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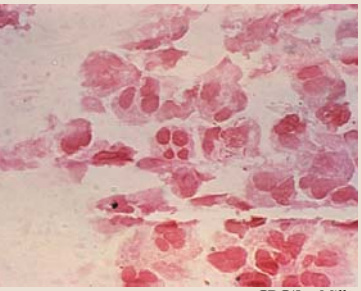

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Transfusion-Transmissible Infections Among U.S. Military Recipients of Emergently Transfused Blood Products, June 2006–December 2012

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In austere deployment environments, transfusion of freshly collected blood products from volunteer donors is sometimes necessary to save wounded service members' lives. Because these blood products may have an increased risk of transmitting bloodborne pathogens, recipients are administratively tracked and offered serial serologic testing by the Blood Look Back (BLB) program. This study evaluates the frequency of transfusion-transmissible infections (TTIs) in U.S. service member (SM) recipients of non-FDA-compliant blood products from 1 June 2006 through 31 December 2012. Routine BLB program efforts identified and evaluated 1,127 SM recipients for evidence of seven TTIs for 12 months following transfusion. The Defense Medical Surveillance System was then queried for evidence of provider-diagnosed TTIs and the results were compared. A single, previously reported incident case of human T-lymphotropic virus (rate of 1.3 per 1,000 persons) was the only TTI identified during the study period. Screening of recipients identified two (rate of 1.9 per 1,000 persons) prevalent (pre-transfusion) cases of chronic hepatitis B virus (HBV) infection, 16 (rate of 15.5 per 1,000 persons) prevalent cases of naturally acquired immunity to HBV and seven (rate of 6.8 per 1,000 persons) prevalent cases of hepatitis C virus infection. No cases of infection with human immunodeficiency virus, syphilis, *Trypanosoma cruzi*, or West Nile virus were identified.

The U.S. Food and Drug Administration (FDA) develops procedures to reduce the inherent risk of communicable disease in the blood supply. U.S. Code of Federal Regulations Title 21 requires all donated blood (including leukocyte-rich cells) to be tested for human immunodeficiency virus (HIV) types 1 and 2, hepatitis B virus (HBV), hepatitis C virus (HCV), human T-lymphotropic virus (HTLV) types I and II, and syphilis.[1] In November 2009, following 30 documented cases of West Nile virus (WNV) infection acquired from blood transfusion, and in December 2010 after seven transfusion reported cases of *Trypanosoma cruzi* infection, the FDA recommended screening of all donated blood for WNV[2] as well as one-time donor testing for *T. cruzi*.[3]

In the early, resuscitative care of combat casualties, the transfusion of blood products, often in large amounts, has proven to be crucial to improving survival in the wounded. In forward areas of combat zones where conditions are austere and resupply is intermittent, supplies of pre-positioned FDA-compliant blood products may be limited, and may be quickly exhausted. Under such circumstances, transfusion with freshly collected blood products is sometimes used to save lives.[4] When such blood products are transfused, Department of Defense (DoD) policy requires recipients to be offered testing for transfusion-transmissible infections (TTIs) at intervals of 3, 6, and 12 months after transfusion. This testing is tracked by The Armed Services Blood Program (ASBP) office via the Blood Look Back (BLB) program. BLB program personnel also ensure that recipients of non-FDA-compliant products have been counseled regarding the reason for their emergent transfusion and understand the importance of laboratory follow-up testing. Program personnel then coordinate with patients, case managers, and medical providers to ensure that transfusion recipients receive follow-up laboratory testing at Clinical Laboratory Improvement Amendments–certified laboratories. When possible, testing is performed at military treatment facilities, or Department of Veterans Affairs (VA) hospitals; however, testing is sometimes performed at civilian facilities as well. Laboratory testing results are transmitted to the BLB, verified by the ASBP, and recorded in the service member's (SM's) medical record. If a recipient demonstrates serologic evidence of a TTI, BLB personnel interview the SM, perform a comprehensive review of the medical records, review the results of blood samples taken from the donor at the time of donation, and in some cases, request testing of the donors' pre-deployment serum.[5] The BLB program routinely tests for HIV types 1 and 2, HTLV types I and II, HBV, HCV, syphilis, WNV and *T. cruzi* (WNV and *T. cruzi* testing were added in May 2013).

Previous research suggests TTIs among SMs transfused in combat with freshly collected blood products are rare. A study by Hakre et al. tested SMs who received non-FDA-compliant blood products from March 2002 through September 2007. Of the 761 recipients of emergently transfused blood products, pre- and post-transfusion sera were tested for HIV (472 recipients), HBV (469 recipients), and HCV (475 recipients). A single case of transfusion-transmitted HCV infection was identified (incidence rate of 2.1 per 1,000 persons). Additionally, the study

identified two cases of prevalent (pre-transfusion) chronic HBV infection (4 per 1,000 persons), nine cases of prevalent natural immunity to HBV (19 per 1,000 persons), and four prevalent cases of HCV infection (8 per 1,000 persons).[6]

This study updates the current body of knowledge by determining the incidence and prevalence of seven TTIs among SMs who received non-FDA-compliant blood products from 1 June 2006 through 31 December 2012. Furthermore, this study examines whether the addition of a passive surveillance system, the Defense Medical Surveillance System (DMSS), detected any SMs diagnosed with TTIs, including *T. cruzi* or WNV prior to routine screening in 2013. Finally, this study explores the use of the DMSS as a potential tool to augment current BLB programmatic surveillance efforts.

