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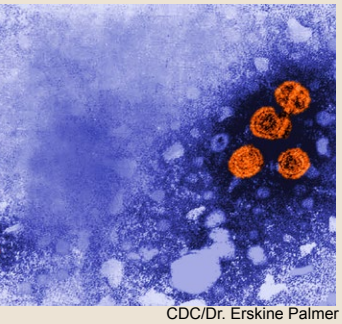
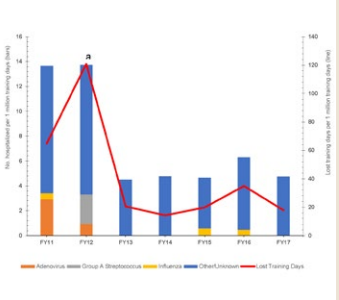
## MEDICAL SURVEILLANCE MONTHLY REPORT



CDC/Dr. Erskine Palmer



# Viral Hepatitis A, Active Component, U.S. Armed Forces, 2007–2016

*Shauna Stahlman, PhD, MPH; Valerie F. Williams, MA, MS; Alexis A. Oetting, MPH*

During 2007–2016, there were 237 incident diagnoses of acute hepatitis A, with an overall incidence rate of 1.88 cases per 100,000 person-years (p-yrs). Crude overall rates of hepatitis A were highest among service members in the youngest age group, those in healthcare occupations, and among Air Force and Navy members. Service members of "other" or unknown race/ethnicity and non-Hispanic black service members had higher overall incidence rates of hepatitis A, compared to their non-Hispanic white and Hispanic counterparts. Annual incidence rates of hepatitis A were relatively stable until 2012 when rates peaked at 2.94 per 100,000. Rates dipped to 1.41 per 100,000 p-yrs in 2015 and then increased to 2.22 per 100,000 p-yrs in 2016. During the 10-year period, annual rates among male service members were relatively stable. The low rates of acute hepatitis A among U.S. service members overall reflect the widespread use of the hepatitis A virus vaccine.

Hepatitis A is an infectious disease of the liver caused by the hepatitis A virus (HAV). An estimated 1.4 million cases are reported worldwide each year.[1] The virus is transmitted by the fecal-oral route via either person-to-person contact or consumption of contaminated food or water. Unlike hepatitis B and C, hepatitis A infection is a self-limited illness that does not become chronic. Hepatitis A infection confers lifelong immunity against reinfection and is preventable via vaccination.

Hepatitis A has long been a concern of the U.S. military. Widespread outbreaks of hepatitis A due to contaminated food or water and spread by unsanitary food and water handling practices threatened many wartime operations during World War II and the Vietnam conflict.[2,3] Military operations in endemic areas and rapidly changing field conditions placed service members at elevated risk of infection.[2-4] Because of the impact of hepatitis A on military populations and the demonstrated difficulty in preventing the infection during wartime by addressing sanitation alone, it became clear that preventive measures were needed.[2] In response, U.S. military medical researchers and their civilian counterparts developed, tested, and facilitated widespread distribution of an HAV vaccine.[2-4]

After the U.S. Food and Drug Administration's approval of the HAV vaccine (1995 and 1996), the Department of Defense mandated screening and hepatitis A immunization of immunologically naïve individuals entering the military and for service members assigned or deployed to areas of high endemicity.[5,6] Annual hospitalization rates of hepatitis A cases declined dramatically after the implementation of these policies.[7,8] Rates of hepatitis A infection and hospitalizations in the U.S. general population also decreased—especially after 1999, when routine vaccinations were expanded from children at the highest risk to a wider population of high-risk individuals.[9-11]

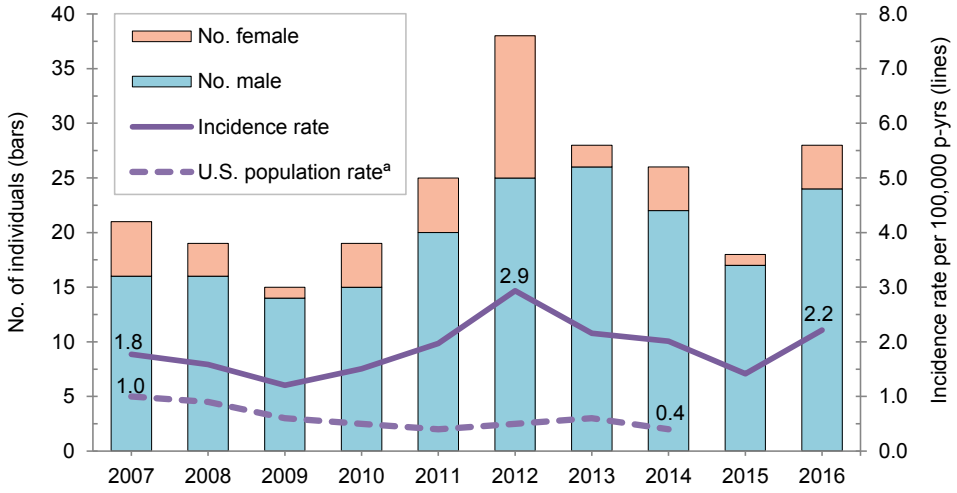
This report estimates the frequencies, incidence rates, trends, and correlates of risk of hepatitis A among active component service members of the U.S. military during the 10 years of 2007–2016.

## METHODS

The surveillance period was 1 January 2007 through 31 December 2016. The surveillance population included all members of the active components of the Army, Navy, Air Force, and Marine Corps who served at any time during the surveillance period.

Cases of hepatitis A were identified using the Armed Forces Health Surveillance Branch (AFHSB) surveillance case definition.[12] This case definition was applied to the data derived from records routinely maintained in the Defense Medical Surveillance System (DMSS) for health surveillance purposes. An individual was considered a case of hepatitis A if he or she had a notifiable medical event report of a confirmed case of hepatitis A, a single inpatient diagnosis of hepatitis A, or two outpatient encounters not more than 14 days apart with diagnoses of hepatitis A in any diagnostic position. The diagnosis codes were 070.0 and 070.1 (ICD-9) and B15.0 and B15.9 (ICD-10). Each individual was considered an incident case only once during the surveillance period. In addition, cases were excluded if they met criteria for the AFHSB case definition at any time prior to the start of the surveillance period. To remove encounters that were potentially miscoded screening visits, outpatient encounters were excluded if they had a record of hepatitis A vaccine immunization or an immunization exception within 7 days of the incident date. The following CVX codes for vaccine administration were used to identify instances of hepatitis A immunization: 031, 052, 083, 084, 085, and 104. For the calculation of incidence rates, the numbers of cases were divided by the person-time for all members of the surveillance population except for any person-time associated with overseas deployment.

**FIGURE 1.** Incident cases and incidence rates of acute hepatitis A, by gender, active component, U.S. Armed Forces, 2007–2016




[a]Incidence rate per 100,000 population

Source: www.cdc.gov/hepatitis/statistics/2014surveillance/index.htm#tabs-1170596-1

The country of birth of each case was considered the country reported at the time of military accession. Centers for Disease Control and Prevention travel guidelines were used to characterize some countries as "high endemicity" for hepatitis A.[13-15] Immunization records were reviewed to identify previous HAV vaccinations.

## RESULTS

There were 237 incident cases of acute hepatitis A diagnosed during the surveillance period, with an overall incidence rate of 1.88 cases per 100,000 person-years (p-yrs) **(Table)**. Crude overall rates of hepatitis A were highest among service members in the youngest age group (2.49 per 100,000 p-yrs), those in healthcare occupations (2.87 per 100,000 p-yrs), and among Air Force and Navy members (2.21 and 2.18 per 100,000 p-yrs, respectively). Service members of "other" or unknown race/ethnicity and non-Hispanic black service members (2.60 and 2.50 per 100,000 p-yrs, respectively) had higher overall incidence rates of hepatitis A, compared to their non-Hispanic white and Hispanic counterparts **(Table)**.

Annual incidence rates of hepatitis A were relatively stable until 2012 when rates peaked at 2.94 per 100,000. Rates dipped to 1.41 per 100,000 p-yrs in 2015 and then increased to 2.22 per 100,000 p-yrs in 2016 **(Figure 1)**. During the 10-year surveillance period, annual rates among male service members were relatively stable and fluctuated between 1.32 per 100,000 p-yrs and 2.36 per 100,000 p-yrs. Annual rates among females were higher than among males in 5 of the 10 years during the surveillance period (2007–2008 and 2010–2012) and lower in 4 of the years (2009, 2013, 2015–2016). Annual rates were very similar for both sexes in 2014 **(Figure 2)**. There were only 3 years (2007, 2011, and 2012) in which there were more than four cases of hepatitis A in females (namely, 5, 5, and 13 cases, respectively) **(data not shown)**.

Almost 90% of cases (n=211) had their countries of birth documented on routinely available records. Of these cases, most (78.7%) were born in the U.S.; approximately 15.6% were born in countries with high hepatitis A endemicity **(data not shown)**.[6] Of the 237 service members with hepatitis A infections, 27 (11.4%) had no record of prior receipt of the HAV vaccine; 29 (12.2%) had received one dose of vaccine; and 181 (76.4%) had received two or more doses **(Figure 3)**.

**TABLE.** Acute hepatitis A virus infections among active component service members, U.S. Armed Forces, January 2007–2016

| | Total (2007–2016) | | |
|---|---|---|---|
| | No. | Rate[a] | IRR |
| Total | 237 | 1.88 | . |
| Sex | | | |
| Female | 42 | 2.21 | 1.21 |
| Male | 195 | 1.83 | Ref |
| Age group | | | |
| 17–19 | 21 | 2.49 | 1.55 |
| 20–29 | 132 | 1.89 | 1.17 |
| 30–39 | 55 | 1.61 | Ref |
| 40+ | 29 | 2.13 | 1.32 |
| Age group (by sex) | | | |
| *Male* | | | |
| 17–19 | 14 | 2.00 | 1.24 |
| 20–29 | 107 | 1.82 | 1.14 |
| 30–39 | 47 | 1.61 | Ref |
| 40+ | 27 | 2.28 | 1.42 |
| *Female* | | | |
| 17–19 | 7 | 4.94 | 2.99 |
| 20–29 | 25 | 2.27 | 1.37 |
| 30–39 | 8 | 1.65 | Ref |
| 40+ | 2 | 1.15 | 0.69 |
| Race/ethnicity | | | |
| Non-Hispanic white | 128 | 1.68 | 1.15 |
| Non-Hispanic black | 51 | 2.50 | 1.71 |
| Hispanic | 23 | 1.46 | Ref |
| Other/unknown | 35 | 2.60 | 1.78 |
| Service | | | |
| Army | 79 | 1.73 | 0.80 |
| Navy | 69 | 2.18 | Ref |
| Air Force | 68 | 2.21 | 1.02 |
| Marine Corps | 21 | 1.18 | 0.54 |
| Military occupation | | | |
| Health care | 32 | 2.87 | 1.63 |
| Combat-specific | 159 | 1.76 | Ref |
| Other | 46 | 1.90 | 1.08 |
| Recruit status | | | |
| Recruit | 7 | 2.68 | 1.44 |
| Non-recruit | 230 | 1.87 | Ref |
| No. of previous deployments | | | |
| 0 | 158 | 2.21 | Ref |
| 1 | 41 | 1.38 | 0.63 |
| 2 or more | 38 | 1.54 | 0.70 |

[a]Rate per 100,000 person-years
IRR, incidence rate ratio

**FIGURE 2.** Annual incidence rates of hepatitis A infection, by sex, active component, U.S. Armed Forces, 2007–2016

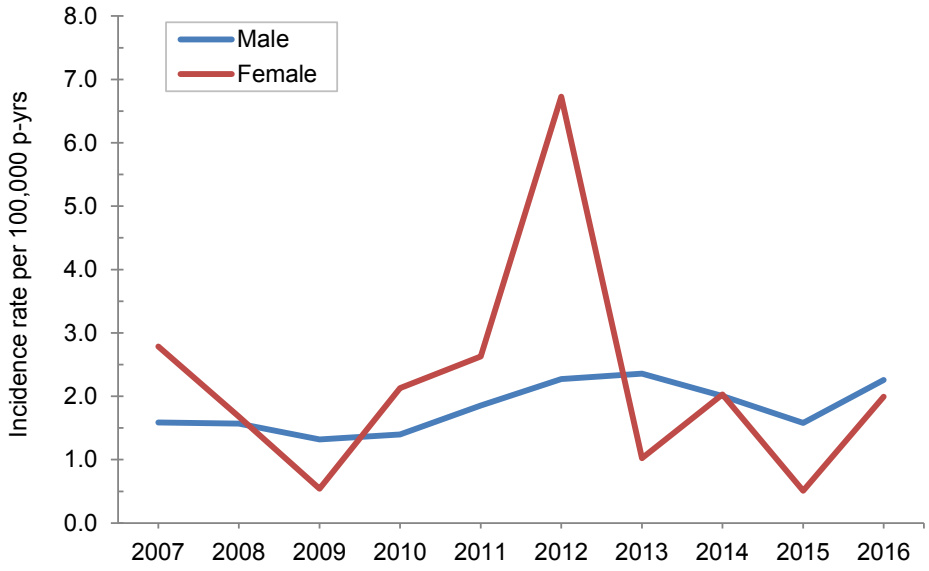
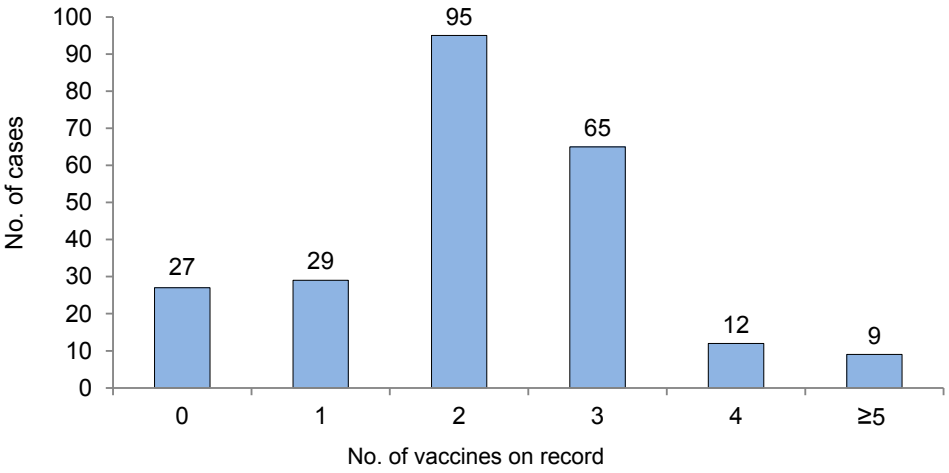



**FIGURE 3.** Number of hepatitis A virus (HAV) acute infections, by number of HAV vaccines on record for each case, active component, U.S. Armed Forces, 2007–2016




## EDITORIAL COMMENT

This report documents relatively low and stable rates of hepatitis A in the active component of the U.S. military over the past 10 years. During that period, the average number of annual cases was about 24, including annual averages of four and 20 cases for females and males, respectively.

