 August 2016. Accessed 23 February 2021. https://www.who.int/news-room/detail/30-08-2016-growing-antibiotic-resistance-forces-updates-to-recommended-treatment-for-sexually-transmitted-infections
6. Tien V, Punjabi C, Holubar MK. Antimicrobial resistance in sexually transmitted infections. *J Travel Med*. 2020;27(1):1–11.
7. Garland SM, Steben M, Sings HL, et al. Natural

history of genital warts: Analysis of the placebo arm of 2 randomized phase III trials of a quadrivalent human papillomavirus (types 6, 11, 16, and 18) vaccine. *J infect Dis*. 2009;199(6):805-814.
8. National Cancer Institute. HPV and cancer. Accessed 14 March 2022. https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-fact-sheet
9. Bernstein DI, Bellamy AR, Hook EW, Levin MJ, Wald A, Ewell MG, et al. Epidemiology, clinical presentation, and antibody response to primary infection with herpes simplex virus type 1 and type 2 in young women. *Clin Infect Dis*. 2013;56(3):344–351.
10. Garges E, Stahlman S, Jordan N, Clark LL. P3.69 Administrative medical encounter data and medical event reports for syphilis surveillance: a cautionary tale. *Sex Transm Infect.* 2017;93(suppl 2):A118.
11. Armed Forces Health Surveillance Branch. Use of ICD-10 code A51.31 (condyloma latum) for identifying cases of secondary syphilis. *MSMR*. 2017;24(9):23.
12. Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance 2019. Atlanta, GA; U.S. Department of Health and Human Services; 2021.
13. Pagaoa M, Grey J, Torrone E, Kreisel K, Stenger M, Weinstock H. Trends in nationaly notifiable sexually transmitted disease case reports during the US COVID-19 pandemic, January to December 2020. *Sex Trans Dis*. 2021;48(10):798–804.
14. Centers for Disease Control and Prevention. National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. NCHHSTP Newsroom. 2021 Releases. Trends in STD case reports during the U.S. COVID-19 pandemic, January-December 2020. Accessed 14 March 2022. https://www.cdc.gov/nchhstp/newsroom/2021/2020-std-trend-report.html
15. Meadows SO, Engel CO, Collins RL, et al. 2018 Department of Defense Health Related Behaviors Survey (HRBS): Results for the Active Component. Sexual Behavior and Health. RAND Corporation Report. Accessed 16 March 2022. https://www.rand.org/pubs/research_reports/RR4222.html
16. HPV Infections Targeted by Vaccine Decrease in U.S. [news release]. Bethesda, MD; National Cancer Institute; 9 March 2016. Accessed 24 February 2021. https://www.cancer.gov/news-events/cancer-currents-blog/2016/hpv-infections-decreased

Evaluation of ICD-10-CM-based Case Definitions of Ambulatory Encounters for COVID-19 Among Department of Defense Health Care Beneficiaries

Angelia A. Eick-Cost, PhD; Alyssa Fedgo, MS

SARS-CoV-2 ICD-10-CM-based case definitions are lacking in the literature. This analysis was conducted to evaluate the performance metrics of 3 COVID-19 case definitions among Department of Defense (DoD) beneficiaries. SARS-CoV-2 tested specimens collected from 1 March 2020 to 28 February 2021 were matched to ambulatory medical encounters (68% match). The COVID-19 case definition (ICD-10-CM: U07.1) had high specificity (99%) and positive predictive value (PPV) (94%) but low to moderate (29%–66%) sensitivity. The COVID-specific case definition (10 additional codes added), had moderate to high specificity (82–93%), moderate sensitivity (65–75%), and low to moderate PPV (23%–77%). The COVID-like illness case definition (19 additional codes added to the COVID-specific definition), had moderate specificity (65%–86%), moderate sensitivity (76%–79%), and low to moderate PPV (15%–62%). Regardless of the case definition, all metrics improved over the surveillance period. The COVID-19 case definition is ideal for studies that need to ensure all cases are true positives. However, for broad surveillance efforts, the COVID-specific case definition may be the best to maximize specificity without a large decrease in sensitivity and PPV.

The emergence of SARS-CoV-2 in 2019 and the rapid global spread of the virus throughout 2020 and 2021 required quick implementation and development of clinical, laboratory, and epidemiologic surveillance efforts to identify, track, and mitigate the virus. Prior to 1 April 2020, ICD-10-CM coding guidance for SARS-CoV-2 associated medical encounters was not available. In April of 2020, the Centers for Disease Control and Prevention (CDC) released official ICD-10-CM coding and reporting guidelines for use in the U.S. for a confirmed diagnosis of COVID-19.[1] However, a report on the early use of U07.1 within the Department of Defense (DoD), found that 30% of the encounters evaluated did not meet the criteria for COVID-19 and incorrectly documented encounters for recruit screening for COVID-19 as opposed to an actual infection.[2] However, the report also found a lack of full capture of laboratory results within the DoD, which warrants consideration of alternative methods of case identification, such as validated standardized ICD-10-CM case definitions. A review of the current literature found a paucity of data on administrative case definitions for COVID-19, with most publications evaluating case definitions using symptom reporting as opposed to ICD-10-CM coding or studies focusing solely on U07.1.[3–8] Therefore, to enhance the DoD's ability to conduct COVID-19 surveillance among the military population as a whole, this study was conducted to evaluate 3 ICD-10-CM-based case definitions for COVID-19 and COVID-like-illnesses for ambulatory encounters.

WHAT ARE THE NEW FINDINGS?

This is the first evaluation of ICD-10-CM-based cased definitions for COVID-19 surveillance among DoD health care beneficiaries. The 3 case definitions ranged from highly specific to a lower specificity, but improved balance between sensitivity and specificity.

WHAT IS THE IMPACT ON READINESS AND FORCE HEALTH PROTECTION?

The development and use of these ICD-10-CM case definitions should improve the DoD's ability to provide comprehensive population-level COVID-19 surveillance and will allow the DoD to better assess the spread and impact of COVID-19 among military beneficiaries.

METHODS

The study population consisted of all DoD health care beneficiaries who had a specimen collected between 1 March 2020 and 28 February 2021 for SARS-CoV-2 laboratory testing. Standardized laboratory data were provided by the Navy and Marine Corps Public Health Center (NMCPHC). Only laboratory tests reported through the Composite Health Care System (CHCS) or MHS GENESIS were captured in the study. Eligible SARS-CoV-2 laboratory tests included both polymerase chain reaction (PCR) and antigen tests. The analysis allowed for 1 specimen per day per individual, preferentially selecting a specimen with a positive result over a negative result over an unknown result.

Data from the Defense Medical Surveillance System (DMSS) were used to match each laboratory test to a single ambulatory medical encounter occurring within 7 days before or after the tested specimen collection date.[9] If more than 1 encounter was temporally associated with a laboratory test, the priority for selection was given to encounters with a COVID-19 diagnostic code, COVID-specific diagnostic code, a COVID-like illness (CLI) diagnostic code, and then any other encounter **(Table 1)**. Laboratory tests without a matching encounter were excluded from the sensitivity/specificity analysis.

The surveillance period was partitioned into 4 separate periods for the analysis: 1 March 2020–31 May 2020, 1 June 2020–31 August 2020, 1 September 2020–30 November 2020, and 1 December 2020–28 February 2021. This partitioning was done to account for changing availability of ICD-10 codes and coding practices over the course of the first year of the COVID-19 pandemic. For each period, the percentage of laboratory tests that matched to any medical encounter was calculated. Three COVID-19 case definitions were evaluated in the analysis; COVID-19, COVID-specific, and CLI case definitions **(Table 1)**. The case definitions were not mutually exclusive, but rather expanded upon the prior case definition. The case definitions were developed early in the pandemic by Armed Forces Health Surveillance Division (AFHSD) physicians and epidemiologists using interim clinical case definitions proposed by the CDC and expert knowledge, which incorporated random chart reviews of cases to better ascertain coding practices of DoD physicians.[1] The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated for each case definition and time period **(Table 2)**.