METHODS

A retrospective cohort study was designed using pre-existing data routinely collected by the BLB program as well as ICD-9 diagnostic information routinely captured from SM electronic health records in the DMSS. Maintained by the Armed Forces Health Surveillance Center, DMSS records document provider diagnoses recorded during outpatient encounters and inpatient hospitalizations of active component SMs in fixed military and civilian (if reimbursed through the Military Health System [MHS]) treatment facilities.[7] The cohort consisted of active-duty SM recipients of non-FDA-compliant blood products identified by the BLB program. The primary outcomes of interest were the presence of laboratory-confirmed TTIs within 12 months of receiving a non-FDA-compliant blood transfusion. The exposure period was 1 June 2006 through 31 December 2012, and the total surveillance period was 1 June 2006 through 31 December 2013. SMs were followed for at least 12 months after date of transfusion; until completion of follow-up laboratory testing; or until completion of the study surveillance period. To account for patient noncompliance with BLB program–recommended follow-up, as well as the introduction of WNV and *T. cruzi* laboratory testing after the study exposure period, SM medical records were also queried in the DMSS for evidence of provider-diagnosed TTI during the 12-month surveillance period following transfusion. Case definitions for DMSS-diagnosed TTIs were based on standardized, previously published criteria.[8] This project was reviewed and approved by the Uniformed Services University of the Health Sciences Offices of Research and determined to be exempt from Institutional Review Board review.

Demographic characteristics and primary outcome of the study cohort were reported using descriptive statistics. Rates were calculated and expressed as rates per 1,000 persons. All statistical analysis was completed in Stata/IC 12.1.[9]

RESULTS

BLB data initially identified 1,206 recipients during the study exposure period **(Figure 1)**. Despite initially surviving their injuries and transfusion, 31 SMs succumbed to their injuries prior to completion of follow-up and were excluded from analysis. Another 48 recipients were later identified as civilians at the time of their transfusion and were excluded from the analysis because they did not meet the criteria for inclusion into the study because no health information was available on DoD civilians through DMSS. The remaining 1,127 SMs were then matched to DMSS diagnostic data in accordance with the standardized case definitions. A total of 97 SMs had no documentation of completing any laboratory follow-up testing. The remaining 1,030 SMs received at least some follow-up laboratory testing for TTIs. A total of 778 SMs completed all required follow-up serologic tests; an additional 252 SMs had incomplete follow-up, defined as missing documentation of at least one or more required laboratory tests.

The typical recipient of non-FDA-compliant blood was a junior enlisted soldier, aged 20–24 years **(Table 1)**. The Army and Marine Corps combined represented 96% of those who received non-FDA-compliant blood, while the Air Force and Navy each represented only 2%.

FIGURE 1. Selection of the study population

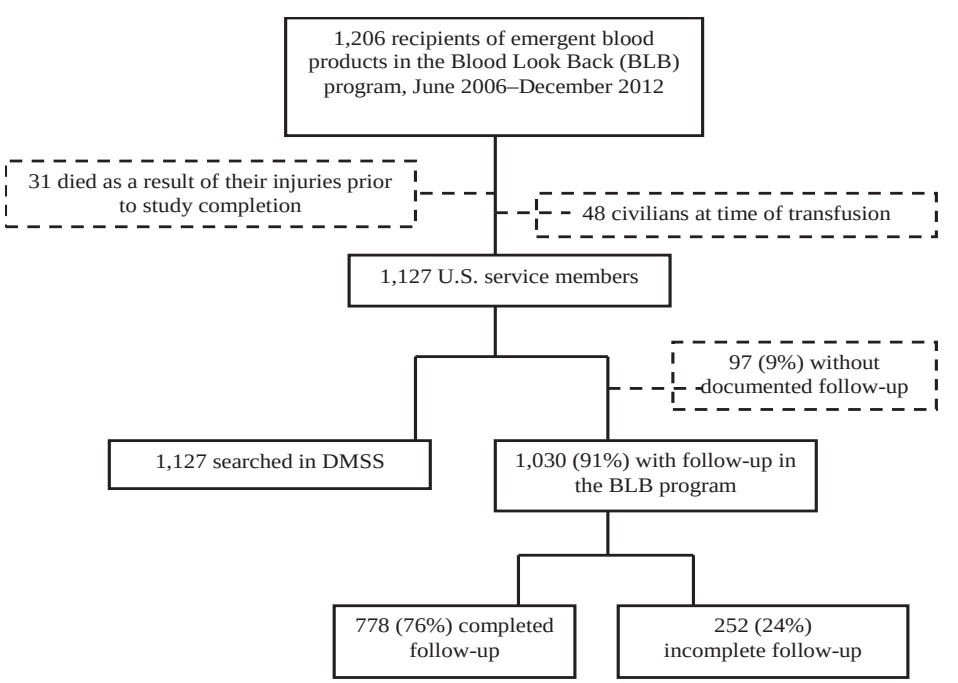

TABLE 1. Demographic characteristics of U.S. service member recipients of non-FDA-compliant blood products, June 2006–December 2012