Crude annual incidence rates of hepatitis A in the general U.S. population were consistently lower than the incidence rates among active component service members **(Figure 1)**. After 2009, the difference between the two sets of annual rates became more pronounced as rates among active component service members increased. The rates in the general U.S. population decreased to a low of 0.4 per 100,000 population in 2011 and again in 2014. During this same period, the service member rates fluctuated between 1.51 per 100,000 p-yrs in 2015 and 2.94 per 100,000 p-yrs in 2012. However, direct comparisons of rates between U.S. military members and U.S. civilians should be interpreted with caution for several reasons. First, the analysis reported here estimated HAV infection incidence rates by dividing the number of incident HAV infections by the cumulative person-time exposed to risk (non-deployed person-time) while rates in the general U.S. population were estimated as cases per 100,000 population. Second, the general population of the U.S. includes individuals of all ages; in turn, rates in the general (but not the military) population during this period reflect dramatic declines in HAV infection rates among infants and children as well as lower rates among the sizable civilian population aged 40 years or older.[13] The fall in U.S. incidence rates was largely due to the widespread use of the HAV vaccine, particularly among infants, children, and other high-risk populations. The most recent surveillance report on HAV incidence in the U.S. population indicates that the highest incidence rates are among those aged 20–29 years and 30–39 years, the age groups that contain the overwhelming majority of service members.[16] Third, it is noteworthy that the highest rate of hepatitis A among service members during the surveillance period (2.94 per 100.000 p-yrs in 2012) was the highest recorded rate since the year 2000.[17] By comparison, the rate for the U.S. general population in 2000 was approximately 30 per 100,000 population and it was not until 2006 that it fell to below 1.5 cases per 100,000 population.

It should be noted that the annual incidence rates among female service members were markedly higher than rates among male service members during 2010–2012. This finding contrasts with the U.S. civilian population in which male and female rates were similar. From 2000–2011 in the U.S. civilian population, rates of hepatitis A among males and females both declined, and by 2011, the rates in these two groups were similar. In 2014, the incidence rate was 0.4 cases per 100,000 population for males and females.[18] Information available for this analysis cannot explain this observation, but it is conceivable that military service may expose women to greater risks of exposure to HAV and at the same time may also afford readier access to health care

in which the diagnosis can be confirmed. It is also important to note that all of the annual incidence rates for females reported here are based on small numbers of cases.

This summary has certain limitations that should be considered when interpreting the results. For example, as previously mentioned, some subgroup-specific incidence rates are based on small numbers of cases in a single year (e.g., annual rates for 2009 and 2015 among female service members are based on single cases) and fluctuate dramatically over the course of the surveillance period. In such situations, it is difficult to know when changes or differences in rates are meaningful. Because of this, caution must be used and any comparisons interpreted critically.

More than three-quarters of the incident cases included in this analysis had two or more HAV vaccinations on record. The HAV vaccines in current use are highly effective; however, two to four doses are required to achieve maximum protective efficacy. Thus, despite routine and widespread vaccination, because some individuals remain susceptible to infection risk after two or three doses, at any given time at least some service members will be immunologically susceptible to HAV infection. For this reason (and to counter threats from other food, water, and fecal-orally transmitted pathogens), field sanitation and hygiene preventive measures—particularly hand washing after using latrines and before/after handling food—must continue to be emphasized.

Over the past 10 years, numbers and rates of hepatitis A diagnoses among U.S. military members have been consistently low. This finding is particularly noteworthy in light of the U.S. military's engagement in combat operations during much of this period in a hyperendemic region for hepatitis A. The experience reported here is undoubtedly attributable to widespread vaccination in U.S. and civilian populations; as such, the experience serves as a tribute to the U.S. military medical researchers and their civilian collaborators who developed the vaccine.

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# Viral Hepatitis B, Active Component, U.S. Armed Forces, 2007–2016

*Shauna Stahlman, PhD, MPH; Valerie F. Williams, MA, MS; Alexis A. Oetting, MPH*

During 2007–2016, there were 1,258 and 1,259 incident diagnoses of acute and chronic hepatitis B virus (HBV) infection, respectively. The overall incidence rates of diagnoses of acute and chronic hepatitis B were both 10.0 per 100,000 person-years (p-yrs). Overall crude incidence rates of acute hepatitis B were highest among females, Navy members, Asian/Pacific Islander and non-Hispanic black service members, those in healthcare occupations, recruits, and service members with no history of deployment. Overall incidence rates of chronic hepatitis B were highest among service members who were female; in the Navy or the Army; in healthcare occupations; and of non-recruit status. Asian/Pacific Islander service members, those of other/unknown race/ethnicity, and non-Hispanic black service members had overall rates of chronic hepatitis B that were more than 41, 11, and 10 times that of non-Hispanic white service members, respectively. Crude annual incidence rates of acute hepatitis B fluctuated between 7.7 per 100,000 p-yrs and 13.2 per 100,000 p-yrs during the surveillance period. Approximately one of 10 acute cases and close to one of five chronic cases had at least one HBV-related hospitalization. Rates of hospitalized cases of acute hepatitis B decreased over the 10-year period.

Hepatitis B virus (HBV) attacks the liver and can cause both acute and chronic disease (hepatitis B) in affected individuals. HBV is spread by percutaneous and mucous membrane exposures to infectious body fluids such as blood, serum, saliva, and semen.[1] Among adults, high-risk sexual activity (e.g., unprotected sex, multiple partners) is one of the most common routes of transmission of HBV.[2,3] Other high-risk groups among adults include persons who share needles during intravenous drug use, healthcare workers who may be exposed to blood and blood products through their work, and travelers who have not completed their hepatitis B vaccination series before leaving for endemic areas.[4-6]

HBV infection acquired in adulthood often results in symptomatic acute hepatitis followed by clearance of hepatitis B surface antigen in the majority of patients. In a low-prevalence setting, such as the civilian population of the U.S., most persons with acute HBV infection are adults and chronic infection develops in only 1%–5% of the newly infected.[7] Of those who develop chronic HBV infection, most are asymptomatic carriers. Carriers of HBV have no persistent liver inflammation or dysfunction; however, because they are chronically infected with the virus, they are capable of transmitting it to others. Chronic active hepatitis due to HBV can have serious long-term effects, including cirrhosis and hepatocellular carcinoma as well as extrahepatic complications such as membranous glomerulonephritis.[1]

HBV is a militarily relevant infection because it degrades the health and military operational capabilities of those affected and demands significant healthcare resources for its clinical management. In recent years, rates of newly acquired HBV infections in the general U.S. population have declined; the trend is attributable to effective vaccination programs among children and high-risk individuals, general increased awareness and avoidance of risky behaviors, as well as universal precautions in needle use and in healthcare in general.[8,9]

In the U.S. military, potential applicants are not eligible for military service if they demonstrate a current acute or chronic hepatitis B carrier state, clinically apparent hepatitis B within the preceding 6 months, or evidence of liver function impairment.[10] In 2002, the Department of Defense began vaccinating all new recruits against HBV.[11] In 2005, the Army Surgeon General implemented protocols to screen recruits for antibodies to HBV and vaccinate those who were not seroimmune (during initial entry training).[12] Accession screening was revised in 2012 to include HBV laboratory confirmation during the initial enlistment process at Military Entrance Processing Stations and to require that an HBV test be conducted every 25 months thereafter.[13] However, in 2014, because it was determined that there was no medical or force readiness indication for such frequent testing, the Secretary of the Navy issued a temporary deferral from the follow-up HBV testing requirement.[14] Additional screening is in accordance with the U.S. Preventive Task Force Recommendation Statement (which recommends screening for HBV in persons at high risk for infection) and as medically indicated.[14]

This report estimates frequencies, incidence rates, trends, and correlates of risk of acute and chronic HBV infections among active component U.S. military members during 2007–2016.

## METHODS

The surveillance period was 1 January 2007 through 31 December 2016. The surveillance population included all individuals who served in the active components of the Army, Navy, Air Force, or Marine Corps at any time during the surveillance period. The following case definition was applied to the data derived from records routinely maintained in the Defense Medical Surveillance System (DMSS) for health surveillance purposes. An individual was considered a case of hepatitis B if he or she had a confirmed reportable medical event of hepatitis B; a single inpatient diagnosis (in any diagnostic position) of acute or chronic hepatitis B; or two diagnoses (in any diagnostic positions) of acute hepatitis B or chronic hepatitis B during outpatient encounters not more than 90 days apart. The ICD-9 diagnosis codes were 070.20–070.23, 070.30–070.33, and V02.61. The ICD-10 codes were B16, B191, B180, B181, and Z22.51. Each individual was considered an incident case only once during the surveillance period. In addition, cases were excluded if they met criteria for the case definition at any time prior to the start of the surveillance period. Outpatient encounters were excluded if they had a record of hepatitis B vaccine immunization or an immunization exception within 7 days of the incident date, to remove encounters that were potentially miscoded screening visits. The following vaccine administration (CVX) codes were used to identify instances of hepatitis B immunization: 008, 030, 042–045, 051, 102, 104, and 110. For the calculation of incidence rates, the numbers of cases were divided by the person-time for all members of the surveillance population except for any person-time associated with overseas deployment.

The country of birth of each case was considered to be the country reported at the time of accession to military service. CDC travel guidelines were used to characterize some countries as "high endemicity" for hepatitis B.[15] HBV vaccinations of service members were ascertained from records of immunizations while in U.S. military service.

## RESULTS

During the 10-year surveillance period, there were 1,258 and 1,259 incident diagnoses of acute and chronic hepatitis B, respectively. The overall incidence rates of diagnoses of acute and chronic hepatitis B were both 10.0 per 100,000 person-years (p-yrs) **(Table)**.