TABLE 1. ICD-10-CM codes for SARS-CoV-2 case definitions

ICD-10-CM code	Description	COVID-19	COVID-specific	COVID-like-illness
U07.1	2019-nCoV acute respiratory disease, COVID-19, virus identified	x	x	x
B34.2	Coronavirus, unspecified		x	x
B97.21	SARS-associated coronavirus as the cause of disease classified elsewhere		x	x
B97.29	Other coronavirus as the cause of diseases classified elsewhere		x	x
J12.81	Pneumonia due to SARS-associated coronavirus		x	x
J12.89	Other viral pneumonia		x	x
J20.8	Acute bronchitis due to other specified organisms		x	x
J22	Unspecified acute lower respiratory infection		x	x
J40	Bronchitis, not specified as acute or chronic		x	x
J80	Acute Respiratory Distress Syndrome		x	x
R05	Cough		x	x
J00	Acute nasopharyngitis; common cold			x
J06.9	Acute upper respiratory infection, unspecified			x
J12.9	Viral pneumonia unspecified			x
J16.8	Pneumonia due to other specified infectious organism			x
J17	Pneumonia in diseases classified elsewhere			x
J18.0	Bronchopneumonia, unspecified organism			x
J18.1	Lobar pneumonia, unspecified organism			x
J18.8	Other pneumonia, unspecified organism			x
J18.9	Pneumonia, unspecified organism			x
J20.9	Acute bronchitis, unspecified			x
J84.111	Idiopathic interstitial pneumonia not otherwise specified			x
R06.0	Dyspnea			x
R06.00	Dyspnea, unspecified			x
R06.02	Shortness of breath			x
R06.03	Acute Respiratory Distress			x
R06.09	Other forms of dyspnea			x
R43.0	Anosmia			x
R43.2	Ageusia			x
R50.9	Fever, unspecified			x

ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification.

RESULTS

A total of 2,425,501 SARS-CoV-2 laboratory tests were identified for the entire study period. The lowest number of tests were conducted in the March–May 2020 time period (155,297 tests) and the highest number were conducted in the September–November 2020 time period (828,669 tests) **(Table 3)**. Overall, 68.1% of laboratory tests were matched to medical encounters. A higher percentage of positive laboratory tests (85.7%) were matched to ambulatory medical encounters than negative laboratory tests (65.9%). The percentages of laboratory tests that matched to medical encounters were relatively similar across time periods, with the exception of positive laboratory tests, for which only 62.5% matched to encounters in the first time period, while about 87% matched to encounters in the 3 later time periods.

Among laboratory tests that matched to medical encounters, the 3 COVID-19 case definitions were evaluated for sensitivity, specificity, PPV and NPV during each of the 4 time periods. NPV was high regardless of the time period or case definition **(Tables 4–6)**. As expected, the COVID-19 case definition had very high specificity (98.6%–99.2%) regardless of the time period. However, the sensitivity of this case definition ranged from low (28.9%) in March–May 2020 to moderate

TABLE 2. Definitions used for calculation of sensitivity, specificity, NPV and PPV

	Positive test	Negative test
COVID-19 encounter	True positive	False positive
non-COVID-19 encounter	False negative	True negative

Sensitivity: no. true positive / no. with positive lab tests

Specificity: no. true negative / no. with negative lab tests

NPV: no. true negative / no. with non-COVID-19 encounters

PPV: no. true positive / no. with COVID-19 encounters

NPV, negative predictive value; PPV, positive predictive value; no., number.

(66.5%) in December–February 2021 **(Table 4)**. The PPV of the COVID-19 case definition also increased through the first year of the pandemic; from 62.6% during the first period to 94.2% during the last period evaluated.

The sensitivity, specificity, and PPV of the COVID-specific case definition all increased over time **(Table 5)**. The sensitivity of this case definition was moderate during the first period (65.1%) and increased to moderately high (75.4%) during the last period. The specificity was moderately high during the first period (81.6%) and increased to be high (93.3%) during the last period. The PPV of this case definition was very poor (22.8%) early in the pandemic, but improved to a moderately high level (76.5%) during the last period of surveillance.

The broadest of the 3 case definitions, CLI, had the highest sensitivity (range=75.5%–79.2%) compared to the other case definitions, but it was only slightly higher than the COVID-specific case definition **(Table 6)**. As expected, specificity was lowest among the CLI case definition compared to the other case definitions. The specificity of this case definition ranged from 64.9% during the first period to 86.0% during the last period. The PPV was very low during the first period (15.3%), but increased to a moderate level (62.1%) by the last period of surveillance.

TABLE 3. Matching of SARS-CoV-2 laboratory tests to ambulatory medical encounters by time period and result

Time period	All laboratory tests			Positive result			Negative result		
	No. laboratory tests	No. matched	%	No. laboratory tests	No. matched	%	No. laboratory tests	No. matched	%
Combined	2,425,501	1,652,162	68.1	271,395	232,654	85.7	2,154,106	1,419,508	65.9
1 March–31 May 2020	155,297	102,322	65.9	12,629	7,899	62.5	142,668	94,423	66.2
1 June–31 August 2020	745,295	510,757	68.5	59,851	52,260	87.3	685,444	458,497	66.9
1 September–30 November 2020	828,669	568,549	68.6	77,032	67,118	87.1	751,637	501,431	66.7
1 December 2020–28 February 2021	696,240	470,534	67.6	121,883	105,377	86.5	574,357	365,157	63.6

No., number.

TABLE 4. Sensitivity and specificity of the COVID-19 case definition[a] among laboratory tests that matched to ambulatory medical encounters

Time period	Encounter type	Test result		Total	Performance metrics	
		Positive	Negative			
1 March–31 May 2020	COVID-19[a]	2,283	1,365	3,648	Sensitivity	28.9
	Non-COVID-19	5,616	93,058	98,674	Specificity	98.6
	Total	7,899	94,423	102,322	NPV	94.3
					PPV	62.6
1 June–31 August 2020	COVID-19[a]	31,545	4,529	36,074	Sensitivity	60.4
	Non-COVID-19	20,715	453,968	474,683	Specificity	99.0
	Total	52,260	458,497	510,757	NPV	95.6
					PPV	87.4
1 September–30 November 2020	COVID-19[a]	39,802	3,975	43,777	Sensitivity	59.3
	Non-COVID-19	27,316	497,456	524,772	Specificity	99.2
	Total	67,118	501,431	568,549	NPV	94.8
					PPV	90.9
1 December 2020–28 February 2021	COVID-19[a]	70,056	4,340	74,396	Sensitivity	66.5
	Non-COVID-19	35,321	360,817	396,138	Specificity	98.8
	Total	105,377	365,157	470,534	NPV	91.1
					PPV	94.2

[a]COVID-19: defined as having a medical encounter with a diagnosis of ICD-CM-10: U07.1 in any diagnostic position.
NPV, negative predictive value; PPV, positive predictive value.

TABLE 5. Sensitivity and specificity of the COVID-specific case definition[a] among laboratory tests that matched to ambulatory medical encounters

Time period	Encounter type	Test result		Total	Performance metrics	
		Positive	Negative			
1 March–31 May 2020	COVID-specific[a]	5,144	17,371	22,515	Sensitivity	65.1
	Non-COVID-specific	2,755	77,052	79,807	Specificity	81.6
	Total	7,899	94,423	102,322	NPV	96.5
					PPV	22.8
1 June–31 August 2020	COVID-specific[a]	38,854	29,537	68,391	Sensitivity	74.3
	Non-COVID-specific	13,406	428,960	442,366	Specificity	93.6
	Total	52,260	458,497	510,757	NPV	97.0
					PPV	56.8
1 September–30 November 2020	COVID-specific[a]	48,831	34,691	83,522	Sensitivity	72.8
	Non-COVID-specific	18,287	466,740	485,027	Specificity	93.1
	Total	67,118	501,431	568,549	NPV	96.2
					PPV	58.5
1 December 2020–28 February 2021	COVID-specific[a]	79,445	24,399	103,844	Sensitivity	75.4
	Non-COVID-specific	25,932	340,758	366,690	Specificity	93.3
	Total	105,377	365,157	470,534	NPV	92.9
					PPV	76.5

[a]COVID-specific: defined as having a medical encounter with a diagnosis of B34.2, B97.21, B97.29, J12.81, J12.89, J20.8, J22, J40, J80, R05, or U07.1 in any diagnostic position.