	No.	%
Total	1,127	
Age		
<20	59	5.0
20–24	576	51.0
25–29	297	26.0
30–34	115	10.0
35–39	47	4.0
40+	33	3.0
Service		
Army	762	68.0
Air Force	24	2.0
Marine Corps	320	28.0
Navy	21	2.0
Rank		
E1–E4	659	58.0
E5–E9	385	34.0
O1–O9, WO	83	7.0
Year of transfusion		
2006	136	12.0
2007	203	18.0
2008	94	8.0
2009	82	7.0
2010	205	18.0
2011	252	22.0
2012	155	14.0

FDA=U.S. Food and Drug Administration

TABLE 2. Non-FDA-compliant blood products transfused to U.S. service members, June 2006–December 2012

Blood product	No. of recipients	No. of units	Minimum-maximum units per recipient
Whole blood	253	2,116	1–57
Platelets	1,022	2,712	1–26
Fresh frozen plasma	15	29	1–9
Total	1,127[a]	4,857	

[a]Some recipients were transfused multiple types of blood products.

FDA=U.S. Food and Drug Administration

Blood products

A total of 4,857 units of non-FDA-compliant blood products were transfused to 1,127 SMs during the study period **(Table 2)**. Apheresis platelets were the most utilized product (2,712 units transfused to 1,022 personnel) followed by whole blood (2,116 units transfused to 253 personnel). These values represent only the quantity of non-FDA-compliant blood products because the BLB database does not systematically record type and volume of FDA-compliant banked blood products. According to the Armed Services Blood Program (AFBP), the U.S. military transfused 237,100 units of blood products between June 2006 and December 2012. Thus, the 4,857 non-FDA-compliant units represented approximately 2% of the total blood products.

Transfusion-transmitted infections

Between June 2006 and December 2013, there was a single occurrence of the primary outcome of interest: an incident laboratory-confirmed case of HTLV infection (rate of 1.3 per 1,000 persons) among the 778 individuals who completed all required testing **(Table 3)**.

Hepatitis B virus

The BLB program identified 16 recipients (rate of 15.5 per 1,000 persons) who were repeatedly reactive for HBV core antibody (HBcAb) and HBV surface antibody (HBsAb) but were negative for HBV surface antigen (HBsAg). These recipients were identified as having a history of exposure to HBV and natural immunity. Two recipients (rate of 1.9 per 1,000 persons) were HBcAb repeat reactive with HBsAg positivity and were identified as having chronic HBV infection.

By using the standardized surveillance case definitions, DMSS records were identified for three transfusion recipients as having been diagnosed with HBV infection. Two of these recipients corresponded to SMs previously identified by the BLB program as having a history of HBV prior to receiving a transfusion. The third individual had completed all follow-up laboratory testing and was serologically negative for evidence of HBV infection.

Hepatitis C virus

Within the BLB program, seven transfusion recipients (rate of 6.8 per 1,000 persons) were anti-HCV positive, confirmed by either recombinant immunoblot assay or nucleic acid amplification testing. All seven transfusion recipients were determined to have a history of HCV prior to transfusion by a combination of medical record review, patient report, or serologic analysis of pre-transfusion aliquot for HCV.

DMSS records were identified for five transfusion recipients as having been diagnosed with HCV infection. Three of these records corresponded to recipients previously identified by the BLB program as having a history of HCV prior to transfusion. One record was for a recipient determined to have an initial false-positive test for HCV infection, and later serologically confirmed to be HCV negative. The final recipient completed all follow-up laboratory testing and was serologically negative for evidence of HCV infection.

HIV, syphilis, *T. cruzi*, and WNV

No cases of HIV, syphilis, *T. cruzi*, or WNV infection were identified by either the BLB program or the DMSS.

EDITORIAL COMMENT

This study confirms and reaffirms a previously reported 2010 case of HTLV type I[10] as the only incident case of a TTI identified to date in this cohort of 1,127 SMs receiving non-FDA-compliant blood products from 1 June 2006 through 31 December 2012. The addition of DMSS as a passive surveillance tool did not identify additional positive cases of TTIs among

TABLE 3. Incidence and prevalence of potential TTIs by data source

	Blood Look Back program		DMSS
TTI	No. of cases (rate)[a] Incidence[b]	No. of cases (rate)[a] Prevalence[c]	No. of cases[d]
HIV	0	0	0
HBV/chronic	0	2 (1.9)[a]	3
HBV/naturally acquired immunity	N/A	16 (15.5)[a]	N/A
HCV	0	7 (6.8)[a]	5
HTLV I and II	1 (1.3)[a]	0	1
Syphilis	0	0	0
WNV	Not tested	Not tested	0
Trypanosoma cruzi	Not tested	Not tested	0

[a]Cases per 1,000 persons

[b]Rate derived from 778 service members who completed all laboratory testing.

[c]Rate derived from 1,030 service members at risk of outcome; includes incomplete follow-up.