The overall crude incidence rate of acute hepatitis B was higher among female than male service members (13.0 per 100,000 p-yrs and 9.5 per 100,000

**TABLE.** Acute and chronic HBV among active component service members, U.S. Armed Forces, 2007–2016

| | Acute HBV | | | Chronic HBV | | |
|---|---|---|---|---|---|---|
| | No. | Rate[a] | IRR | No. | Rate[a] | IRR |
| Total | 1,258 | 10.0 | . | 1,259 | 10.0 | . |
| Sex | | | | | | |
| Female | 248 | 13.0 | 1.38 | 302 | 15.9 | 1.77 |
| Male | 1,010 | 9.5 | Ref | 957 | 9.0 | Ref |
| Service | | | | | | |
| Army | 361 | 7.9 | 0.46 | 539 | 11.8 | 0.96 |
| Navy | 544 | 17.2 | Ref | 390 | 12.3 | Ref |
| Air Force | 223 | 7.3 | 0.42 | 235 | 7.6 | 0.62 |
| Marine Corps | 130 | 7.3 | 0.42 | 95 | 5.3 | 0.43 |
| Age group | | | | | | |
| 17–19 | 83 | 9.8 | Ref | 50 | 5.9 | Ref |
| 20–29 | 622 | 8.9 | 0.91 | 545 | 7.8 | 1.32 |
| 30–39 | 389 | 11.4 | 1.16 | 455 | 13.3 | 2.25 |
| 40+ | 164 | 12.1 | 1.22 | 209 | 15.4 | 2.59 |
| Age group (by sex) | | | | | | |
| *Female* | | | | | | |
| 17–19 | 25 | 17.65 | 1.50 | 15 | 10.59 | 0.56 |
| 20–29 | 149 | 13.51 | 1.15 | 171 | 15.51 | 0.83 |
| 30–39 | 57 | 11.77 | Ref | 91 | 18.78 | Ref |
| 40+ | 17 | 9.75 | 0.83 | 25 | 14.34 | 0.76 |
| *Male* | | | | | | |
| 17–19 | 58 | 8.27 | 0.73 | 35 | 4.99 | 0.40 |
| 20–29 | 473 | 8.06 | 0.71 | 374 | 6.37 | 0.51 |
| 30–39 | 332 | 11.35 | Ref | 364 | 12.45 | Ref |
| 40+ | 147 | 12.40 | 1.09 | 184 | 15.52 | 1.25 |
| Race/ethnicity | | | | | | |
| Non-Hispanic white | 248 | 3.3 | Ref | 160 | 2.1 | Ref |
| Non-Hispanic black | 451 | 22.2 | 6.82 | 427 | 21.0 | 10.00 |
| Hispanic | 82 | 5.2 | 1.61 | 51 | 3.2 | 1.55 |
| Asian/Pacific Islander | 309 | 65.5 | 20.14 | 414.0 | 87.7 | 41.80 |
| Other/unknown | 168 | 19.3 | 5.93 | 207 | 23.8 | 11.33 |
| Military occupation | | | | | | |
| Health care | 170 | 15.3 | 1.80 | 236 | 21.2 | 2.37 |
| Combat-specific | 768 | 8.5 | Ref | 807 | 8.9 | Ref |
| Other | 320 | 13.2 | 1.56 | 216 | 8.9 | 1.00 |
| Recruit status | | | | | | |
| Recruit | 245 | 93.83 | 11.41 | 21 | 8.04 | 0.80 |
| Non-recruit | 1,013 | 8.22 | Ref | 1,238 | 10.05 | Ref |
| No. of previous deployments | | | | | | |
| 0 | 855 | 11.95 | Ref | 733 | 10.24 | Ref |
| 1 | 242 | 8.17 | 0.68 | 309 | 10.43 | 1.02 |
| 2 or more | 161 | 6.55 | 0.55 | 217 | 8.82 | 0.86 |

[a]Rate per 100,000 person-years
IRR, incidence rate ratio

p-yrs, respectively) **(Table)**. The overall rate of acute hepatitis B infection among Navy members was more than two times that of rates among members of the other Services. Overall incidence rates of acute hepatitis B generally increased with age. However, stratification by sex shows that the overall rate of acute hepatitis B infection among female service members decreased with age while it increased with age among male service members aged 20 years or older **(Figure 1)**. Asian/Pacific Islander and non-Hispanic black service members had overall rates of acute hepatitis B diagnoses that were more than 20 and 6 times that of non-Hispanic white service members, respectively **(Table)**. Relative to their respective counterparts, the highest overall incidence rates of acute hepatitis B infection affected those in healthcare occupations, recruits, and service members with no history of deployment.

During the surveillance period, overall incidence rates of chronic hepatitis B were highest among service members who were female; in the Navy or the Army; in healthcare occupations; and of non-recruit status **(Table)**. As with acute hepatitis B, overall rates of diagnoses of chronic infections increased with age. However, stratification by sex shows that the increase in the overall rate of chronic hepatitis B infection among females was only apparent for the first three age groups. The overall rate of chronic hepatitis B among females in the oldest group (40+ years old) was lower than that among females aged 20–29 years. Among males, the rate of chronic hepatitis B increased with age **(Figure 1)**. Asian/Pacific Islander service members, those of other/unknown race/ethnicity, and non-Hispanic black service members had overall rates of chronic hepatitis B that were more than 41, 11, and 10 times that of non-Hispanic white service members, respectively.

Crude annual incidence rates of diagnoses of acute hepatitis B fluctuated between 7.7 per 100,000 p-yrs and 13.2 per 100,000 p-yrs during the surveillance period **(Figure 2)**. Annual incidence rates of acute hepatitis B were consistently higher among Asian/Pacific Islander service members than their counterparts in other race/ethnicity groups **(Figure 3)**. Rates among Asian/Pacific Islanders decreased by 35.6%

**FIGURE 1.** Incidence rates of acute and chronic hepatitis B, by sex, by age group, active component, U.S. Armed Forces, 2007–2016

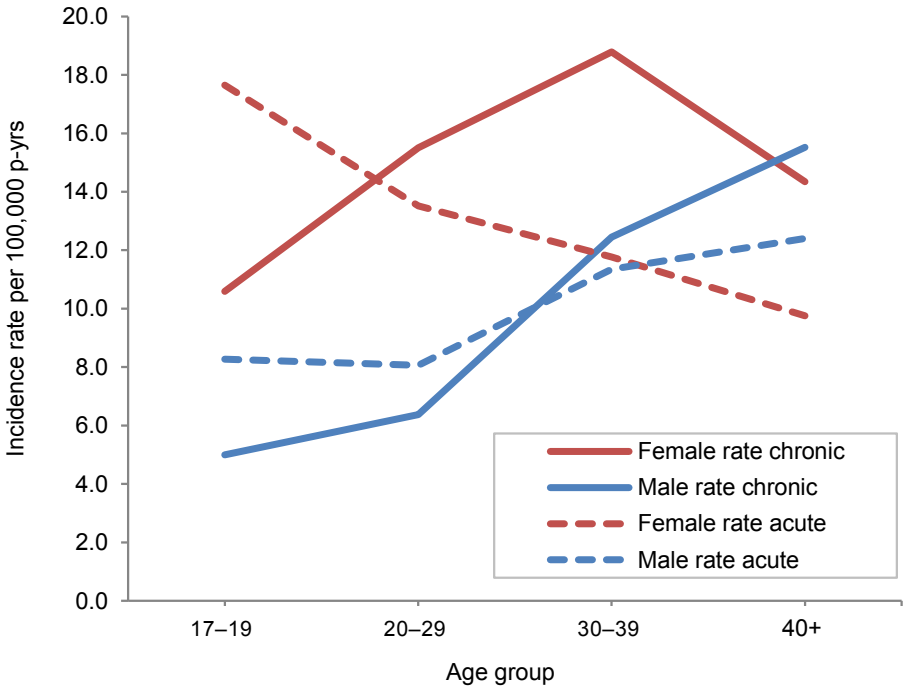
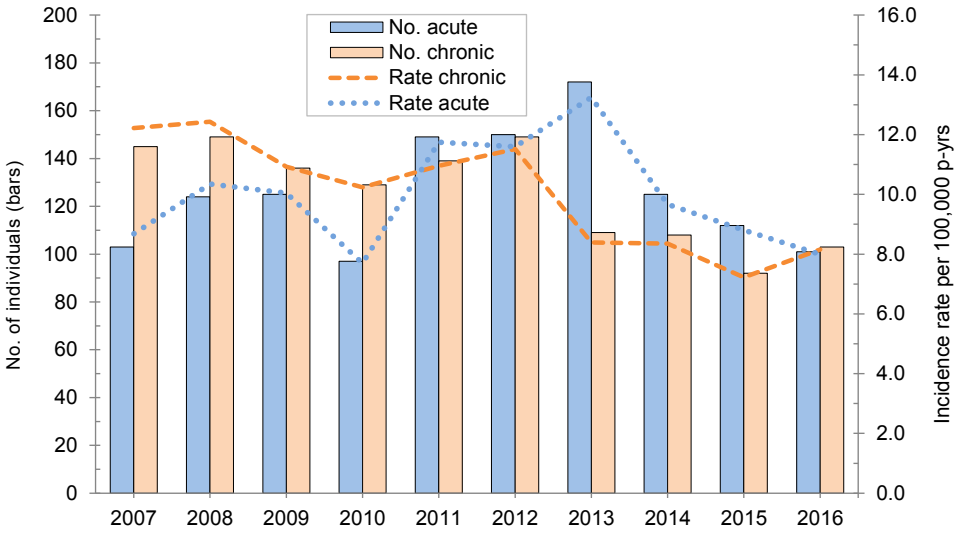



**FIGURE 2.** Incident cases and incidence rates of acute and chronic hepatitis B, active component, U.S. Armed Forces, 2007–2016




during the surveillance period. Annual incidence rates of acute hepatitis B also varied by service and recruit status. During 2008–2016, annual rates of acute hepatitis B among Navy members were consistently and markedly higher than rates among members of the other services **(Figure 4)**. Among recruits, annual incidence rates of acute hepatitis B increased dramatically between 2010 and 2013 (14.6 per 100,000 p-yrs and 231.4 per 100,000 p-yrs, respectively) and then dropped to 136.5 per 100,000 p-yrs in 2014 **(Figure 5)**.

Crude annual rates of diagnoses of chronic hepatitis B decreased slightly during the 10-year period. The highest and

**FIGURE 3.** Incidence rates of acute hepatitis B, by race/ethnicity, active component, U.S. Armed Forces, 2007–2016

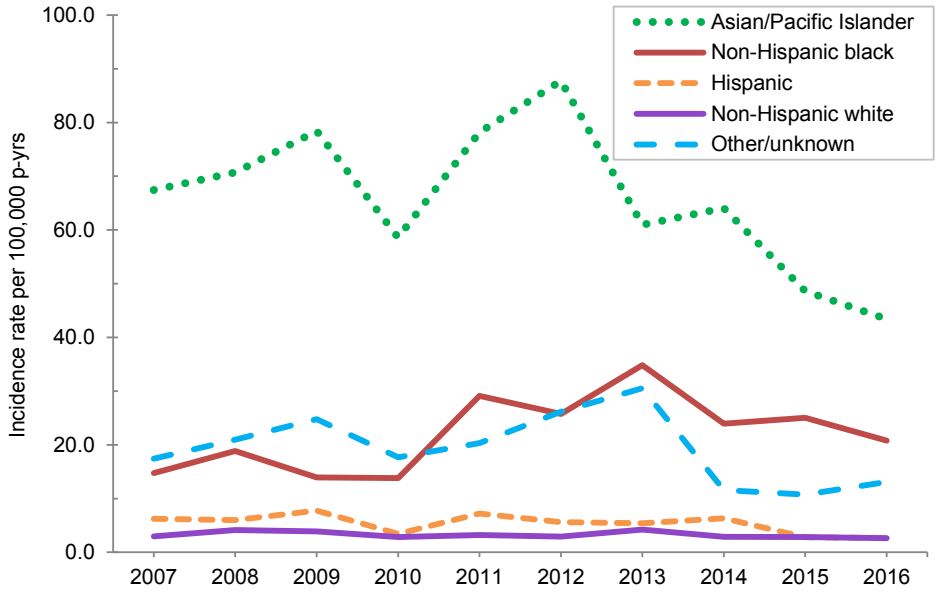
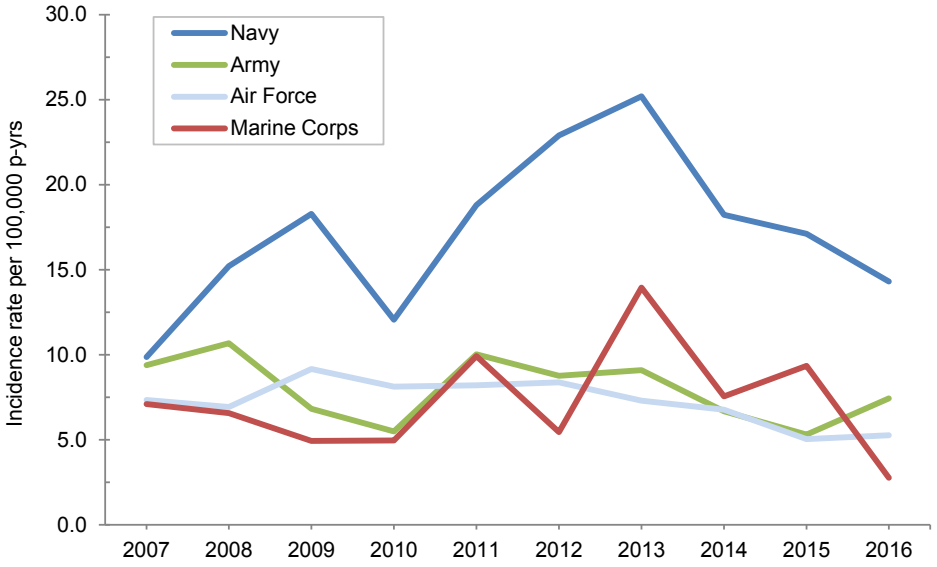



**FIGURE 4.** Incidence rates of acute hepatitis B by service, active component, U.S. Armed Forces, 2007–2016




lowest annual rates were in 2008 (12.4 per 100,000 p-yrs) and 2015 (7.2 per 100,000 p-yrs), respectively **(Figure 2)**. There were more chronic hepatitis B cases than acute cases in the first 4 years of the surveillance period (2007–2010). During 2011–2015, there were more acute cases of hepatitis B than chronic cases. The difference in numbers of acute versus chronic cases was most pronounced in 2013. By 2016, the numbers and rates of the two types of infection had converged **(Figure 2)**. As with acute hepatitis B, annual rates of chronic infection among Asian/Pacific Islander service members were consistently higher than the rates in the other race/ethnicity subgroups **(Figure 6)**. During the surveillance period, annual rates among Asian/Pacific Islanders decreased from 124.0 per 100,000 p-yrs in 2007 to 49.3 per 100,000 p-yrs in 2016 (60.2% decrease). The biggest drop in annual rates of chronic hepatitis B among service members in this race/ethnicity subgroup occurred after 2012.