TABLE 6. Sensitivity and specificity of the COVID-like-illness (CLI) case definition[a] among laboratory tests that matched to ambulatory medical encounters

Time period	Encounter type	Test result		Total	Performance metrics	
		Positive	Negative			
1 March–31 May 2020	CLI[a]	5,963	33,111	39,074	Sensitivity	75.5
	Non-COVID-specific	1,936	61,312	63,248	Specificity	64.9
	Total	7,899	94,423	102,322	NPV	96.9
					PPV	15.3
1 June–31 August 2020	CLI[a]	41,243	63,606	104,849	Sensitivity	78.9
	Non-COVID-specific	11,017	394,891	405,908	Specificity	86.1
	Total	52,260	458,497	510,757	NPV	97.3
					PPV	39.3
1 September–30 November 2020	CLI[a]	52,070	76,632	128,702	Sensitivity	77.6
	Non-COVID-specific	15,048	424,799	439,847	Specificity	84.7
	Total	67,118	501,431	568,549	NPV	96.6
					PPV	40.5
1 December 2020–28 February 2021	CLI[a]	83,439	51,030	134,469	Sensitivity	79.2
	Non-COVID-specific	21,938	314,127	336,065	Specificity	86.0
	Total	105,377	365,157	470,534	NPV	93.5
					PPV	62.1

[a]COVID-like illness (CLI): defined as having a medical encounter with a diagnosis of B34.2, B97.21, B97.29, J00, J06.9, J12.81, J12.89, J12.9, J16.8, J17, J18.0, J18.1, J18.8, J18.9, J20.8, J20.9, J22, J40, J80, J84.111, R05, R06.0, R06.00, R06.02, R06.03, R06.09, R43.0, R43.2, R50.9, or U07.1 in any diagnostic position.
NPV, negative predictive value; PPV, positive predictive value.

EDITORIAL COMMENT

As the COVID-19 pandemic expanded in the U.S. in March 2020, surveillance, diagnosis, and tracking efforts were rapidly deployed and evolved. With the addition of new ICD-10-CM codes for COVID-19 and guidance for their use, it was crucial to develop and evaluate various ICD-10-CM-based case definitions to allow for accurate, population-level surveillance of COVID-19. This study evaluated 3 COVID-19 case definitions to determine and compare their sensitivity, specificity, and PPV.

Two-thirds of laboratory tests could be matched to ambulatory encounters. Given that there were multiple locations where individuals could be tested for the SARS-CoV-2 virus (e.g., medical offices, pharmacies, drive-thru testing locations), many of which would not be linked to an ambulatory medical encounter, this finding is not surprising. However, positive laboratory tests were more likely to have an associated ambulatory encounter than negative tests. This finding indicates that individuals who tested positive may have symptoms requiring medical treatment or consultation with a medical provider.

Results were as expected, with the highest specificity and PPV occurring with the most specific case definition of U07.1. The CDC issued official coding and reporting guidelines to use this code for a confirmed diagnosis of COVID-19.[1] The timing of this release, 1 April 2020, aligns with the finding of lower sensitivity and PPV of this code during the March–May 2020 period, when this code may not have been available to all providers and/or training on its use was being rolled out. One study found that it took 2 weeks for U07.1 to be widely used for COVID-19 hospitalizations in the U.S.[6] The PPV of U07.1 for the entire study period, 91.0%, was higher than a previous publication among Veterans Affairs outpatient encounters, which reported PPV to be 77.7% during a similar time period.[7] Although published studies on the sensitivity and specificity of U07.1 among ambulatory encounters were not available at the time of this report, there have been 2 publications among hospitalizations: 1 among adults and 1 among a pediatric population.[6,8] All studies found high specificity of the code (current study: 98.9%, adult study: 99.0%, pediatric study: 99.9%). However, the hospitalization studies found much higher sensitivity of U07.1 (adult study: 98.0%; pediatric study: 89.7%) compared to the current ambulatory encounter sensitivity (66.5% during the last period). This difference may be due to the fact that inpatient encounters require a nosologist (an individual who specializes in the systemic classification of diseases) to generate the discharge diagnoses, whereas this is not necessarily done with ambulatory encounters. Additionally, medical providers may not have laboratory test results available when generating ambulatory encounter diagnostic codes and therefore may have been hesitant to code U07.1 without laboratory confirmation.

With the addition of more ICD-10-CM codes for the COVID-specific and CLI case definitions, sensitivity increased, but at the expense of specificity and PPV. These case definitions provided a better balance between sensitivity and specificity compared to standardized case definitions used for other respiratory infections, such as influenza-like illness, which had very high sensitivity (92–93%), but very low specificity (26–30%).[10] However, none of the COVID-19 case definitions reached a sensitivity as high as the influenza-like-illness definitions. This may be due to a larger variety of ICD-10 codes being used by providers, especially early in the pandemic, and the more diverse symptoms associated with COVID-19 cases compared to influenza cases.[11–13]

This analysis was limited to medical encounters for which SARS-CoV-2 tests were ordered at military treatment facilities. As multiple SARS-CoV-2 testing locations were available, separate from MTFs, there is the possibility that the study population was not representative of DoD beneficiaries tested for SARS-CoV-2 during this time period. Additionally, the analysis required a medical encounter, so asymptomatic and non-medically attended individuals will not be captured in this analysis and should be considered a gap in surveillance utilizing ICD-10-CM case definitions. However, with those limitations, this analysis was able to provide data on a population level that can be used to enhance public health surveillance of COVID-19 cases. Improved surveillance for COVID-19 can provide a more accurate assessment of the burden of disease and the impact on military readiness among service members. As with all surveillance efforts, decisions on the most appropriate case definition to use need to incorporate an understanding of the data sources being used, the population being studied, and the purpose of the surveillance.

Author affiliations: Defense Health Agency, Armed Forces Health Surveillance Division, Silver Spring, MD (Dr. Eick-Cost, Ms. Fedgo).