[d]DMSS recorded both incident and prevalent cases derived from 1,127 service members searchable in the DMSS.

DMSS=Defense Medical Surveillance System; HBV=hepatitis B virus; HCV=hepatitis C virus; HTLV=human T-lymphotropic virus; TTI=transfusion-transmissible infection; WNV=West Nile virus

SMs with incomplete follow-up or among those who may not have received laboratory testing for WNV and *T. cruzi* by the BLB program.

The incidence rate of a TTI in this population was one case out of 1,127 (0.9 per 1,000 persons). Confining incidence estimates to the most conservative denominator (778 recipients who completed 12 months of laboratory testing) yields an incidence rate of 1.3 per 1,000 persons. This rate is below the previously reported incidence rate of 2.1 per 1,000 transfusions among 475 recipients from 2002 to 2007.[6]

The BLB program data identified 16 recipients (rate of 15.5 per 1,000 persons) with evidence of HBV from a natural infection prior to transfusion and two (rate of 1.9 per 1,000 persons) recipients chronically infected with HBV with evidence of infection prior to transfusion. These prevalence results are less than the rates reported in the 2002–2007 transfusion cohort (19 per 1,000 persons and 4 per 1,000 persons, respectively).[6] The observed rate of SMs with chronic HBV was substantially higher than the rate of 0.095 per 1,000 persons reported in a 2011 study of all active component SMs from 2000 through 2010.[11] The existence of undiagnosed, chronic HBV infection may result from lack of a servicewide systematic screening process for HBV, as well as potential patient disclosure issues, because chronic hepatitis and hepatitis carrier state are grounds for rejection from appointment, enlistment, or induction in military service.[12] Methodologic differences may also account for the observed differences in reported prevalence. The study design for the report utilized both laboratory and diagnostic criteria, an approach that is likely more sensitive than the diagnostic only estimate provided by the 2011 study.

The BLB program identified seven recipients (rate of 9 per 1,000 persons) with evidence of HCV prior to transfusion, similar to the prevalence of HCV in the 2002–2007 cohort of 8 per 1,000 persons,[6] but also substantially higher than the prevalence of chronic HCV (0.17 per 1,000) reported in the U.S. Armed Forces from 2000 through 2010.[13] Methodologic differences likely account for these differences as 91% of this study cohort was serologically screened for HCV as compared to an unknown, but presumably low, percentage of individuals receiving actual serologic screening in the previous study.[13]

This study utilized DMSS records to augment routine BLB program follow-up by identifying transfusion recipients who received a diagnosis of a TTI by a healthcare provider. Additionally, DMSS records were searched for evidence of diagnoses of WNV and *T. cruzi* infection because routine laboratory testing for these conditions was not introduced until after the exposure period of this study. By using standardized case definitions, DMSS records enabled the correct identification of the two prevalent cases of HBV identified through routine BLB program laboratory testing. One SM serologically proven to demonstrate no serologic evidence of HBV infection had a healthcare provider diagnosis of HBV in the medical record and thus was incorrectly identified as a case by using the standardized case definition. Standardized case definitions applied to DMSS records allowed for the correct identification of three out of seven individuals with HCV; however, two SMs whose DMSS records contained diagnoses of HCV infection were serologically proven to demonstrate no evidence of HCV infection. Despite these limitations, approximately one-quarter of the cohort did not complete all recommended laboratory follow-up for a variety of reasons; the ability to continue tracking these individuals through a passive surveillance tool is a valuable practice that should be further investigated.

Interpretation of this study is subject to several limitations. First, despite robust administrative support and coordination with case managers across the spectrum of the MHS, the VA, and civilian care, nearly one-quarter of the cohort did not complete all recommended laboratory testing. Second, some infectious conditions monitored by the BLB program (particularly HCV and *T. cruzi*) can demonstrate long latency periods prior to an individual becoming symptomatic. SMs who are non-compliant with laboratory follow-up may require greater than 12 months of follow-up prior to experiencing symptoms that may result in a provider diagnosis if indeed infected with a TTI. Third, while inclusion of the DMSS data may help compensate for incomplete BLB program follow-up, diagnostic information resulting from care provided to SMs outside of the MHS or care that is not reimbursed by the

MHS (e.g., care provided out-of-pocket or for free at a public health department clinic) will not be captured in DMSS. Fourth, despite use of standardized surveillance case definitions, DMSS data still depend on individual providers entering correctly coded diagnoses into the medical record. If providers misdiagnosed a condition (e.g., if a case of meningitis was secondary to WNV, the diagnosis may only be recorded as meningitis), this would result in under-reporting and an underestimate of frequency of infection. Finally, the study design resulted in differential follow-up because SMs enrolled in the cohort earlier in the study period were necessarily followed for a greater amount of time compared to those enrolled in later years.