Approximately three-eighths (37.3%) of all service members diagnosed with acute hepatitis B had subsequent diagnoses of chronic infection; of these cases, 69.7% were diagnosed with chronic hepatitis B within 6 months, and 79.1% within 1 year after first diagnosis with acute infection **(data not shown)**.

During the surveillance period, approximately one of 10 acute cases (n=124; 9.9%) and close to one of five chronic cases (n=229; 18.2%) had at least one HBV-related hospitalization (i.e., HBV infection was included as a discharge diagnosis). Rates of hospitalized cases of acute hepatitis B decreased over the 10-year period (change in acute rates, 2007–2016: -53.1%). Rates of hospitalized cases of chronic hepatitis B fluctuated between 1.3 per 100,000 p-yrs and 2.5 per 100,000 p-yrs during the surveillance period **(data not shown)**.

The vast majority (n=1,829; 89.3%) of all cases (acute and chronic) had their countries of birth documented on routinely available records **(data not shown)**. Of cases with known birth countries, three-eighths (38.4%) were born in the U.S.; more than one-quarter (29.6%) were born in Asia or the Pacific Islands; 20.2% were born in Africa; 5.9% were born in the Caribbean region; and 4.4% were born in other endemic areas (e.g., India, Romania). Service members from the Philippines accounted for more than three-quarters (n=204; 79.4%) of the cases born in the Pacific Islands and 11.2% of the total cases with documented birth countries **(data not shown)**.

Of the 2,048 service members who were diagnosed with HBV infections during the surveillance period, 606 (29.6%) had no HBV immunizations on record prior to their infection diagnoses. Of the remainder, 356 (17.4% of the total) had one or two immunization doses and 1,086 (53.0% of the total) had three or more immunization doses on record prior to their infection diagnoses **(Figure 7)**.

**FIGURE 5.** Incidence rates of acute hepatitis B by recruit status, active component, U.S. Armed Forces, 2007–2016

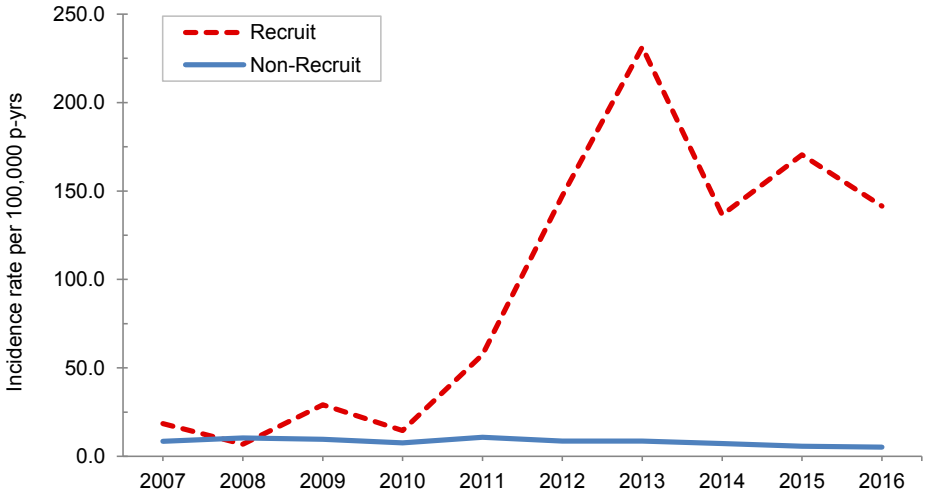
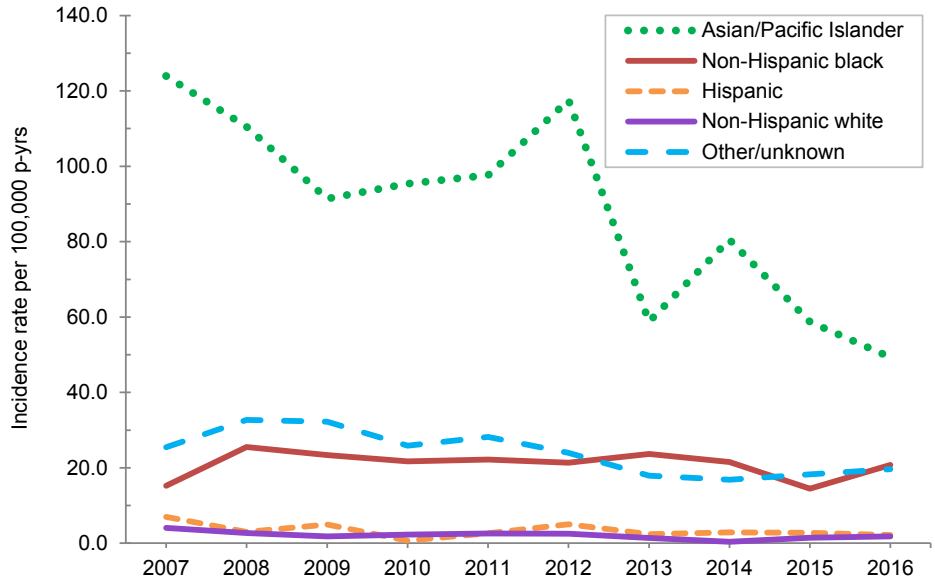



**FIGURE 6.** Incidence rates of chronic hepatitis B, by race/ethnicity, active component, U.S. Armed Forces, 2007–2016




## EDITORIAL COMMENT

During the 10-year surveillance period, the total number of cases and the overall incidence rates of acute and chronic hepatitis B were very similar. Annual rates of chronic hepatitis B decreased slightly over the course of the surveillance period. During the first 4 years of the surveillance period (2007–2010), there were more chronic hepatitis B cases than acute cases. During 2011–2015, there were more acute cases of hepatitis B than chronic cases. By 2016, the numbers and rates of the two types of infection had converged.

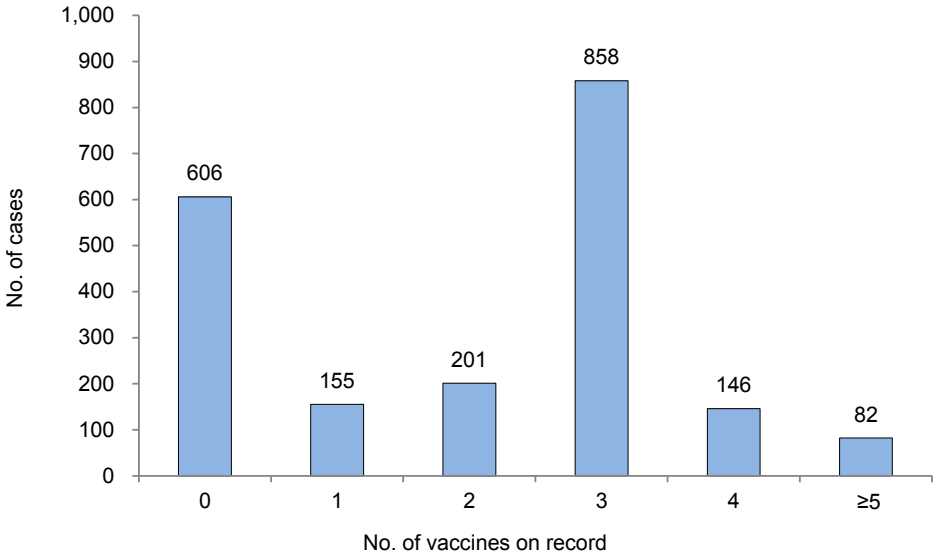
In the past 10 years, there were particularly high crude annual incidence rates of acute and chronic hepatitis B among Asian/Pacific Islander service members. However, rates of both acute and chronic hepatitis B among service members in this race/ethnicity subgroup decreased by 35.6% and 60.2%, respectively. The biggest drops in annual rates of both acute and chronic hepatitis B occurred after 2012. These patterns may be attributable, at least in part, to the 2012 revision to accession screening to include laboratory testing for HBV infection or immunity. The dramatic increase in annual incidence rates of acute hepatitis B among recruits during 2010–2013 also may reflect, to some degree, the implementation of this change in the accession screening process.

This report is subject to several limitations. First, because cases of chronic HBV infection are generally asymptomatic (and less likely to be identified and reported), the numbers and rates of chronic hepatitis B infections reported here are likely underestimates of the true burden of disease in this population. Acute cases may have been overestimated if an individual had hepatitis B infection prior to entering the military but later had documentation of a reportable medical event or a misclassified diagnosis for acute infection during the surveillance period. Acute cases would also be overestimated if any prior hepatitis infection was not documented in earlier medical encounters in the form of a single hospitalization, reportable medical event, or two outpatient medical encounters within 90 days of each other.

Higher rates of hepatitis B diagnoses among female compared to male service members reflects, at least in part, more complete ascertainment of asymptomatic HBV infections. For example, the U.S. Preventive Services Task Force recommends screening for HBV during the first prenatal visits of all pregnant women. Also, HBV screening is recommended for the sexual and household contacts of HBV infected persons.

This analysis produced several results that were unexpected and which will require further analyses to clarify the reasons for the findings. First, rates of acute or chronic hepatitis B diagnoses were strikingly higher among members of the Navy, service members in healthcare occupations, and recruit trainees. Second, the vast majority of service members who received diagnoses of acute or chronic hepatitis B infection had apparently received HBV

**FIGURE 7.** Number of cases of hepatitis B by number of vaccines on record, active component, U.S. Armed Forces, 2007–2016




vaccine prior to their first diagnosis of HBV infection. Future studies to clarify the significance of these findings should examine the testing methods used during accession screening for pre-existing HBV infection, the accuracy of records documenting the administration of HBV vaccine, and the role of birthplace in predisposing to chronic HBV infection acquired in infancy or childhood. A pertinent finding of this study was that less than 40% of individuals diagnosed with hepatitis B infection and with documented birth countries had been born in the U.S.

Finally, it may not be surprising that rates of hepatitis B diagnoses are higher among military healthcare workers than other service members. Many healthcare workers are exposed to potentially infectious blood and other body fluids in the course of their duties (e.g., battlefield trauma care, surgical and invasive diagnostic procedures, phlebotomies, drug injections, wound care). Because of the inherent occupational risks, health care workers may be closely monitored for infections with bloodborne pathogens; in turn, asymptomatic HBV infections (e.g., chronic HBV carriers) may be more completely detected among healthcare workers than other service members. On the other hand, workers in the medical environment were the first occupational group to embrace the protections offered by HBV vaccine in the mid-1990s, so it would be surprising if individuals entering healthcare careers were not persuaded or required to be vaccinated. These findings warrant further exploration.

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# Viral Hepatitis C, U.S. Military Service Members and Beneficiaries, 2008–2016

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Hepatitis C virus (HCV) infection remains an important concern for the Military Health System (MHS). This report updates numbers and incidence rates of HCV infection of U.S. military service members and MHS beneficiaries, incorporating a surveillance period before and after 2012 screening policy changes for military members. From 2008 to 2016, there were 342 and 1,491 incident cases of acute and chronic hepatitis C, respectively, among active component members of the U.S. Armed Forces; crude overall incidence rates during the period were 2.8 (acute) and 12.2 (chronic) cases per 100,000 person-years. Annual incidence rates of chronic hepatitis C decreased over the surveillance period; however, rates of acute hepatitis C remained steady. There were 141 acute and 587 chronic incident cases among reserve/guard service members, with annual counts of both acute and chronic cases decreasing over the surveillance period. In addition, there were 2,541 acute and 21,418 chronic cases among non-service member beneficiaries, with annual counts of acute and chronic cases also decreasing steadily over the surveillance period. Given recent pharmaceutical advances in treatment, screening and linkage to care are critical to improving health outcomes for those with HCV infection.

The hepatitis C virus (HCV) is the most common etiology of both acute and chronic hepatitis globally. Worldwide, more than 185 million persons are infected with HCV,[1] and persistent (chronic) HCV infection can result in liver cirrhosis and hepatocellular carcinoma.[2] In the U.S., it has been estimated that nearly 4 million persons possess HCV antibodies, and that almost 2.7 million of these individuals are chronically infected.[3] It is noteworthy that there are approximately 30,000 new acute HCV infections each year in the U.S. with up to an estimated 10,000 deaths.[3,4] Among those who are newly infected, the majority of cases (approximately 60%) involve intravenous drug users; some (approximately 20%) are acquired through sexual contact; and, a small proportion (approximately 10%) are due to other causes such as occupational or perinatal exposures.[3] Recent U.S. national surveillance data indicate that the number of acute HCV cases increased each year from 2009–2013, and that the prevalence remains high due to underlying chronic HCV infections (75%–85%).[5] In 2013, the highest HCV-related mortality rates were among males, those aged 55–64 years, and American Indians/Alaska Natives.[5,6] Because chronic HCV infections are commonly asymptomatic, persons infected may not be cognizant of the diagnosis until progression to advanced liver disease, a main contributor to mortality. In August 2012 and June 2013, both the Centers for Disease Control and Prevention (CDC) and the U.S. Preventive Services Task Force, respectively, recommended a one-time HCV screening among those born between 1945 and 1965.[7-9]

In the U.S. military, HCV infection is an important public health concern because emergency battlefield blood supply and operational capabilities may be compromised. Furthermore, due to the long-term, adverse health outcomes of chronic HCV infection, significant morbidity and the associated treatment costs could burden the military healthcare system.[10] An earlier *MSMR* article on HCV infection among active component service members (2000–2010) reported that approximately one-half (51%) of all service members with a diagnosis of acute HCV had a subsequent diagnosis of chronic HCV (76% progressed within 6 months; 85% within 1 year; and, 94% within 2 years).[11] Although there was a decline in the annual incidence rates of acute HCV during 2000–2010, crude overall incidence rates were higher among females, Army members, and those in healthcare occupations.[11]

Before entry into military service, accession applicants are required to reveal medical history, including HCV infection. Individuals are considered medically ineligible if they demonstrate a current acute or chronic hepatitis carrier state, clinically apparent hepatitis within the preceding 6 months, or evidence of liver function impairment.[12] Despite these accession medical standards, applicants are not formally screened by laboratory testing for HCV infection; thus, asymptomatic HCV-infected individuals may potentially enter military service. In response, the U.S. Navy and Marine Corps revised their service-specific accession screening procedures (dated 13 August 2012) to include laboratory testing for HCV infection during the initial enlistment process at Military Entrance Processing Stations.[13] A more recent study supports the value of accession applicant screening for HCV infection by estimating resultant net cost savings and a decrease in the burden of disease within the U.S. military.[10]

The main aim of this study is to report updated numbers and incidence rates of HCV infection (acute and chronic) among

members of the U.S. military by demographic and military characteristics, with a surveillance period including periods before and after the August 2012 screening policy change. This study also summarizes the numbers and demographic characteristics of non-service member beneficiaries who were diagnosed with HCV (acute and chronic) during the surveillance period.