REFERENCES

1. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19) 2020 interim case definition, Approved April 5, 2020. Accessed 19 Jan 2022. https://ndc.services.cdc.gov/case-definitions/coronavirus-disease-2019-2020
2. Clausen S, Stahlman S, Cost A. Early use of ICD-10-CM code "U07.1, COVID-19" to identify 2019 novel coronavirus cases in Military Health System administrative data. *MSMR*. 2000;27(05):55–59.
3. Pulia MS, Hekman DJ, Glazer JM, et al. Electronic health record-based surveillance for community transmitted COVID-19 in the emergency department. *West J Emerg Med*. 2020;21(4):748–751.
4. Crabb BT, Lyons A, Bale M, et al. Comparison of International Classification of Diseases and related health problems, tenth revision codes with electronic medical records among patients with symptoms of coronavirus disease 2019. *JAMA Netw Open*. 2020;3(8):e2017703.
5. Kluberg SA, Hou L, Dutcher SK, et al. Validation of diagnosis codes to identify hospitalized COVID-19 patients in health care claims data [published online ahead of print, 2021 Dec 16]. *Pharmacoepidemiol Drug Saf*. 2021;10.1002/pds.5401.
6. Kadri SS, Gundrum J, Warner S, et al. Uptake and accuracy of the diagnosis code for COVID-19 among US hospitalizations. *JAMA*. 2020;324(24):2553–2554.
7. Lynch KE, Viernes B, Gatsby E, et al. Positive predictive value of COVID-19 ICD-10 diagnosis codes across calendar time and clinical setting. *Clin Epidemiol*. 2021;13:1011–1018.
8. Blatz AM, David MZ, Otto WR, Luan X, Gerber JS. Validation of International Classification of Disease-10 code for identifying children hospitalized with coronavirus disease-2019. *J Pediatric Infect Dis Soc*. 2021;10(4):547–548.
9. Rubertone MV, Brundage JF. The Defense Medical Surveillance System and the Department of Defense serum repository: glimpses of the future of public health surveillance. *Am J Public Health*. 2002;92(12):1900–1904.
10. Eick-Cost AA, Hunt DJ. Assessment of ICD-9-based case definitions for influenza-like illness surveillance. *MSMR*. 2015;22(9):2–7.
11. Mayo Clinic. Unusual coronovirus (COVID-19) symptoms: What are they? Accessed 26 Jan 2022. https://www.mayoclinic.org/diseases-conditions/coronavirus/expert-answers/coronavirus-unusual-symptoms/faq-20487367
12. Centers for Disease Control and Prevention. Symptoms of COVID-19. Accessed 26 Jan 2022. https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html
13. Burke RM, Killerby ME, Newton S, et al. Symptom profiles of a convenience sample of patients with COVID-19 - United States, January-April 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(28):904–908.

The Association Between Two Bogus Items, Demographics, and Military Characteristics in a 2019 Cross-sectional Survey of U.S. Army Soldiers

Jacob D. Smith, MPH; Matthew R. Beymer, PhD, MPH; Katherine C. L. Schaughency, PhD, MHS

Careless responding to surveys has not been sufficiently characterized in military populations. The objective of the current study was to determine the proportion and characteristics of careless responding in a 2019 survey given to a large sample of U.S. Army soldiers at 1 installation (n = 4,892). Two bogus survey items were asked to assess careless responding. Nearly 96% of soldier respondents correctly answered both bogus items and 4.5% incorrectly answered at least 1 bogus question. In the adjusted multiple logistic regression model, race and marital status were associated with incorrect answers to bogus item questions after controlling for all other covariates. Specifically, the odds of Black respondents incorrectly answering the bogus items (adjusted odds ratio [AOR]: 2.53; 95% CI: 1.74–3.68) were more than 2.5 times those of White respondents. The recommendations that stem from the results of surveys can influence policy decisions. A large proportion of careless responses could inadvertently lead to results that are not representative of the population surveyed. Careless responding could be detected through the inclusion of bogus items in military surveys which would allow researchers to analyze how careless responses may impact outcomes of interest.

WHAT ARE THE NEW FINDINGS?

Careless responding to survey questions has not been previously studied in military populations. In a behavioral health survey with 2 bogus items used to assess careless responding, 4.5% of soldier respondents provided at least 1 incorrect answer. In an adjusted multiple logistic regression model, race (Black) and marital status (other) were associated with bogus item passage. Black respondents had odds of failing the bogus items that were more than 2.5 times those of White respondents.

WHAT IS THE IMPACT ON READINESS AND FORCE HEALTH PROTECTION?

Data from surveys may be used to make public health decisions at both the installation and the Department of the Army level. This study demonstrates that a vast majority of soldiers were likely sufficiently engaged and answered both bogus items correctly. Future surveys should continue to investigate careless responding to ensure data quality in military populations.

Public health surveys are routinely used to determine health disparities in a given population. However, less attentive responses to survey questions ("careless responding") could introduce bias and affect the reliability and validity of health measures.[1,2,3] Thus, careless responding may change the magnitude and direction of estimates which could lead to misleading results[1,2,3] and erroneous public health recommendations. Previous studies on careless responding to surveys have been primarily conducted outside of public health.[4–10] These studies have focused on various methods to detect, describe, and reduce careless responding.[4–10] One strategy to detect careless responses to survey questions is via bogus items. A bogus item is a survey question designed to elicit the same answer from all respondents, which is typically an obvious correct answer, such as "I was born on planet Earth." Bogus items are inexpensive to include in a survey, require minimal computation, and minimize Type I error (i.e., false positives) due to the high likelihood for participants to answer correctly (e.g., affirming that the American flag is "red, white, and blue" is readily answered by people who live in the U.S.).[8] However, false negatives (i.e., answering correctly for the wrong reason) may be likely if respondents answer questions in a routine pattern that has nothing to do with the questions' content (e.g., answering "strongly agree" to every question). Furthermore, incorrect responses to bogus items may not be representative of engagement throughout the survey. Instead, there may be a lapse in a respondent's engagement or attentiveness in different sections of the survey or accidental selection of an incorrect response.[8,10] Alternatively, incorrect responses to bogus items may reflect measurement error due to the bogus items used. The modal proportion of careless respondents in a typical survey is near 10%.[7,8,11]

The recommendations that stem from the results of surveys can influence policy decisions. However, careless responding has not yet been studied in military populations. The prevalence of careless responding and associated factors in military surveys warrants evaluation to better understand how careless responding may affect outcomes of interest.

At the time of this analysis, no prior published studies had evaluated the frequency or predictors of careless responding in the U.S. military. The primary objective of this study was to quantify careless responding in a survey of a large U.S. Army population at a single U.S. Army installation using 2 bogus items. The secondary objective was to describe the association between demographic and military characteristics and correct responses to the bogus items.

METHODS

Study population

This secondary analysis used survey data from a behavioral health epidemiological consultation (EPICON) conducted at a U.S. Army installation in 2019 by the U.S. Army Public Health Center's Division of Behavioral and Social Health Outcomes Practice. An anonymous, online, behavioral health survey was provided to soldiers via an Operational Order (OPORD) to estimate the prevalence of adverse behavioral and social health outcomes, following a perceived increase in suicidal behavior at the installation. The OPORD was distributed from the commander of the installation to subordinate units. The survey was web-based and estimated in pilot testing to require 25 minutes to complete. Survey data were collected using Verint Systems software which allowed soldier respondents to complete the survey via any web-enabled device.[12] The survey was open for 28 calendar days. Respondents could start, save, and submit the survey at any point between the opening and closing dates of the survey period. Respondents were not incentivized to complete the survey (i.e., no monetary, gift, time, or other rewards were offered). Only respondents who selected "military" as their duty status in the initial screening question were included in the final dataset. Additionally, respondents who did not answer both of the bogus items were excluded from the analysis.

Respondents' demographic and military characteristics were collected at the beginning of the survey to reduce the likelihood of omission. Demographic characteristics included sex, age group, race (White/Caucasian, Black/African American, Asian/Pacific Islander, and other/multiracial), ethnicity (Hispanic, non-Hispanic), education level, and marital status. Race and ethnicity were assessed based on responses to the question, "What is your race/ethnicity? Select all that apply." The response options included 1) White, 2) Black or African American, 3) Hispanic, Latino, or Spanish Origin, and 4) other race, ethnicity, or origin. Respondents who selected "other race, ethnicity or origin" were classified as "other" and those who selected multiple racial groups were classified as "multiracial." Due to small cell sizes, the "other" and "multiracial" categories were combined. Regarding ethnicity, soldiers who selected "Hispanic, Latino, or Spanish Origin" were classified as "Hispanic" regardless of other selections; the remaining soldiers were classified as "non-Hispanic." Marital status was categorized as married, single, or other (divorced, in a relationship [serious relationship, but not legally married], separated, or widowed).