This study has several strengths: first, the sample size of 1,127 makes this the largest exploration of data about SM recipients of non-FDA-compliant blood products to date. Second, vetting the BLB program data against DMSS data improves the sensitivity of this study's ability to identify a TTI as well as provide a means to potentially identify two diseases for which no laboratory testing was performed at the time of transfusion (*T. cruzi* and WNV). Additionally, DMSS aids in this study's ability to identify and track individuals who did not complete BLB program recommended follow-up. Third, standard procedure within the BLB program was to rigorously follow and confirm potential positive laboratory tests. This practice frequently involved testing for the presence of the infectious agent's DNA or RNA. Additionally, donor serums could be screened for TTIs if recipients declined to complete recommended follow-up. In the case of the recipient identified as an incident case of HTLV, viral DNA sequencing of the donor and recipient allowed for a very high level of evidence for the route of viral transmission. Fourth, whenever possible, standardized disease case definitions were used to allow for more direct comparisons between this study, previously published literature, and potential future research.

One incident case of HTLV was identified in this review, representing a rare outcome of a life-saving measure. Prevalent cases of HBV and HBC were identified, which are a potential concern as they represent the presence of undiagnosed infectious agents in a cohort who themselves may become non-FDA-compliant blood product donors to others. The use of DMSS as an additional passive surveillance tool did not identify additional true positive cases of TTIs potentially validating current BLB programmatic efforts. Considering the substantial numbers of SMs who do not complete all recommended laboratory follow-up after receiving non-FDA-compliant blood products, further evaluation of the DMSS as an additional surveillance tool may be warranted.

Disclaimer: The views expressed are those of the author(s) and do not necessarily reflect the official views of the Uniformed Services University of the Health Sciences, the U.S. Air Force, the U.S. Navy, or the Department of Defense.

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Evaluation of Extragenital Screening for Gonorrhea and Chlamydia in HIV-infected Active Duty Air Force Members

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This study evaluated the hypothesis that detection of *Neisseria gonorrhoeae* (GC) and *Chlamydia trachomatis* (CT) infections among HIV-infected active duty members of the U.S. Air Force would increase after expanding screening to include extragenital infections. Before and after the start of extragenital screening, urethral screening was positive for GC/CT in 2.9% and 1.9% of HIV-infected service members. Much higher proportions of rectal (11.1%) and pharyngeal (21.9%) specimens were found to be positive for GC or CT after starting extragenital screening. Only 5.9% of the extragenital positive specimens were associated with positive urethra specimens. Circumstances that warrant routine extragenital screening and the potential benefits are discussed.

HIV prevention efforts are challenged by the recognition of recent increases in the incidence of sexually transmitted infections (STIs). Yearly increases in the rates and numbers of cases of *Neisseria gonorrhoeae* (GC) and *Chlamydia trachomatis* (CT) infection were observed during 2009–2012 in the U.S.[1] Certain population subgroups, such as men who have sex with men (MSM), are disproportionally affected by STIs, and both GC and CT infections are increasingly recognized among this subgroup.[2] Moreover, a study in HIV-infected MSM has demonstrated that tests for pharyngeal and rectal GC and CT infections were positive two to three times as often as simultaneously collected tests for urethral infections.[3] The detection and treatment of STIs remain an important component of HIV care in the military; one study reported new STIs in approximately one-third of HIV-seropositive active duty military members after HIV diagnosis.[4] This study was undertaken to evaluate the hypothesis that detection of GC and CT infections among HIV-infected active duty members of the U.S. Air Force (USAF) would increase with implementation of screening for extragenital infections. The impact of extragenital screening methods was assessed by comparing the frequency of GC/CT detection before and after commencement of an expanded screening program, including pharyngeal and rectal testing, in addition to standard urethra screening.

METHODS

During mandated clinic visits every 6–12 months, the Infectious Disease clinic at the San Antonio Military Medical Center (SAMMC) evaluates all active duty USAF members diagnosed with HIV infection. Routine screening for GC/CT infection at extragenital sites began on 1 February 2013. The study team conducted a retrospective review of clinical and laboratory data collected from all HIV-infected active duty USAF members evaluated at SAMMC between 1 January 2010 and 31 May 2014. This quality improvement project was approved by the SAMMC Institutional Review Board.

Patients' specimens were screened for asymptomatic GC/CT infection by nucleic acid amplification testing (NAAT) with one or more of the following collection methods: first-void urine sample, posterior pharyngeal swab, and rectal swab. For extragenital screening, the SAMMC laboratory validated the Aptima Combo 2 Assay (Hologic/Gen-Probe Inc., San Diego, CA) according to the Clinical Laboratory Improvement Amendments (CLIA) standard. From 1 January 2010 through 31 January 2013, screening for GC/CT was performed every 6 months by urine NAAT only. Screening was performed at all three anatomic sites after 1 February 2013, and patients with a positive GC/CT test had repeat three-site testing performed at the next visit, whereas patients with negative three-site testing were screened by urine only at the next follow-up and extragenital screening was repeated during the subsequent visit. The prevalences of GC and CT infections were compared by anatomic site and the factors associated with GC/CT detection were calculated by odds ratios (ORs) using IBM SPSS Statistics 22.0, (SPSS Statistics, Chicago, IL).