## METHODS

The surveillance period was 1 January 2008 through 31 December 2016. The military surveillance population included all individuals who served in the active or reserve components of the Army, Navy, Air Force, or Marine Corps at any time during the surveillance period. The non-military surveillance population included non-service member beneficiaries (i.e., spouses, children, parents, retirees) of the Military Health System (MHS) who accessed care through either a military medical facility/provider or a civilian facility/provider (if paid for by the MHS).

Potential cases were identified by searching for diagnoses of acute hepatitis C (ICD-9: 070.41, 070.51; ICD-10: B17.10, B17.11) and chronic hepatitis C (ICD-9: 070.44, 070.54, 070.70, 070.71, V02.62; ICD-10: B18.2, B19.20, B19.21, Z22.52) in records of medical encounters for members of each of the two surveillance populations in U.S. military and civilian (purchased care) medical facilities and in reports of notifiable medical events. Cases were also identified from medical encounters of service members deployed to Southwest Asia/Middle East that are documented in the Theater Medical Data Store (TMDS). For surveillance purposes, a case of acute or chronic HCV infection was defined by a single hospitalization with a relevant diagnosis in any diagnostic position, two outpatient or in-theater medical encounters within 90 days with relevant diagnoses in any diagnostic position, or a report of a notifiable medical event that specified a confirmed diagnosis of hepatitis C.

The date of the incident diagnosis of each case was the date of the earliest reportable medical event, inpatient encounter, outpatient encounter, or in-theater encounter that contributed to the definition of the case. Each individual could be an incident case of acute hepatitis C and chronic hepatitis C only once during the surveillance period. In addition, individuals who were ascertained as acute cases were considered incident chronic cases after a single subsequent outpatient diagnosis of chronic hepatitis C. If diagnoses of acute and chronic hepatitis C occurred on the same day, only the chronic hepatitis C diagnosis was maintained for analysis. Individuals were not considered at risk of acute hepatitis C after any diagnosis of chronic hepatitis C.

For members of the active component, incidence rates were calculated per 100,000 person-years (p-yrs) of service. For the members of the reserve component, incidence rates were not calculated because start and end dates of active duty service periods (and corresponding TRICARE eligibility) were not available. Similarly, rates for non-service member beneficiaries were not calculated because their time periods of TRICARE eligibility were not available.

## RESULTS

### Active component

During the 9-year surveillance period, there were 342 incident diagnoses of acute and 1,491 incident diagnoses of chronic hepatitis C among active component service members **(Table 1)**. The overall crude incidence rates of acute and chronic hepatitis C diagnoses were 2.8 and 12.2 per 100,000 p-yrs, respectively. In each year of the surveillance period, there were more diagnoses and higher rates of chronic than acute hepatitis C **(Figure 1)**.

#### *Acute hepatitis C*

Subgroup-specific overall incidence rates of acute hepatitis C were highest among service members aged 19 years or younger, Navy or Army members, and those with 2 years or less in service **(Table 1)**. The crude overall incidence rate among enlisted service members was four times that of officers (3.2 incident diagnoses per 100,000 p-yrs and 0.8 incident cases per 100,000 p-yrs, respectively). Service members who had never been deployed had the highest crude overall rate compared to those with one or two or more deployments. In terms of birth cohort, the highest overall incidence rate of acute hepatitis C was observed among service members born before 1965 compared to those born between 1965 and 1980 or those born after 1980 **(Table 1)**.

Crude annual incidence rates of acute hepatitis C diagnoses peaked in 2013 at 4.0 incident diagnoses per 100,000 p-yrs but otherwise remained relatively stable **(Figure 1)**. During the period from 2012 to 2016, non-Hispanic white service members and those of other race/ethnicity had the highest annual incidence rates (range: 2.3–4.7 incident cases per 1,000 p-yrs for non-Hispanic white; range: 2.8–6.1 incident cases per 1,000 p-yrs for other). Service members with the least time in service (0–2 years) had the highest annual incidence rates of acute hepatitis C in every year of the surveillance period (range: 3.4–8.2 incident cases per 1,000 p-yrs). Enlisted service members had the highest annual incidence rates in every year of the surveillance period (range: 2.1–4.6 incident cases per 1,000 p-yrs). Annual incidence rates among Marine Corps members increased slightly over the course of the surveillance period **(Figure 2)** and rates among members of the Air Force decreased by 86.2%. Annual rates among service members in the Army showed no pronounced pattern of change; rates fluctuated between 1.7 incident diagnoses per 100,000 p-yrs and 4.9 incident diagnoses per 100,000 p-yrs. Between 2010 and 2016, annual rates among service members in the Navy increased considerably (0.62 incident diagnoses per 100,000 p-yrs and 4.97 incident diagnoses per 100,000 p-yrs, respectively). After the introduction of the Navy screening process for new accessions in late 2012, annual incidence rates of diagnoses of acute HCV infection in 2013–2016 were the highest of the entire surveillance period.

**TABLE 1.** Acute and chronic hepatitis C, active component, U.S. Armed Forces, 2008–2016

| | Acute hepatitis C | | Chronic hepatitis C | |
|---|---|---|---|---|
| | Total 2008–2016 | | Total 2008–2016 | |
| | No. | Rate[a] | No. | Rate[a] |
| Total | 342 | 2.8 | 1,491 | 12.2 |
| Sex | | | | |
| Female | 45 | 2.5 | 237 | 13.1 |
| Male | 297 | 2.8 | 1,254 | 12.0 |
| Service | | | | |
| Army | 156 | 3.3 | 857 | 18.1 |
| Navy | 98 | 3.4 | 308 | 10.7 |
| Air Force | 59 | 2.0 | 193 | 6.7 |
| Marine Corps | 29 | 1.7 | 133 | 7.6 |
| Age group | | | | |
| <20 | 35 | 4.5 | 77 | 10.0 |
| 20–29 | 214 | 3.1 | 805 | 11.7 |
| 30–39 | 54 | 1.6 | 323 | 9.7 |
| 40+ | 39 | 3.0 | 286 | 22.0 |
| Race/ethnicity | | | | |
| Non-Hispanic white | 227 | 3.1 | 959 | 12.9 |
| Non-Hispanic black | 40 | 2.0 | 219 | 11.1 |
| Hispanic | 31 | 2.0 | 152 | 9.8 |
| Other/unknown | 44 | 3.4 | 161 | 12.5 |
| Military occupation | | | | |
| Health care | 25 | 2.4 | 139 | 13.1 |
| Non-health care | 317 | 2.8 | 1,352 | 12.1 |
| Time in service (years) | | | | |
| 0–2 | 161 | 5.7 | 465 | 16.4 |
| 2.1–4.0 | 61 | 2.6 | 282 | 11.9 |
| 4.1–8.0 | 50 | 2.0 | 259 | 10.1 |
| 8.1+ | 70 | 1.6 | 485 | 10.7 |
| Rank | | | | |
| Enlisted | 325 | 3.2 | 1,368 | 13.4 |
| Officer | 17 | 0.8 | 123 | 5.9 |
| No. of deployments | | | | |
| 0 | 221 | 3.6 | 784 | 12.6 |
| 1 | 66 | 2.2 | 403 | 13.1 |
| 2 or more | 55 | 1.9 | 304 | 10.2 |
| Birth cohort year | | | | |
| After 1980 | 258 | 3.2 | 921 | 11.2 |
| 1965–1980 | 71 | 1.9 | 424 | 11.3 |
| Before 1965 | 13 | 4.5 | 146 | 49.8 |

[a]Rate per 100,000 person-years

*Chronic hepatitis C*

During the 9-year period, subgroup-specific overall incidence rates of chronic hepatitis C were highest among service members aged 40 years or older, Army or Navy members, and those with less than 2 years in service **(Table 1)**. The crude overall incidence rate among enlisted service members was more than two times that of officers (13.4 incident diagnoses per 100,000 p-yrs and 5.9 incident cases per 100,000 p-yrs, respectively). Service members who had been deployed two or more times had the lowest crude overall rate compared to those who had never been deployed or those with one deployment. The overall incidence rate of chronic hepatitis C among service members born before 1965 was more than four times that of those born between 1965 and 1980 or those born after 1980 **(Table 1)**.

Crude annual incidence rates of chronic hepatitis C diagnoses decreased 57.4% over the course of the surveillance period from 17.6 incident diagnoses per 100,000 p-yrs in 2008 to 7.5 incident diagnoses per 100,000 p-yrs in 2016. During the surveillance period, annual incidence rates of chronic hepatitis C decreased for all age groups. The most pronounced decline was apparent among service members aged 40 years or older, whose rate dropped from 41.7 to 13.6 incident diagnoses per 100,000 p-yrs from 2008 to 2016. Annual incidence rates decreased in all service branches, with the most pronounced decrease among members of the Army **(Figure 3)**.

Most (92%) service members diagnosed as acute hepatitis C cases were subsequently diagnosed with chronic hepatitis C during the surveillance period. The median time between acute and chronic diagnoses was 23 days and 94% of cases were diagnosed within 6 months **(data not shown)**.

## Reserve/guard component

During the surveillance period, there were 141 incident diagnoses of acute and 587 incident diagnoses of chronic hepatitis C among reserve/guard component members **(Table 2)**. Annual numbers of acute diagnoses of hepatitis C decreased slightly among members of the reserve/guard component during this period **(Figure 4)**. Annual numbers of incident diagnoses of chronic hepatitis C decreased by 65.3% among reserve/guard component members during the 9-year period.

## Beneficiaries of the MHS

There were 2,541 incident diagnoses of acute and 21,418 incident diagnoses of chronic hepatitis C among non-military beneficiaries of the MHS during the surveillance period **(Table 2)**. Most incident diagnoses of both acute and chronic hepatitis C were among those aged 40 years or older, other race/ethnicity groups, and among those born before 1965. From 2008 to 2016, annual numbers of incident diagnoses of both acute (76.9%) and chronic (21.3%) hepatitis C decreased among MHS beneficiaries **(Figure 5)**.