Military characteristics of interest included military rank (enlisted or officer), operational tempo (OPTEMPO), overall job satisfaction, and self-reported likelihood of attrition from the Army. OPTEMPO was assessed using the question, "In the past week, how many hours of work have you averaged per day?" with a scale from 0 to 24 hours and a decline to answer option. Self-reported OPTEMPO was categorized as high (11+ hours) or normal (< 11 hours). Job satisfaction was assessed using the survey question, "How satisfied are you with your job overall?" on a 5-point Likert scale ranging from very satisfied to very dissatisfied. For the purpose of analysis, responses to the job satisfaction item were collapsed into 3 categories: satisfied, neutral, or unsatisfied. Likelihood of attrition from the Army was assessed using the survey question, "How likely are you to leave the Army after your current enlistment/service period?" with a 5-point Likert scale ranging from very likely to very unlikely. Responses to the attrition item were collapsed into 3 categories: likely, neutral, or unlikely.

Outcome

Two bogus items were used as indicators of careless responding in the survey. The first bogus item was placed approximately a quarter of the way through the survey and asked "What planet are you currently on?" Response options included "Saturn," "Pluto," "Earth," "Mars," or "Mercury." The second bogus item was placed approximately three quarters of the way through the survey and asked "What color is the American Flag?" Response options included "red, green, and white"; "green, yellow, and black"; "red, white, and blue"; "blue, yellow, and white"; and "green, red, and black." Both items provided the option to leave the response blank. A composite variable was created to categorize responses to both bogus item questions as "pass" or "fail." If a respondent answered both correctly, then the respondent passed. If a respondent answered either question incorrectly, then the respondent failed.

Statistical Analysis

Bogus item passage (i.e., pass or fail) was stratified by demographic and military characteristics. Chi-square tests were used to identify potential differences in soldiers' bogus item passage by demographic and military characteristics. Additionally, the relationship between the 2 bogus item questions was examined using a chi-square test to assess whether passing 1 bogus item was associated with passing the other bogus item.

The crude relationship between bogus item passage and demographic and military characteristics was assessed individually using univariate logistic regression. A multivariable logistic regression model was used to determine whether an association existed between bogus item passage and the demographic and military characteristics of interest. Covariate selection occurred a priori based on published literature related to bogus items. Covariates included in the model were sex, age group, race, ethnicity, education level, marital status, military rank, OPTEMPO, likelihood of attrition, and job satisfaction. Listwise deletion was used and p values less than .05 were considered statistically significant. All analyses were conducted using SAS/STAT software, version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

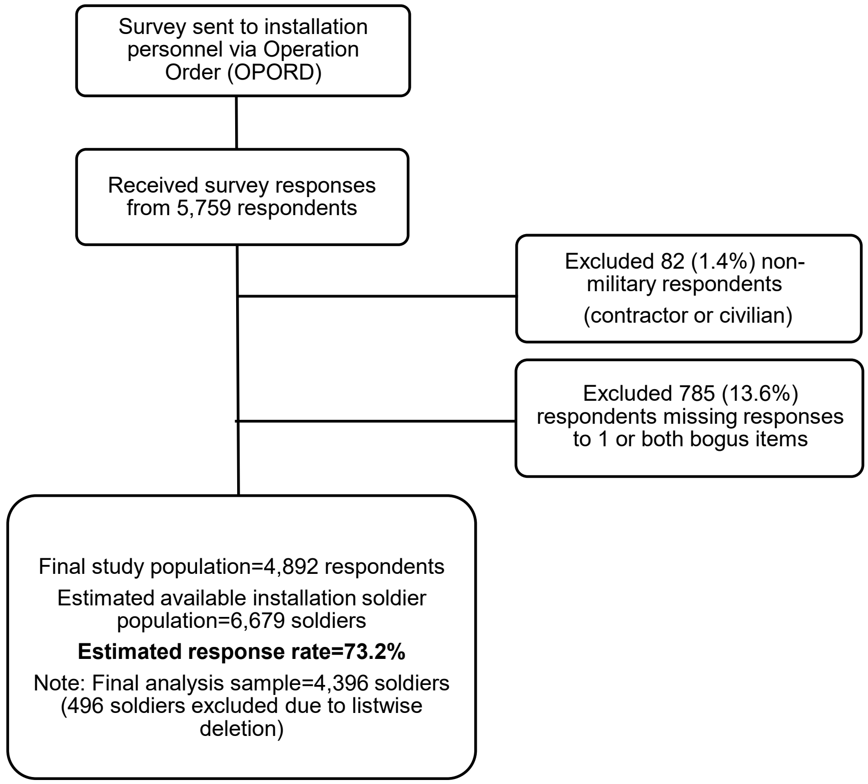
An estimated 6,679 soldiers were eligible for the survey and 5,759 respondents completed surveys during the 1-month data collection period **(Figure)**. Eighty-two respondents (1.4%) were excluded because they reported being either a contractor or a civilian; and 785 (13.6%) respondents were excluded because of missing data on either of the 2 bogus items. The final study population consisted of 4,892 respondents, which represented an estimated response rate of 73.2%.

Respondents were primarily male (85.8%), 17–24 years old (50.3%), White (60.4%), Non-Hispanic (82.2%), recipients of a high school diploma or less (48.3%), enlisted (67.9%), and married (45.5%) **(Table 1)**. The overall median response time was 26 minutes (mean=80 minutes; standard deviation=728 minutes; range=1–32,963 minutes). The vast majority (95.5%) of respondents answered both bogus items correctly ("pass") and 4.5% answered at least 1 incorrectly ("fail"). The first and second bogus items were answered correctly by 96.6% and 98.1% of respondents, respectively.

Respondents' race, marital status, military rank, and individual bogus item responses were significantly associated with the bogus item outcome at the bivariate level **(Table 1)**. Sex, age group, ethnicity, education status, OPTEMPO, attrition, and job satisfaction were not significantly associated with the bogus item outcome. Respondents who failed the first bogus item had odds of failing the second bogus item that were approximately 30 times (odds ratio [OR]: 29.9, 95% confidence interval [CI]: 19.2–46.5) that of respondents who passed the first item **(data not shown)**.

A total of 4,396 respondents (89.9% of the full sample) with complete information for each covariate were included in the adjusted multivariable logistic regression model after listwise deletion. Rank was originally included in the multivariable logistic regression model; however, because this variable was missing for 79.5% of the total listwise deleted observations, it was removed from the final model. Race and marital status were the only variables significantly associated with bogus item passage in the adjusted multivariable logistic regression model **(Table 2)**. Black respondents had odds of failing the bogus items that were more than 2.5 times (adjusted OR [AOR]: 2.53; 95% CI: 1.74–3.68) that of White respondents after adjusting for sex, age group, marital status, ethnicity, education level, OPTEMPO, job satisfaction, and likelihood of Army attrition. Respondents with a marital status categorized as "other" had odds of failing the bogus items that were 1.7 times (AOR: 1.73; 95% CI: 1.19–2.53) that of single respondents after adjusting for covariates.

FIGURE. Study population exclusion flow chart



A sensitivity analysis was performed comparing results of models with and without rank. Results of the 2 models were similar with the exception of the relationship between marital status and the outcome variable; in the model that included rank, marital status was not significantly associated with bogus item passage. Overall, listwise deletion led to the removal of 10.1% of respondents from the multivariable logistic regression analysis. A comparison of those respondents excluded from the model compared to those retained in the analysis showed that the 2 sets of respondents did not differ by demographics or bogus item passage.