RESULTS

A total of 316 patients were tested for GC/CT during the evaluation period; 307 (97.2%) were men **(Table 1)**. The majority of patients were enlisted service members (n=280, 88.6%) and the mean age at first GC/CT testing during the study period was 31 years. Sexual history for men showed a high proportion of sex with males, as 225 (73.3% of males) were MSM and 25 (8.1% of males) were bisexual. The remaining men reported sex with women only (n=49, 16%) or their sexual practices were undisclosed or unknown (n=8, 2.6%). All HIV-infected women (n=9)

TABLE 1. Characteristics of Air Force active duty members with HIV infection who received periodic evaluations at San Antonio Military Medical Center, 2010–2014

Demographic characteristics	No. (%)
Total no. of subjects	316
U.S. Air Force	
Active duty	289 (91.5)
National Guard/Reserves	27 (8.5)
Gender	
Male	307 (97.2)
Female	9 (2.8)
Rank	
Enlisted	280 (88.6)
Officer	36 (11.4)
Sexual practice	
Males	307
MSM	225 (73.3)
Bisexual	25 (8.1)
MSW	49 (16.0)
Unknown/unreported	8 (2.6)
Females	9
Sex with men only	9 (100)
HIV characteristics	Mean (SD)
Age at HIV diagnosis, years	29 (±7.2)
Age at first GC/CT test, years	31 (±8.7)
CD4 count at HIV diagnosis (cells/uL)	539 (±237)
Viral load at HIV diagnosis (log10 copies/mL)	4.20 (±0.93)

SD=standard deviation; GC=*Neisseria gonorrhoeae*; CT=*Chlamydia trachomatis*; MSM=men who have sex with men; MSW=men who have sex with women

TABLE 2. Gonorrhea and chlamydia test results by anatomic site, HIV-infected service members, before and after implementation of extragenital screening

Screening period[a]	GC or CT infection			GC			CT		
Single-site[a]	Cases	Total tests	Prevalence (%)	Cases	Total tests	Prevalence (%)	Cases	Total tests	Prevalence (%)
Urethra	36	1,253	2.9	13	1,253	1.0	23	1,253	1.8
Multi-site[b]	Cases	Total tests	Prevalence (%)	Cases	Total tests	Prevalence (%)	Cases	Total tests	Prevalence (%)
Urethra[c]	9	486	1.9	4	486	0.8	5	486	1.0
Rectum	34	305	11.1	13	305	4.3	21	305	6.9
Pharynx	68	310	21.9	48	310	15.5	20	310	6.5

GC=*Neisseria gonorrhoeae*; CT=*Chlamydia trachomatis*

[a]1 January 2010 through 31 January 2013

[b]1 February 2013 through 31 May 2014

reported sex with men only.

Either GC or CT was detected in the urethra site in 36 of 1,253 tests (2.9%) before, and in nine of 486 tests (1.9%) after, implementation of extragenital screening **(Table 2)**. However, much higher proportions of rectal (11.1%) and pharyngeal (21.9%) specimens were positive for GC or CT after starting extragenital screening. Only 6 (5.9%) of the 102 infections detected by extragenital testing had positive urethra screening results. A total of eight patients had dual infections with both GC and CT on the same testing date and all were detected by extragenital methods. Of the nine women, only two had STIs detected (one each GC and CT by urethra testing). Factors associated with GC/CT detection included use of extragenital testing (odds ratio [OR] 7.49, 95% confidence interval [CI], 5.18–10.74; p<0.001), enlisted duty status (OR 3.09, 95% CI, 1.06–9.02; p=0.039), and age below mean at testing (OR 1.98, 95% CI, 1.16–3.36; p=0.012); a trend was observed for MSM/bisexual behaviors (OR 1.61, 95% CI, 0.89–2.91; p=0.114).

EDITORIAL COMMENT

Extragenital GC and CT infections have been recognized as relatively common among high-risk populations, so the screening of such populations is recommended in the Centers for Disease Control and Prevention STI guidelines and the Infectious Disease Society of America HIV primary care guidelines.[5,6] This analysis demonstrated a high proportion of GC/CT detected in HIV-infected USAF members with longitudinal testing after the implementation of an extragenital screening program. Overall, extragenital testing resulted in a 7-fold increase in GC/CT detection and more than 90% of cases would have been missed by urethra screening alone. These findings are also consistent with a cross-sectional study of HIV-infected Navy and Marine Corps active duty members, which reported a GC/CT prevalence of 24% with use of extragenital screening methods.[7]

Improving the screening and detection of GC and CT in HIV-infected persons is important for several reasons. Extragenital GC/CT infections are unlikely to be detected because 90% of these infections are asymptomatic and patients do not seek care.[8,9] For example, when screening is based upon the presence of symptoms or other history among MSM, 49%–60% of rectal GC/CT infections are missed compared to universal testing of patients regardless of history.[10] Because the majority of men in this analysis reported MSM behaviors, the implementation of universal testing of extragenital sites was particularly important and likely contributed to the observed increase in GC/CT detection. Extragenital screening also plays a significant role in STI prevention as the pharynx and rectum may serve as undetected reservoirs of ongoing GC/CT transmission and may persist for many months if untreated.[11–13] GC and CT infections can also potentiate HIV acquisition and transmission.[14]