**FIGURE 1.** Annual number of incident cases and annual incidence rates of acute and chronic hepatitis C, active component, U.S. Armed Forces, 2008–2016

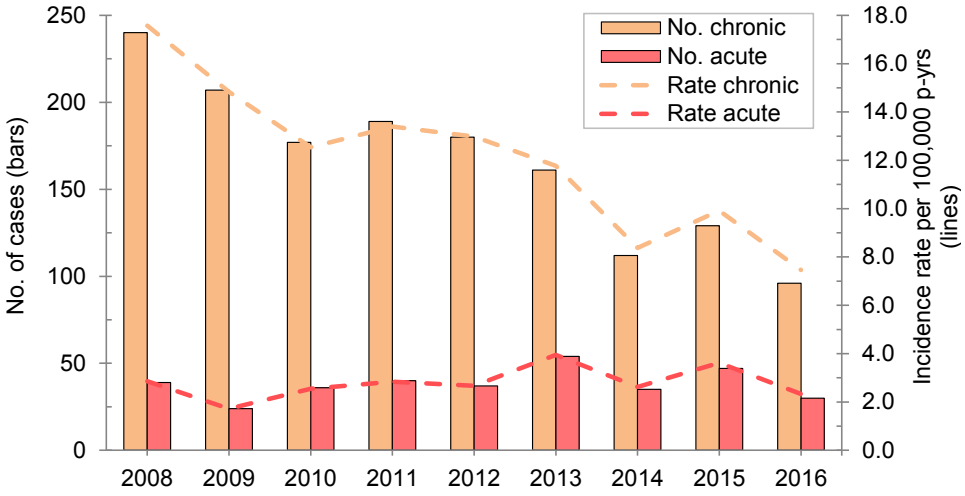



**FIGURE 2.** Annual incidence rates of acute hepatitis C, by service, active component, U.S. Armed Forces, 2008–2016

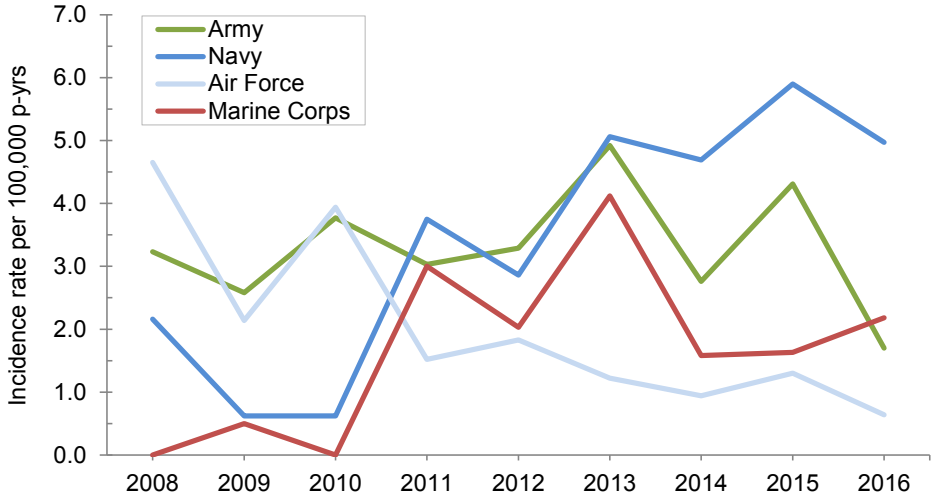
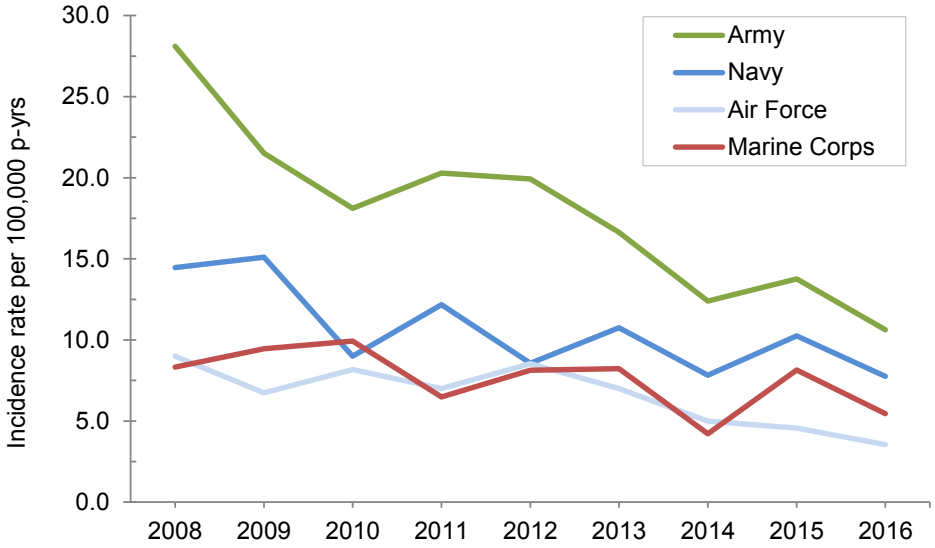



**FIGURE 3.** Annual incidence rates of chronic hepatitis C, by service, active component, U.S. Armed Forces, 2008–2016




## EDITORIAL COMMENT

This report documents a steady decline in crude annual rates of diagnoses of chronic hepatitis C infection and relatively stable rates of diagnoses of acute hepatitis C infection among active component U.S. service members from 2008 to 2016. During this period, numbers of diagnoses of acute and chronic hepatitis C infections among reserve component members and non-service member beneficiaries decreased. Although crude annual incidence rates of HCV infection were declining among service members, the U.S. national HCV incidence rate appears to be on the rise, according the latest 2014 CDC report.[14] Annual incidence rates of acute HCV in the U.S. civilian population remained stable at 0.3 reported cases per 100,000 persons from 2008 to 2010, after which rates increased to 0.7 cases per 100,000 persons in 2013 and 2014.[14]

Annual incidence rates of acute hepatitis C infections increased from 2012 to 2013 among active component members in all services except the Air Force. Annual rates among Marine Corps and Army members then decreased considerably from 2013 to 2014. The trend of continued increase in acute infection rates after 2013 among service members in the Navy runs counter to the expectation that the implementation of the revised accession screening policy would reduce rates because it would screen out individuals with acute hepatitis C before they enter service. However, evaluation of trends in rates is limited by the small number of annual acute hepatitis C cases among the service branches. Further evaluation of trends over time and better characterization of at-risk groups is needed to determine whether the screening policy had an impact on preventive or clinical outcomes.

In this analysis, the majority of active component service members (92%) who were diagnosed as acute cases were subsequently diagnosed as chronic hepatitis C cases, and most were diagnosed within less than 6 months. This proportion of acute infections that were documented as having become chronic is higher than that estimated in the general U.S. population (75%–85%) and considerably higher than the 51% documented in the 2011 *MSMR* for the period from 2000 to 2010.[11] Potentially this observation could be due to a high proportion of actual chronic cases being initially misclassified as acute

**TABLE 2.** Acute and chronic hepatitis C among reserve/guard component service members and beneficiaries of the U.S. Armed Forces, 2008–2016

| | Reserve | | Beneficiaries | |
|---|---|---|---|---|
| | Total 2008–2016 | | Total 2008–2016 | |
| | Acute | Chronic | Acute | Chronic |
| Total | 141 | 587 | 2,541 | 21,418 |
| Sex | | | | |
| Female | 25 | 109 | 1,415 | 10,570 |
| Male | 116 | 478 | 1,126 | 10,848 |
| Service | | | | |
| Army | 100 | 456 | - | - |
| Navy | 13 | 48 | - | - |
| Air Force | 20 | 61 | - | - |
| Marine Corps | 8 | 22 | - | - |
| Age group | | | | |
| <20 | 8 | 16 | 112 | 441 |
| 20–29 | 32 | 138 | 282 | 1,712 |
| 30–39 | 28 | 110 | 187 | 1,252 |
| 40+ | 73 | 323 | 1,960 | 18,013 |
| Race/ethnicity | | | | |
| Non-Hispanic white | 83 | 394 | 147 | 1,469 |
| Non-Hispanic black | 36 | 112 | 47 | 629 |
| Hispanic | 14 | 50 | 7 | 266 |
| Other /unknown | 8 | 31 | 2,340 | 19,054 |
| Military occupation | | | | |
| Health care | 14 | 48 | - | - |
| Non-health care | 127 | 539 | - | - |
| Time in service (years) | | | | |
| 0–2 | 30 | 83 | - | - |
| 2.1–4.0 | 10 | 44 | - | - |
| 4.1–8.0 | 11 | 79 | - | - |
| 8.1 or more | 90 | 381 | - | - |
| Rank | | | | |
| Enlisted | 126 | 533 | - | - |
| Officer | 15 | 54 | - | - |
| No. of deployments | | | | |
| 0 | 76 | 301 | - | - |
| 1 | 46 | 178 | - | - |
| 2 or more | 19 | 108 | - | - |
| Birth cohort year | | | | |
| After 1980 | 48 | 173 | 413 | 2,388 |
| 1965–1980 | 42 | 167 | 302 | 2,213 |
| Before 1965 | 51 | 247 | 1,826 | 16,817 |

cases, but subsequently being reclassified as chronic cases after follow-up evaluations. Such diagnostic uncertainty is a potential limitation in the use of administrative data to classify cases. Notable policy changes during the surveillance period may have also played a role, including the 2012 expansion of the CDC testing recommendations to include HCV testing for all persons born during 1945–1965.[15] Provider awareness of, and adherence to, these guidelines may have increased detection and diagnosis of chronic hepatitis C cases among service members in this birth cohort. Shorter durations between acute and chronic diagnoses among affected military members as compared with previous estimates may also suggest enhanced attention to follow-up of newly diagnosed cases in the MHS, perhaps in effort to link patients with new U.S. Food and Drug Administration–approved medications indicated for treatment of chronic HCV genotype-specific infections.[16]

The findings of this report should be interpreted with consideration of the limitations of the analysis. Given that acute HCV infections are usually asymptomatic (and often undiagnosed), the numbers and rates of acute hepatitis C diagnoses reported here are likely underestimates of the true numbers and rates of new infections among active component U.S. military members. In addition, acute or chronic infection statuses may be inaccurately reported on medical encounter records because serologic assays routinely used for screening for HCV do not distinguish between acute, chronic, and resolved infections.[15] As a result, it is difficult to accurately estimate the true incidence of HCV disease since the symptoms and time to diagnosis may vary.

Holmberg et al. estimated that, in 2012, only about half of the 3.2 million people infected with HCV in the U.S. had been tested and knew their status. Of those tested, only about one-third had been referred for HCV care and only 7%–11% had been treated.[17] For U.S. military service members, HCV screening and access to definitive treatments are critical to improving health outcomes for those infected with HCV. Earlier diagnosis and linkage to care are especially important given the recent pharmaceutical advances in genotype-based HCV treatments. There are now several FDA-approved oral medications for both children (sofosbuvir; ledipasvir and sofosbuvir) and adults (sofosbuvir and velpatasvir; ledipasvir and sofosbuvir; tealaprevir; daclatasvir; ombitasvir, paritaprevir, and ritonavir; boceprevir; elbasvir and grazoprevir) based on patient genotype.[18,19] These recent therapeutic advances have shown more favorable economic outcomes compared to older standard therapies and will likely change the way the Department of Defense treats HCV infection.[20] The burden of acute and chronic hepatitis C disease among the Department of Defense is significant as the MHS revises public health policies to match new screening and treatment guidelines. Moving forward, studies that include laboratory-confirmed genotypes are needed to better characterize cost-benefit estimations that can inform public health policies in screening and treatment of this infectious disease.

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

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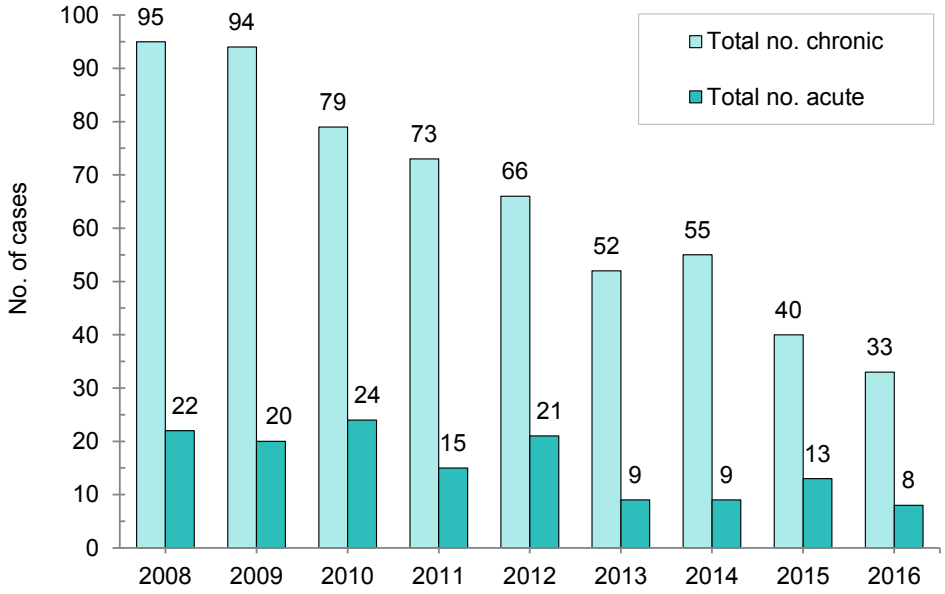
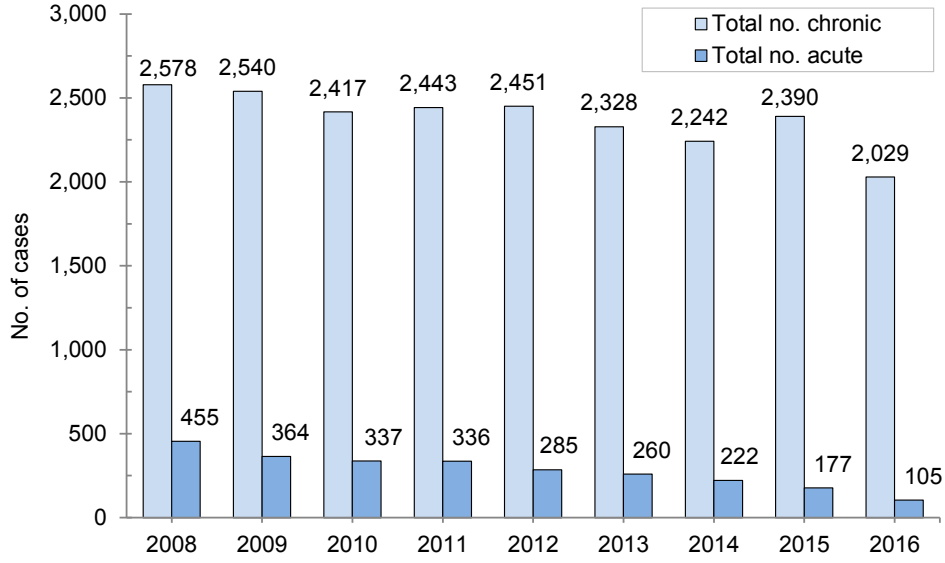
**FIGURE 4.** Counts of HCV cases among reserve/guard component, by HCV infection type, U.S. Armed Forces, 2008–2016