EDITORIAL COMMENT

This study sought to determine the characteristics of careless respondents using bogus items in a survey administered to a sample of U.S. Army soldiers at 1 installation. While it is not feasible to estimate the true prevalence of careless responding across the Department of Defense (DoD) or the Army, this study found that 4.5% of survey respondents failed either of the bogus items and 95.5% passed both bogus items. Prior research estimated the proportion of careless responding in most studies to be around 10% (3%–46%)[7,8,11]; in this study, the proportion of careless responding was at the extreme lower end of the range of existing surveys. The heterogeneous prevalence of careless responding across studies is likely due to the variability in how careless responding is operationalized, differences in survey lengths, study populations used (e.g., Amazon MTurk [online], psychology undergraduate students), and the methods used to categorize careless responding (e.g., data driven methods, bogus items, instructed manipulation checks).[7,8,11] The lower proportion of careless responding observed in the current study could potentially be due to reasons such as soldiers being more interested in this survey topic, wanting to make a difference via their responses, command pressure, or responding to bogus items not validated by prior literature.[5]

This study found greater odds of failing the 2 bogus items among Black respondents when compared to White respondents and greater odds for those categorized as "other" marital status when compared to single respondents. One prior web-based study of 2,000 adults from U.S. households using methods other than bogus items found that Hispanic respondents and unmarried respondents were more likely to be categorized as careless responders in bivariate logistic regression models, although only age and gender were significant predictors of categorization in adjusted models.[13] A 2019 dissertation using 1 instructed manipulation check question found that non-Hispanic Black and White respondents had about 1.2 times and 1.1 times the odds of being categorized as careless responders compared to Hispanic respondents, respectively.[14] It is unclear why those who reported their race as Black in the current study had higher odds of failing the bogus items, as there are few other published studies that document associations between race/ethnicity and careless responding.[13,14]

This study was subject to numerous limitations. First, this study only applied 1 method (i.e., bogus items) to determine careless responding. Second, this study did not compare the demographic and military characteristics of the respondents who did not answer both bogus items to those who did answer both bogus items, which could have impacted the interpretation of the results if the 2 were different. Third, listwise deletion led to the exclusion of 10.1% of respondents from the multivariable logistic regression analysis. However, a comparison

TABLE 1. Demographic and military characteristics of U.S. Army installation survey respondents, 2019 (n=4,892)

	Total (n=4,892)		Bogus item Fail		Bogus item Pass		
	n	%	n	%	n	%	p-value
Total	4,892	100.0	219	4.5	4,673	95.5	—
Sex							
Female	531	10.9	20	9.1	511	10.9	.360
Male	4,198	85.8	195	89.0	4,003	85.7	
Missing	163	3.3	4	1.8	159	3.4	
Age group (years)							
17–24	2,462	50.3	126	57.5	2,336	50.0	.069
25–29	1,158	23.7	41	18.7	1,117	23.9	
30–34	506	10.3	14	6.4	492	10.5	
35–39	326	6.7	13	5.9	313	6.7	
40+	191	3.9	10	4.6	181	3.9	
Missing	249	5.1	15	6.8	234	5.0	
Race							
White	2,956	60.4	107	48.9	2,849	61.0	<.001
Black	636	13.0	50	22.8	586	12.5	
Other	1,262	25.8	62	28.3	1,200	25.7	
Missing	38	0.8	—	—	38	0.8	
Ethnicity							
Not Hispanic or Latino	4,023	82.2	176	80.4	3,847	82.3	.312
Hispanic or Latino	831	17.0	43	19.6	788	16.9	
Missing	38	0.8	—	—	38	0.8	
Education level							
High school diploma, GED, or less	2,364	48.3	122	55.7	2,242	48.0	.091
Some college or associate's degree	1,611	32.9	66	30.1	1,545	33.1	
Bachelor's degree	662	13.5	20	9.1	642	13.7	
Greater than bachelor's degree	223	4.6	11	5.0	212	4.5	
Missing	32	0.7	—	—	32	0.7	
Marital status							
Married	2,226	45.5	74	33.8	2,152	46.1	<.001
Single	1,872	38.3	88	40.2	1,784	38.2	
Other	773	15.8	57	26.0	716	15.3	
Missing	21	0.4	—	—	21	0.4	
Military rank							
Enlisted	3,321	67.9	155	70.8	3,166	67.8	.007
Officer	464	9.5	9	4.1	455	9.7	
Missing	1,107	22.6	55	25.1	1,052	22.5	
Bogus item #1: What planet are you on?							
Earth	4,726	96.6	53	24.2	4,673	100.0	—
Mars	53	1.1	53	24.2	—	—	—
Mercury	24	0.5	24	11.0	—	—	—
Pluto	56	1.1	56	25.6	—	—	—
Saturn	33	0.7	33	15.1	—	—	—
Bogus item #2: What is the color of the American flag?							
Blue, yellow, and white	21	0.4	21	9.6	—	—	—
Green, red, and black	12	0.2	12	5.5	—	—	—
Green, yellow, and black	27	0.6	27	12.3	—	—	—
Red, green, and white	35	0.7	35	16.0	—	—	—
Red, white, and blue	4,797	98.1	124	56.6	4,673	100.0	—
Daily operational tempo							
Normal (average of <11 hours worked per day)	2,365	48.3	117	53.4	2,248	48.1	0.82
High (average of >11 hours worked per day)	2,452	50.1	96	43.8	2,356	50.4	
Missing	75	1.5	6	2.7	69	1.5	
Army attrition likelihood							
Likely	2,669	54.6	132	60.3	2,537	54.3	.242
Neutral	841	17.2	35	16.0	806	17.2	
Unlikely	1,331	27.2	51	23.3	1,280	27.4	
Missing	51	1.0	1	0.5	50	1.1	
Job satisfaction							
Satisfied	2,487	50.8	100	45.7	2,387	51.1	.059
Neutral	1,061	21.7	43	19.6	1,018	21.8	
Unsatisfied	1,279	26.1	72	32.9	1,207	25.8	
Missing	65	1.3	4	1.8	61	1.3	

TABLE 2. Demographic and military characteristics on responses to bogus items among 4,396 Army soldiers at 1 Army installation in 2019[b]

Reference category (Pass bogus items)	n	OR	95% CI	B	SE	AOR	95% CI	p-value
Sex								
Male	3,893	ref	—	—	—	—	—	—
Female	503	0.80	(0.50–1.28)	-0.41	0.26	0.66	(0.40–1.10)	.111
Age group (years)[a]								
17–24	2,319	ref	—	—	—	—	—	—
25–29	1,104	0.68	(0.47–0.97)	-0.25	0.21	0.78	(0.52–1.17)	.232
30–34	481	0.53	(0.30–0.92)	-0.35	0.32	0.70	(0.38–1.31)	.268
35–39	308	0.77	(0.43–1.38)	0.06	0.34	1.06	(0.55–2.05)	.862
40+	184	1.02	(0.53–1.98)	0.12	0.40	1.13	(0.52–2.48)	.762
Race[a]								
White	2,694	ref	—	—	—	—	—	—
Black	564	2.27	(1.61–3.22)	0.93	0.19	2.53	(1.74–3.68)	<.001
Other race	1,138	1.38	(1.00–1.89)	0.19	0.23	1.21	(0.77–1.88)	.408
Ethnicity								
Not Hispanic or Latino	3,655	ref	—	—	—	—	—	—
Hispanic or Latino	741	1.19	(0.85–1.68)	0.17	0.25	1.19	(0.73–1.92)	.485
Educational level								
High school diploma, GED, or less	2,142	ref	—	—	—	—	—	—
Bachelor's degree	1,447	0.57	(0.35–0.93)	-0.29	0.28	0.75	(0.43–1.30)	.301
Greater than Bachelor's degree	200	0.95	(0.51–1.80)	0.28	0.39	1.32	(0.62–2.83)	.471
Some college or Associate's degree	1,447	0.79	(0.58–1.07)	-0.09	0.18	0.92	(0.64–1.31)	.636
Marital status[a]								
Single	1,689	ref	—	—	—	—	—	—
Married	2,006	0.70	(0.51–0.96)	-0.17	0.19	0.84	(0.58–1.22)	.357
Other[C]	701	1.61	(1.14–2.28)	0.55	0.19	1.73	(1.19–2.53)	.004
Daily operational tempo								
Normal (<11 hour workday)	2,156	1.28	(0.97–1.68)	0.17	0.15	1.18	(0.87–1.59)	.280
High (>11 hour workday)	2,240	ref	—	—	—	—	—	—
Likelihood of Army attrition								
Likely	2,421	1.31	(0.94–1.82)	0.14	0.19	1.15	(0.79–1.66)	.472
Neutral	769	1.09	(0.70–1.69)	-0.01	0.25	0.99	(0.61–1.60)	.971
Unlikely	1,206	ref	—	—	—	—	—	—
Job satisfaction								
Satisfied	2,276	ref	—	—	—	—	—	—
Neutral	955	1.01	(0.70–1.45)	0.32	0.18	1.38	(0.97–1.97)	.075
Unsatisfied	1,165	1.42	(1.04–1.94)	-0.05	0.20	0.95	(0.64–1.41)	.810