Studies have shown that extragenital screening is relatively infrequent outside of STI and HIV specialty clinics.[15,16] The results of this study and the findings from other studies suggest that clinicians

would identify, treat, and prevent more GC/CT infections if extragenital screening was conducted according to published guidelines. In the military, a recent survey of USAF primary care providers found that 81% of providers did not offer the full complement of STI screening to MSM in the prior year.[17] Because of these findings and the results of the current analysis, preparations are under way to have extragenital testing be made available and utilized at other clinical sites in the USAF. Clinicians should also assess GC/CT risk and consider extragenital screening in other populations engaging in receptive anal or oral intercourse, including HIV-seronegative persons, heterosexual men, and women. In addition to testing expanded to include pharyngeal and rectal sites, continued education about STI risk reduction and safer sexual practices is warranted to reduce the risk of GC and CT infections and to prevent HIV acquisition and transmission.

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An Outbreak of *Campylobacter* Enteritis Associated with a Community Water Supply on a U.S. Military Installation

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An outbreak of acute gastroenteritis involving 249 persons, 32% of whom were hospitalized, occurred on a U.S. Army installation in 1990. *Campylobacter jejuni* was isolated from 81 of 163 (50%) persons cultured. Seventeen isolates of *C. jejuni* available for serotyping were Lior serotype 5. The outbreak remained restricted to one recruit barracks area and adjacent Junior Reserve Officer Training Corps cadet barracks. Infection of sequential cohorts of recruits over an interval of 3 weeks suggested a continuing or intermittent common source. Contaminated food was not implicated because affected persons ate at separate dining facilities and other facilities with the same food sources had no associated illnesses. There was a strong association between the amount of water consumed by recruits and risk of diarrhea (chi-square test for trend, $p<0.001$). Samples of drinking water collected in the affected area had no residual chlorine and when cultured yielded greater than 200 colonies of coliform bacteria per 100 mL of water sampled. Although *Campylobacter* was not isolated from water, living and dead birds were found in an elevated water storage tank providing drinking water to the affected area. This and other similar outbreaks indicate that contamination of water storage tanks can lead to large outbreaks of *Campylobacter* enteritis.

Campylobacter jejuni is among the most common food- and waterborne bacterial pathogens implicated in disease outbreaks in the U.S. and worldwide.[1] Although most sporadic cases and small outbreaks have been linked to food or unpasteurized dairy products,[1] the larger epidemics of *Campylobacter* enteritis have resulted from drinking contaminated water.[2–17] Untreated surface water was implicated in outbreaks among hikers in the Rocky Mountains,[5] soldiers in Finland,[6] at a kibbutz near Jerusalem,[7] and a community in Norway.[8] In other outbreaks, municipal water systems were contaminated with *Campylobacter*.[2–4, 9–11]

Campylobacter is inoculated into water in animal feces. In several reported waterborne outbreaks, birds or other animals had access to drinking water at its source or during treatment.[3–8, 12, 13] The use of serotyping methods of Lior[18] or Penner[19] on *Campylobacter* isolates from water, animals, and humans during outbreaks has helped identify likely sources of contamination.[5, 6, 8, 12, 14–16]

This report describes an outbreak of enteritis that occurred primarily among recruits and cadets living in adjacent barracks areas at Fort Knox, KY, between 22 May and 14 June 1990. This outbreak, caused by *C. jejuni* of a single serotype, exhibited many features of transmission associated with a common source of drinking water.

The outbreak was first recognized when 17 recruits from the reception barracks area were admitted to the post hospital with acute gastroenteritis on 27 and 28 May. Isolation of *C. jejuni* from stool specimens from several recruits resulted in an investigation focused initially on the local dining facility. Shortly thereafter, additional cases of acute diarrhea were recognized in an adjacent barracks area housing Junior Reserve Officer Training Corps (JROTC) cadets.