HCV, hepatitis C virus

**FIGURE 5.** Counts of HCV cases among Military Health System beneficiaries, by HCV infection type, 2008–2016




HCV, hepatitis C virus

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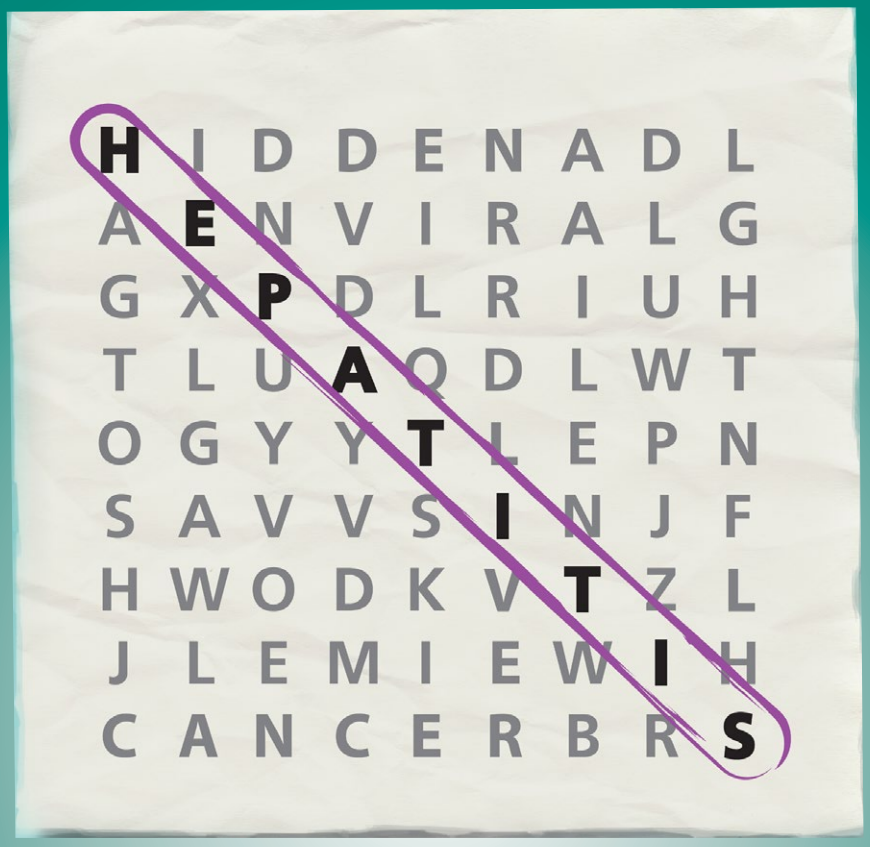


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*Brief Report*

# Tinea Pedis, Active Component, U.S. Armed Forces, 2000–2016

*Valerie F. Williams, MA, MS; Shauna Stahlman, PhD, MPH; Mark G. McNellis, PhD*

Tinea pedis, also known as athlete's foot, is a chronic fungal infection of the feet and toes and is the most common dermatophyte infection among adults. Up to 25% of the global population is affected by tinea pedis at any given time.[1-3] Athlete's foot is also a common problem among military service members. Recent studies among non-U.S. military personnel reported high infection rates, costs of morbidity, and the potential reduction in service members' performance resulting from this infection.[4-10] The prevalence of tinea pedis among military personnel in these studies ranged from 12% to 70%.[4-10] These reports highlighted risk factors for infection such as high-intensity training, heavy sweating, protracted shoe/boot wearing, and less frequent sock changes.[4-10] During field training exercises and/or deployment, service members may be exposed to additional risk factors including hot and humid ambient weather, poor skin hygiene, and close-quarter living.[4,5,11,12] A study focused on cutaneous fungal infections among U.S. Army members during 1998–1999 found that, of more than 66,000 visits to military treatment facilities for fungal infections, 19.1% were for tinea pedis.[13]

The most common clinical presentation of tinea pedis is infection of the skin between the toes. If left untreated, this pattern of infection may cause softening (maceration), reddening (erythema), and fissures of the skin. These changes in the skin increase the risk of cellulitis, a serious bacterial infection of the skin capable of spreading to other parts of the body.[14]

This brief report summarizes the counts, rates, trends, and demographic characteristics of diagnoses of tinea pedis among U.S. active component service members during 2000–2016.

## METHODS

The surveillance period was 1 January 2000 through 31 December 2016. The surveillance population included all individuals who served in the active components of the Army, Navy, Air Force, or Marine Corps at any time during the surveillance period. The Defense Medical Surveillance System (DMSS) was searched to identify inpatient and outpatient encounters that included diagnoses of tinea pedis. The Theater Medical Data Store (TMDS) was searched for in-theater encounters for tinea pedis. A case of tinea pedis was defined as an inpatient, outpatient, or TMDS encounter with ICD-9: 110.4 ("dermatophytosis of foot") or ICD-10: B35.3 ("tinea pedis") in the primary or secondary diagnostic position. A 60-day gap between qualifying encounters was applied to identify incident cases. If service members had two or more case-defining encounters for tinea pedis that occurred within 60 days of each other, an inpatient diagnosis was prioritized over an in-theater (TMDS) diagnosis which was prioritized over an outpatient diagnosis. Person-time accumulated while not deployed was used as the denominator for outpatient and hospitalization rates. Overall and annual prevalence of tinea pedis were calculated by dividing the number of service members who received such a diagnosis during the time period of interest by the number of service members who served at any time during that period.

## RESULTS

During the 17-year surveillance period, there were a total of 193,432 medical encounters for tinea pedis **(Table)**. Of these total encounters, 91.0% were ambulatory visits and 8.8% were TMDS encounters.

**TABLE.** Counts and rates of tinea pedis by demographic and military characteristics, active component, 2000–2016

| | No. | Rate[a] |
|---|---|---|
| Total | 193,432 | 84.0 |
| Sex | | |
| Male | 168,661 | 85.9 |
| Female | 24,771 | 73.1 |
| Race/ethnicity | | |
| Non-Hispanic white | 109,074 | 77.1 |
| Non-Hispanic black | 43,511 | 109.9 |
| Hispanic | 23,838 | 91.3 |
| Asian/Pacific Islander | 5,405 | 63.1 |
| Other/unknown | 11,604 | 79.4 |
| Age group | | |
| <20 | 26,687 | 170.1 |
| 20–24 | 63,139 | 84.5 |
| 25–29 | 37,285 | 71.8 |
| 30–34 | 24,230 | 69.2 |
| 35–39 | 20,995 | 73.6 |
| 40+ | 21,096 | 86.4 |
| Service | | |
| Army | 78,814 | 92.6 |
| Navy | 45,046 | 78.6 |
| Air Force | 42,566 | 74.8 |
| Marine Corps | 27,006 | 86.9 |
| Status | | |
| Recruit | 19,204 | 412.5 |
| Non-recruit | 174,228 | 77.2 |
| Rank | | |
| Junior enlisted (E1–E4) | 107,609 | 107.7 |
| Senior enlisted (E5–E9) | 63,655 | 69.1 |
| Junior officer (O1–O3, W1–W3) | 12,743 | 54.8 |
| Senior officer (O4–O9, W4–W5) | 9,425 | 62.6 |
| Occupation | | |
| Combat-specific | 19,996 | 62.8 |
| Armor/motor transport | 7,626 | 107.0 |
| Pilot/air crew | 4,917 | 55.6 |
| Repair/engineering | 55,639 | 81.9 |
| Communications/intelligence | 40,752 | 78.0 |
| Health care | 13,872 | 70.9 |
| Other | 50,630 | 118.4 |

[a]Rate per 10,000 person-years

**FIGURE 1.** Incident cases and incidence rates of tinea pedis, active component, U.S. Armed Forces, 2000–2016

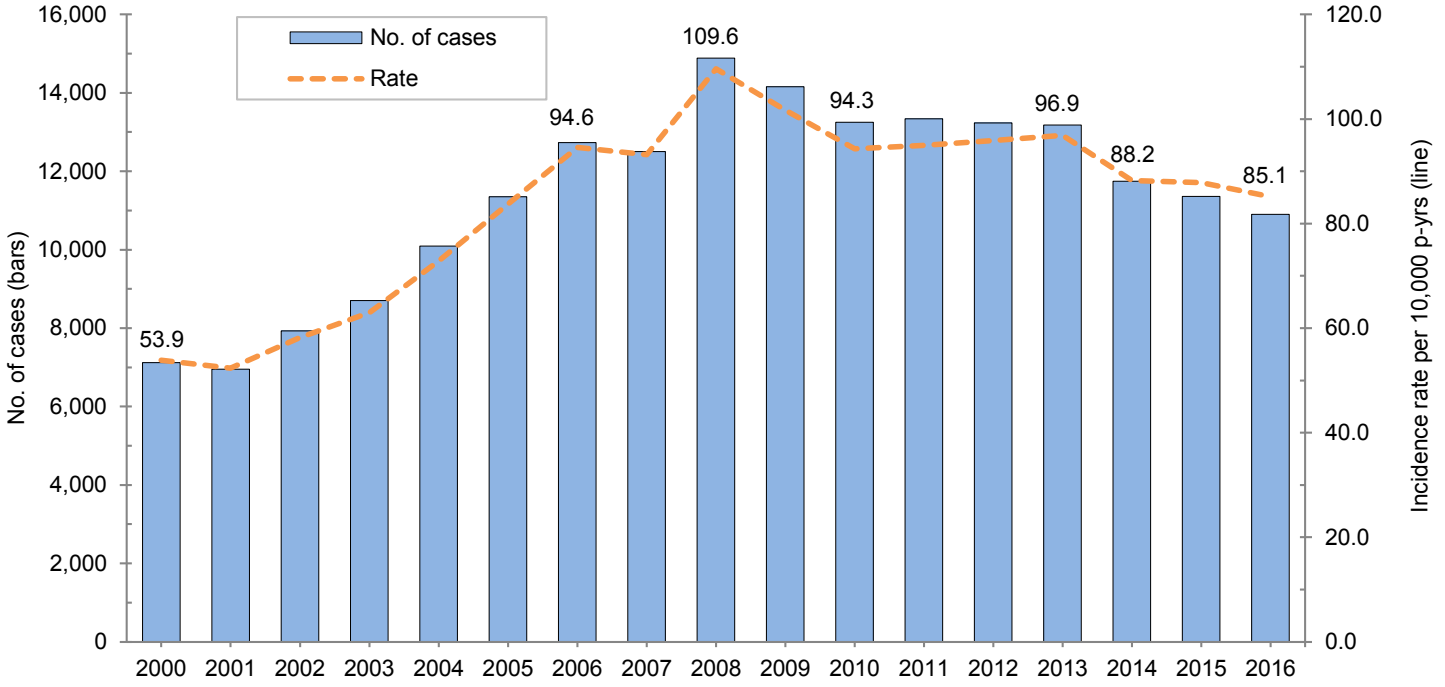
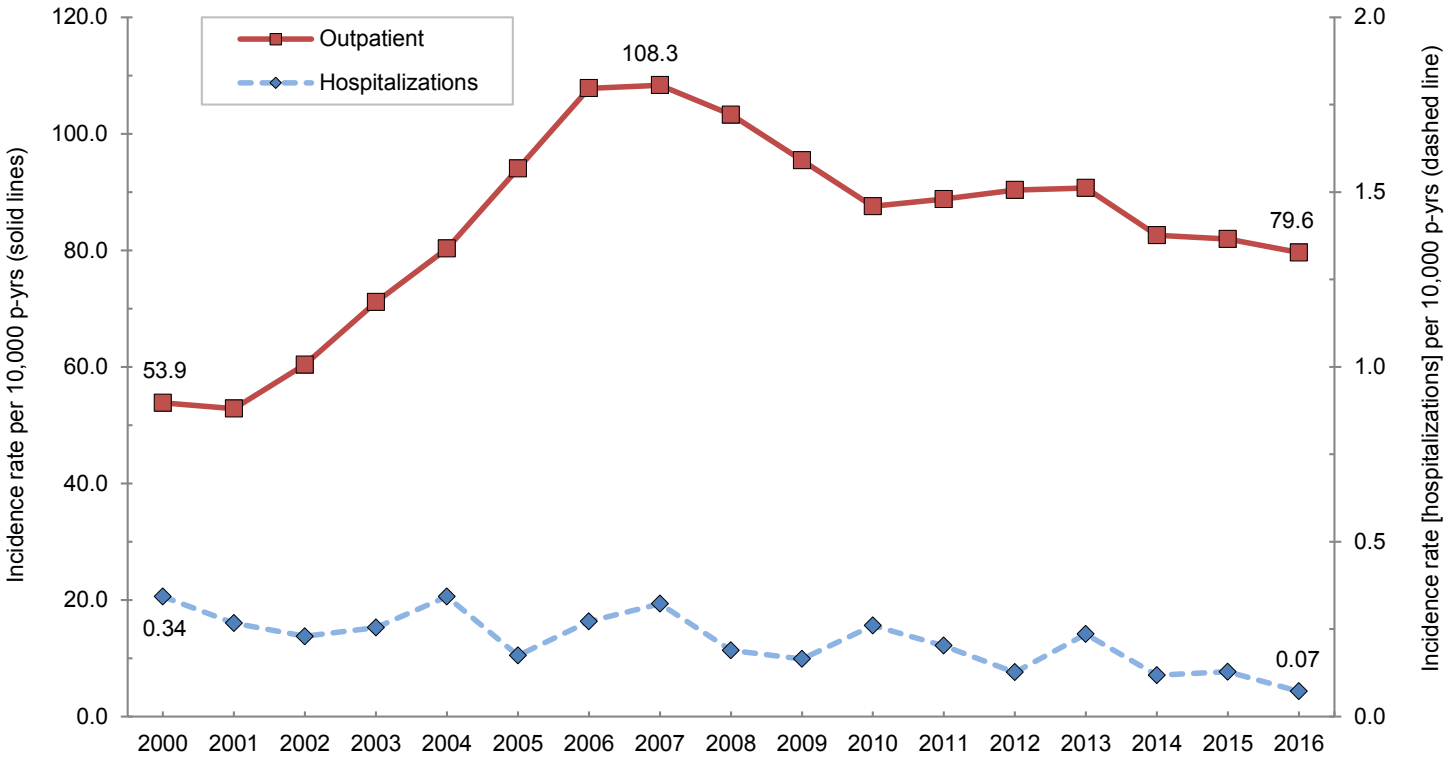



**FIGURE 2.** Annual incidence rates of tinea pedis, by medical encounter type, active component, U.S. Armed Forces, 2000–2016




[a]Theater Medical Data Store (TMDS) data available from 2008 onward

Hospitalizations accounted for the remaining 0.2% of the encounters **(data not shown)**.