[a]Univariate logistic regression showed statistically significant association with bogus item passage (p<.05).
[b]Included in this model were 4,892 soldiers. Of those, the model removed 496 due to missing covariate values. 4,396 soldiers were retained in the final model.
[C]Other includes: divorced, separated, widowed, in a relationship (e.g., serious relationship, but not legally married).
OR, odds ratio; CI, confidence interval; B, beta coefficient; SE, standard error; AOR, adjusted odds ratio; ref, reference group.

of those respondents excluded from the model compared to those retained in the analysis showed that the 2 sets of respondents did not differ on demographics or bogus item passage. Fourth, bogus items could reflect careless responding across the entire survey or capture survey inattention at a specific point in time.[4,10,15] This study was able to detect careless responding at only 2 specific points in the survey. A combination of methods may be more suitable for detecting careless response bias, such as bogus items, instructed manipulation checks, self-report items, etc. Response time is an inexpensive way to screen for careless responders and assumes a minimum time required to complete the survey; however, there is no clear cutoff point.[8,11] Fifth, incorrect answers to 1 question (e.g., "What planet are you on?") may be less about attention and more about sarcasm, where the responses were influenced by the tone and nature of the bogus question and answered incorrectly on purpose.[8,16] A sarcastic comment was indicated by 4 (<0.1%) soldiers in the open-ended comment at the end of the survey. Sixth, no identifying information (e.g., name, social security number, or IP address) was collected. Therefore, it is unclear if respondents completed multiple surveys. In subsequent EPICON surveys, a question that asks, "is this the first time you have taken this particular survey?" has been included to identify surveys completed by the same individual.

Several limitations were related to the bogus items themselves. First, the bogus items employed in this study were not validated by previously published work. As a result, measurement error due to the 2 bogus items may have contributed to the higher pass rate found in this study (95.5%) compared to other studies (approximately 90%).[7,8,11] Many studies use bogus items that produce a similar response among all respondents, so that an incorrect response is likely due to careless responding.[8] Subsequent articles by Qualtrics on published work from Vannette and Krosnick have shown that the inclusion of bogus items may affect the quality of subsequent answers on surveys.[17,18] However, how the bogus items impacted later responses in the current study is unknown. Second, the correct response to both bogus items fell in the middle of each 5-item multiple choice response list. An option to randomize the order of the correct response to each bogus item was not used. Straight-lining (i.e., selecting responses in a predictable pattern) may have occurred and option order bias (i.e., the order of the answer options influences the respondent's answer) may also have been present. If the first option had been correct, however, the order would have limited the potential for detecting primacy bias (i.e., a greater likelihood to select the first response in a multiple choice question). Third, soldiers may have responded based on pressure from leaders, a factor which may have biased engagement in the survey. The survey for this analysis did not measure whether soldiers were pressured to take the survey. To adjust for this limitation, a question on leadership pressure has been incorporated into future EPICON surveys. Lastly, the soldiers who responded to this survey may not be representative of the overall U.S. Army or DoD populations, and the findings may not be generalizable as a result.

There are several potential solutions to reduce careless responding among soldiers. First, surveys need to clearly state why the survey is being done and how results of the survey will be used to improve the installation(s). If soldiers are unclear about the purpose and the intent of a survey, careless responding may be more likely to occur.[8] Second, multiple bogus items should be incorporated at different points throughout the survey and the correct response order should be randomized.[4,10] Multiple methods should be used to estimate careless responding, where possible.[4,10,11] Third, if bogus items or other items intended to detect careless responding are used, then the results should be stratified by careless responding to examine if any effect exists due to removing careless responders from the study population.[10] Some research has shown that a demographic bias may be introduced if certain demographic groups are more likely to be classified as careless responders and excluded.[18] Fourth, a representative sample could be selected instead of targeting all soldiers at an installation. Selecting a subset of the population will reduce survey fatigue by ensuring that only a fraction of soldiers receive each survey.[19] Fifth, it should be emphasized that most surveys are voluntary and that duty time cannot be extended to force participation. Lastly, surveys should be pared down to only the most essential questions to save soldier time.[8] Decreased survey length assists with improving respondent willingness to participate and may reduce multitasking.

Researchers must thoughtfully anticipate the type of careless responding that may be present in their survey data and use appropriate methods to detect potential careless responses.[5,10] Although a small proportion of respondents provided careless responses, careless responding is just one of many types of bias which can pose a threat to survey validity.

Author affiliations: Division of Behavioral and Social Health Outcomes Practice, U.S. Army Public Health Center, Aberdeen Proving Ground, MD (Mr. Smith, Dr. Beymer, Dr. Schaughency); General Dynamics Information Technology Inc., Falls Church, VA (Mr. Smith)