The overall prevalence of tinea pedis among active component service members was 71.7 per 10,000 service members **(data not shown)**. The annual prevalence of tinea pedis ranged from 44.3 per 10,000 service members (6,770 service members affected) in 2001 to 93.1 per 10,000 service members (14,390 service members affected) in 2008 **(data not shown)**.

The overall incidence rate of tinea pedis was 84.0 cases per 10,000 person-years (p-yrs). Male service members had an overall incidence rate that was 17.4% higher than females **(Table)**. Non-Hispanic black and Hispanic service members had the highest overall incidence rates of tinea pedis. Service members younger than 20 years of age had an overall incidence rate about two or more times that of the older age groups. Army members had the highest overall incidence rate compared to members of the other services. Recruits had an overall incidence rate five times that of non-recruits. Junior enlisted service members had the highest overall incidence rate of tinea pedis and junior officers had the lowest rate **(Table)**.

Annual incidence rates of tinea pedis among active component service members during the 17-year surveillance period were lowest in 2001 (52.3 cases per 10,000 p-yrs), peaked in 2008 at 109.6 cases per 10,000 p-years, and then decreased to 85.1 cases per 10,000 p-yrs in 2016 (22.4% decrease) **(Figure 1)**. Outpatient rates of tinea pedis peaked in 2007 at 108.3 cases per 10,000 p-yrs and then decreased to 79.6 cases per 10,000 p-yrs in 2016. Inpatient rates remained low during the surveillance period and fluctuated between 0.34 cases per 10,000 p-yrs in 2000 (and then again in 2004) and 0.07 cases per 10,000 p-yrs in 2016 **(Figure 2)**.

Of the 459 hospitalization records that contained diagnoses of athlete's foot during the surveillance period, a total of 275 (59.9%) had a primary diagnosis of cellulitis or abscess of the foot or leg during the incident tinea pedis hospitalization (146 diagnoses of "cellulitis and abscess of leg, except foot"; 123 diagnoses of "cellulitis and abscess of foot, except toes"; five diagnoses of "cellulitis of left lower limb"; and one diagnosis of "cutaneous abscess of right foot"). Less than 10% (n=37; 8.1%) of the 459 hospitalizations had a primary diagnosis of tinea pedis **(data not shown)**.

## EDITORIAL COMMENT

This brief report documents the slight decrease in crude annual incidence rates of tinea pedis between 2008 and 2016 (reflecting mostly those cases diagnosed during outpatient encounters). Consistent with existing literature on athletes' foot among military personnel, results of this study showed that tinea pedis infections were more common among males, those in the youngest age group, and junior enlisted service members.

The numbers and rates of tinea pedis reported here undoubtedly underestimate the actual numbers and rates of this fungal skin infection. For example, many mild infections are likely not documented in medical records because they are self-treated by individuals using over-the-counter medications and improvements in foot hygiene.

Examination of case-defining inpatient encounters highlights the risk of secondary bacterial infection associated with tinea pedis. Complications such as cellulitis may result in significant reduction in service members' performance, increased sick calls, and increased costs due to treatment.[15-17] One recent study suggested that, while fungal infections of the feet accounted for a little more than one-quarter of total fungal infections among U.S. Army members during 2010–2012, foot infections accounted for almost half of the medical costs.[18] Given these costs, prevention efforts such as training and education about foot and skin health warrant continual emphasis, especially during initial entry training and in preparation for field exercises and deployments to warm locations.

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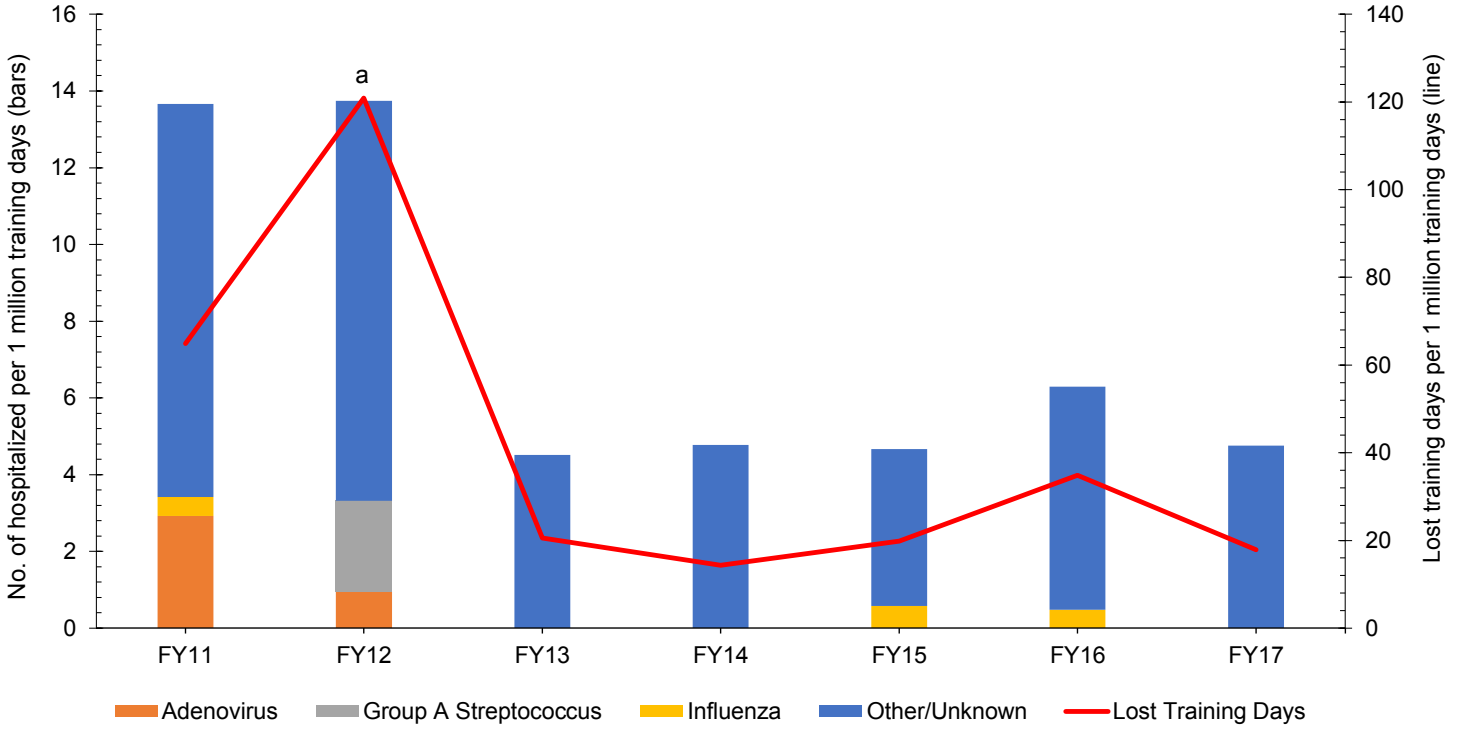
# Surveillance Snapshot: Respiratory Infections Resulting in Hospitalization, U.S. Air Force Recruits, October 2010–February 2017

*Joshua R. Duncan, MD (Maj, USAF); Bryant J. Webber, MD, MPH (Maj, USAF)*

**FIGURE.** Rates of hospitalization and hospital days for respiratory infections among U.S. Air Force recruits by fiscal year, October 2010–February 2017, with associated preventive medicine interventions




[a]Adenovirus vaccine reintroduced (November 2011) and group A streptococcus chemoprophlyaxis transitioned from oral penicillin to intramuscular benzathine penicillin (January 2012)
Data sources: Trainee Health Surveillance hospitalization registry; U.S. Air Force Basic Training Management System

A number of vaccine and non-vaccine interventions have been used to reduce the historically high burden of respiratory infections during military training.[1] This snapshot displays the trend in hospitalizations for respiratory infections, stratified by major pathogens, and the associated hospital days for all recruits in U.S. Air Force Basic Military Training at Joint Base San Antonio–Lackland, TX. Several preventive measures were employed throughout the surveillance period, including an emphasis on hand hygiene, "head-to-toe" sleeping arrangements, liberal use of respiratory face masks, isolation of febrile trainees, a stringent gas mask cleaning protocol, and universal provision of seasonal influenza vaccine during non-summer months. Two major interventions were implemented during the period: provision of year-round adenovirus (Ad4 and Ad7) vaccine (November 2011) and a shift in chemoprophylaxis against group A streptococcus from oral penicillin to intramuscular benzathine penicillin (January 2012). No recruits have been hospitalized due to adenovirus or group A streptococcus since the respective interventions were implemented. In addition to preventing incident infections and hospitalizations, adenovirus vaccine and benzathine penicillin chemoprophylaxis decrease the likelihood of severe respiratory disease outbreaks, which could be highly disruptive to the training mission. Although other host (e.g., healthier recruits) and environmental (e.g., climatic shift) factors may be contributing to the downward trend in respiratory infection hospitalizations, and although causality cannot be inferred from these data alone, the interventions appear to be inversely associated with hospitalization rates, are largely evidence based,[2,3] and should continue at military training sites.

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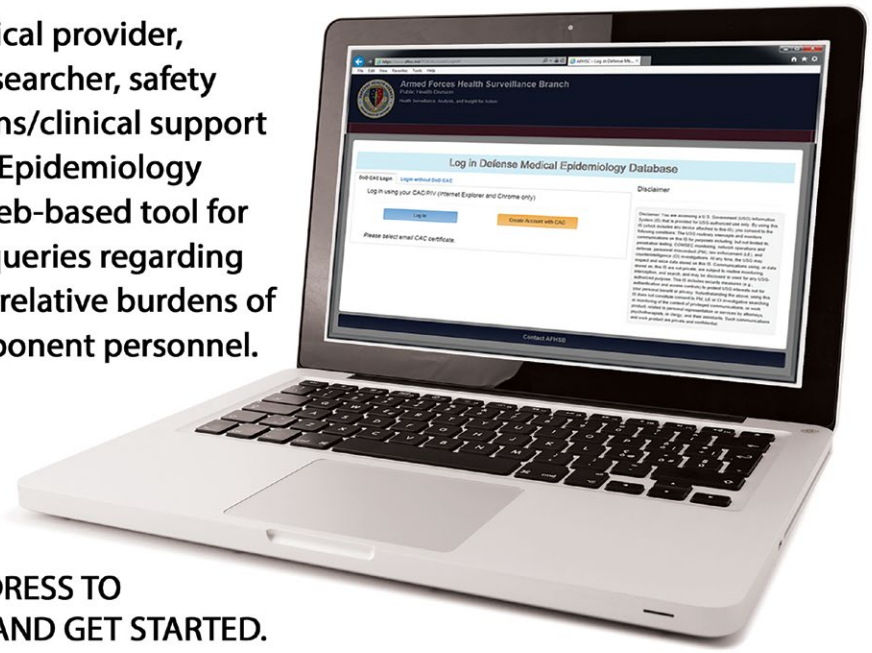


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In addition, *MSMR* encourages the submission for publication of reports on evidence-based estimates of the incidence, distribution, impact, or trends of illness and injuries among members of the U.S. Armed Forces and other beneficiaries of the MHS. Information about manuscript submissions is available at www.health.mil/MSMRInstructions.

Please email your article ideas and suggestions to the *MSMR* editorial staff at: dha.ncr.health-surv.mbx.afhs-msmr@mail.mil.

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*MEDICAL SURVEILLANCE MONTHLY REPORT (MSMR)*, in continuous publication since 1995, is produced by the Armed Forces Health Surveillance Branch (AFHSB). 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 AFHSB and integrated into the Defense Medical Surveillance System for health surveillance purposes.

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