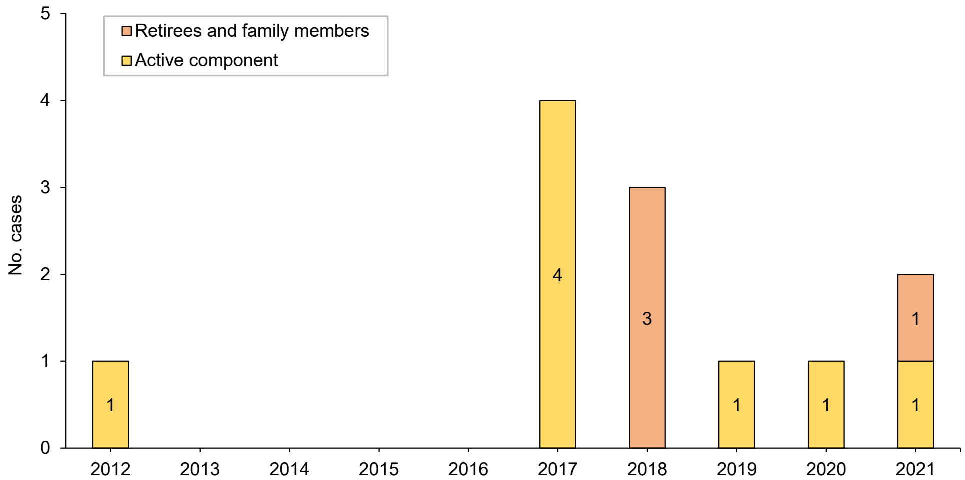
REFERENCES

1. Huang JL, Liu M, Bowling NA. Insufficient effort responding: Examining an insidious confound in survey data. *J Applied Psychol*. 2015;100(3):828–845.
2. Nichols, A.L. and Edlund, J.E. Why don't we care more about carelessness? Understanding the causes and consequences of careless participants. *Int J of Soc Res Method. 2020; 23*(6): 625–638.
3. McGrath RE, Mitchell M, Kim BH, Hough L. Evidence for response bias as a source of error variance in applied assessment. *Psychol Bul*. 2010;136(3):450.
4. Berinsky A, Margolis M, Sances M. Separating the shirkers from the workers? Making sure respondents pay attention on self□administered surveys. *Am J Pol Science*. 2014;58(3):739–753.
5. Curran P. Methods for the detection of carelessly invalid responses in survey data. *J Exp Soc Psychol*. 2016;66:4–19.
6. Johnson J. Ascertaining the validity of individual protocols from web-based personality inventories. *J Res Personal*. 2005;39(1):103–129.
7. Maniaci M, Rogge R. Caring about carelessness: Participant inattention and its effects on research. *J Res Personal*. 2014;48:61–83.
8. Meade A, Craig S. Identifying careless responses in survey data. *Psychol Methods*. 2012;17(3):437.
9. Oppenheimer D, Meyvis T, Davidenko N. Instructional manipulation checks: Detecting satisficing to increase statistical power. *J Exp Soc Psychol*. 2009;45(4):867–872.
10. DeSimone J, Harms P, DeSimone A. Best practice recommendations for data screening. *J Org Behavior*. 2015;36(2):171–181.
11. Huang J, Curran P, Keeney J, Poposki E, DeShon R. Detecting and deterring insufficient effort responding to surveys. *J Bus Psychol*. 2012;27(1):99–114.
12. Verint Enterprise Experience [computer program]. Melville, NY:Verint; 2017.
13. Schneider S, May M, Stone AA. Careless responding in internet-based quality of life assessments. *Qual Life Res*. 2018;27(4):1077–1088.
14. Melipillán EM. Careless survey respondents: Approaches to identify and reduce their negative impacts on survey estimates. [dissertation]. Ann Arbor: University of Michigan; 2019.
15. Anduiza E, Galais C. Answering without reading: IMCs and strong satisficing in online surveys. *Int J Pub Opi Research*. 2017;29(3):497–519.
16. Nichols D, Greene R, Schmolck P. Criteria for assessing inconsistent patterns of item endorsement on the MMPI: Rationale, development, and empirical trials. *J Clin Psychol*. 1989;45(2):239–250.
17. Qualtrics. Using Attention Checks in Your Surveys May Harm Data Quality. 2017. Accessed 22 September 2021. https://www.qualtrics.com/blog/using-attention-checks-in-your-surveys-may-harm-data-quality/
18. Vannette D, Krosnick J. Answering questions: A Comparison of Survey Satisficing and Mindlessness. In Ie A, Ngnoumen CT, Langer EJ, eds. *The Wiley Blackwell Handbook of Mindfulness*. West Sussex, UK: John Wiley & Sons Ltd. 2014:312–327.
19. Office of the Secretary of Defense. Implementation of Department of Defense Survey Burden Action Plan - Reducing Survey Burden, Cost and Duplication. 2016. Accessed 22 September 2021. https://apps.dtic.mil/sti/pdfs/AD1038400.pdf

Surveillance Snapshot: Tick-borne Encephalitis in Military Health System Beneficiaries, 2012–2021

Shauna Stahlman, PhD, MPH

FIGURE. Confirmed or probable TBE cases among U.S. military service members and other beneficiaries, 2012–2021



TBE, tick-borne encephalitis; No., number.

Tick-borne encephalitis (TBE) is a viral infection of the central nervous system that is transmitted by the bite of infected ticks, mostly found in wooded habitats in parts of Europe and Asia.[1] In Germany, the rate of 0.5 confirmed cases per 100,000 people in 2019 was the third highest of the 25 European countries reporting data on TBE.[1] TBE has been of historical military significance because there are a large number of U.S. service members stationed in Germany, with an estimate of about 35,000 active duty members as of September 2021.[2] In the Department of Defense (DoD) reportable medical event guidelines, TBE is a notifiable event listed under arboviral diseases.[3]

In August 2021, the U.S. Food and Drug Administration (FDA) approved a TBE vaccine ("TICOVAC") for U.S. travelers visiting or living in endemic areas.[4] In February 2022, the U.S. Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP) voted to recommend Pfizer's TICOVAC vaccine for use in U.S. populations who travel or move to endemic areas and will have extensive exposure to ticks based on their planned outdoor activities, including many service members serving in these locations.[5]

A 2019 *MSMR* report described the cases of TBE occurring among U.S. military service members and other beneficiaries between 2006 and 2018.[6] This snapshot updates these results through the end of 2021 using confirmed and probable medical event reports of TBE cases contained in the U.S. military's Disease Reporting System internet, with a focus on the past 10-year surveillance period.

The reported TBE cases between 2012 and 2018 have been previously described,[6] consisting of 1 active component service member in 2012, 4 in 2017, and 3 other beneficiaries in 2018 **(Figure)**. In 2019, there was 1 probable case reported in a 45 year-old male Army active component service member, and in 2020 there was 1 confirmed case in a 38 year-old male Army active component service member. In 2021, there were 2 cases reported: 1 probable case in a 6 year-old female Army dependent, and 1 probable case in a 34 year-old Army active component service member. All cases reported between 2019 and 2021 occurred in Germany in the months of June and July. Case comments were available for 2 of the 4 cases; both indicated that tick exposure likely occurred from living or exercising in a wooded area. None of the cases had a prior history of TBE vaccination.

The number of TBE cases per 5-year period among military health system beneficiaries grew from 1 in 2012–2016 to 11 in 2017–2021. Although the total number of cases is small, the increase in recent years provides information that should be considered when contemplating use of the FDA-approved vaccine for U.S. service members and beneficiaries who live or participate in extensive outdoor activities in a TBE-endemic area.

Author affiliation: Defense Health Agency, Armed Forces Health Surveillance Division, Silver Spring, MD.

REFERENCES

1. European Centre for Disease Prevention and Control. Tick-borne Encephalitis – Annual Epidemiologic report for 2019. Accessed 1 April 2022. https://www.ecdc.europa.eu/en/publications-data/tick-borne-encephalitis-annual-epidemiological-report-2019
2. Defense Manpower Data Center. Number of Military and DoD Appropriated Fund (APF) Civilian Personnel Permanently Assigned By Duty Location and Service/Component. September 30, 2021. Accessed 24 March 2022. https://dwp.dmdc.osd.mil/dwp/app/dod-data-reports/workforce-reports
3. Armed Forces Health Surveillance Branch. Armed Forces Reportable Medical Events, Guidelines and Case Definitions. January 2020. Accessed 2 April 2022. https://health.mil/Reference-Center/Publications/2020/01/01/Armed-Forces-Reportable-Medical-Events-Guidelines
4. Pfizer Press Release. U.S. FDA Approves TICOVAC, Pfizer's Tick-Borne Encephalitis (TBE) Vaccine. 13 August 2021. Accessed 1 April 2022. https://www.pfizer.com/news/press-release/press-release-detail/us-fda-approves-ticovactm-pfizers-tick-borne-encephalitis
5. Pfizer Press Release. CDC Advisory Committee on Immunization Practices Votes to Recommend TICOVAC, Pfizer's Tick-Borne Encephalitis (TBE) Vaccine, For Those at Risk of Virus Exposure. 23 February 2022. Accessed 1 April 2022. https://www.pfizer.com/news/press-release/press-release-detail/cdc-advisory-committee-immunization-practices-votes.
6. Mancuso JD, Bazaco S, Stahlman S, Clausen SS, Cost AA. Tick-borne encephalitis surveillance in U.S. military service members and beneficiaries, 2006–2018. *MSMR*. 2019;26(11):4–10.

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

- *Archive:* Past issues of the *MSMR* are available as downloadable PDF files at www.health.mil/MSMRArchives.
- *Online Subscriptions:* Submit subscription requests at www.health.mil/MSMRSubscribe.
- *Editorial Inquiries*: Call (301) 319-3240 or email dha.ncr.health-surv.mbx.msmr@mail.mil.
- *Instructions for Authors:* Information about article submissions is provided at www.health.mil/MSMRInstructions.

Follow us:

Facebook: https://www.facebook.com/AFHSDPAGE/

Twitter: https://twitter.com/AFHSDPAGE

ISSN 2158-0111 (print)

ISSN 2152-8217 (online)

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