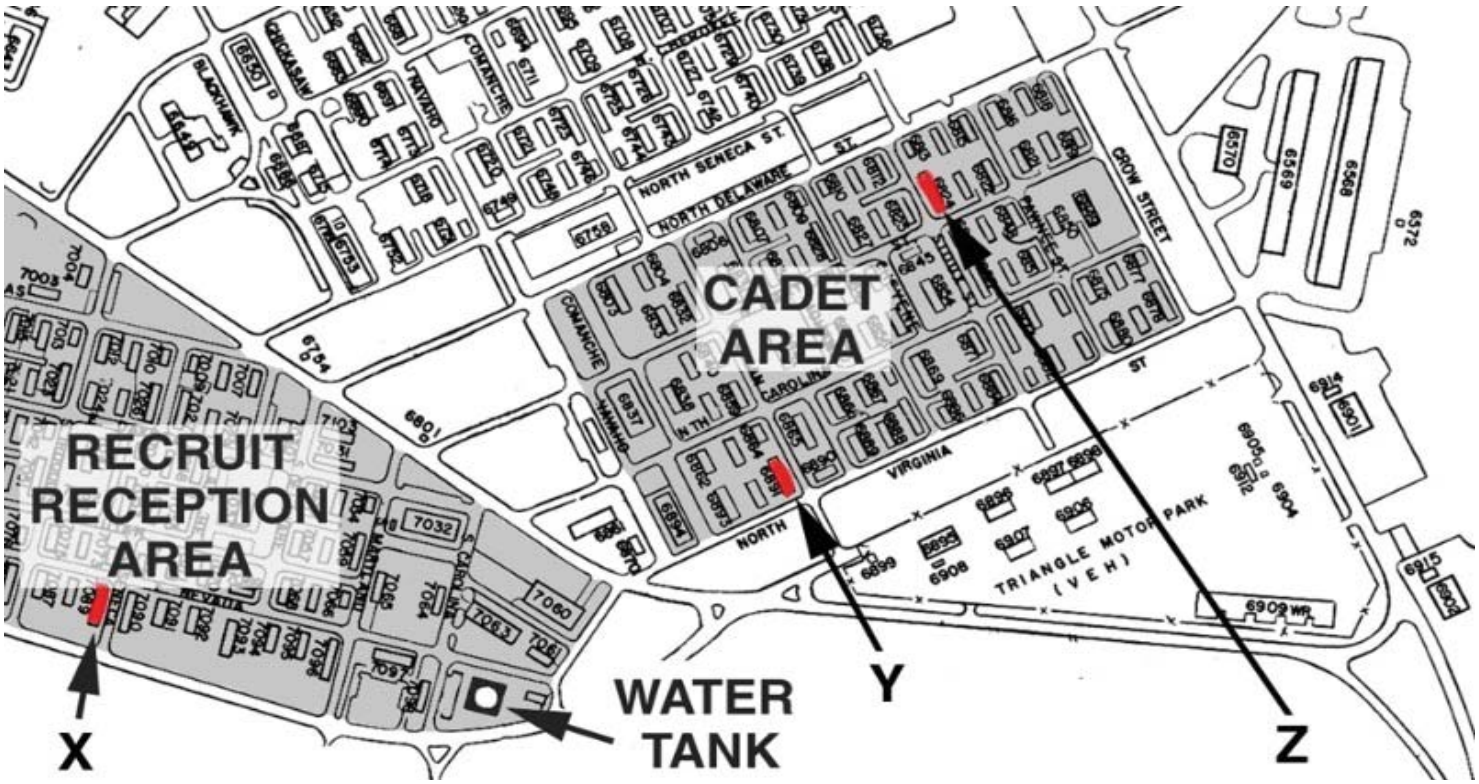
METHODS

Fort Knox is a 170-square-mile (440 km^2) Army training installation located 40 km southwest of Louisville, KY (May 1990 population: 10,950 soldiers and civilian workers and 11,000 family members). On an average day in 1990, an additional 6,000 soldiers engaged in basic and advanced military training there.

Upon arrival at Fort Knox, new recruits were routinely restricted to the reception barracks area for several days of orientation. Each evening, 20–40 recruits arrived in this area (560 × 250 m, containing 94 buildings) **(Figure 1)**. Over several days, approximately 150 recruits would be organized into one company and move to another area to begin basic combat training. Between 22 May and 8 June 1990, 622 recruits arrived and lived for several days in the reception barracks. During the period of the outbreak, all recruits in this area ate at the dining facility in building No. 7089 **(X, Figure 1)**.

A total of 421 high school students (JROTC cadets) from several schools in Kentucky and Tennessee participated in a summer camp at Fort Knox 3–9 June 1990. In contrast to recruits, all cadets arrived and departed together. During the camp, they lived in a barracks area (approximately 250 × 460 m) located immediately northeast of the reception area and ate at two other dining facilities in building Nos. 6891 and 6824 **(Y and Z, Figure 1).** Cadets

FIGURE 1. Enlarged detail of the 6800 (JROTC Barracks) and 7100 (Recruit Reception Battalion) areas, Fort Knox, KY, showing locations of water storage tank and dining facilities in building Nos. 7089 (X), 6891 (Y), and 6824 (Z)



were organized into Companies B, C, and E, each of which was subdivided into four platoons of 30–40 cadets each.

Initially, 46 recruits with acute gastroenteritis (diarrhea, nausea, vomiting, or abdominal cramps with or without fever) with onset since arrival at Fort Knox were included in the investigation. All ill recruits had arrived on post after 21 May. Rectal swabs (one or two per person) were taken for culture of enteric bacteria, including *Campylobacter*. A total of 30 asymptomatic recruits (each chosen at random from the same company as a case recruit) were selected as initial controls and had cultures obtained. As gastroenteritis case patients were identified among the cadets, they were questioned and cultures were obtained from them in a similar manner. Cultures were eventually obtained from 163 recruits, cadets, and Fort Knox staff. Case and control recruits and others who were interviewed as part of the investigation were asked to permit a blood draw for *Campylobacter* serologic studies between 6–14 June and 9–13 July for acute and convalescent phase antibody titers, respectively. One or more serum specimens were obtained from 98 recruits, cadets, and staff.

The three dining facilities in the two affected areas were inspected. Menus, work schedules, and procedures for procurement, distribution, and storage of food were examined. Staff at the dining facilities were examined and had rectal swabs for culture taken. Swabs from food preparation surfaces from the dining facilities and foods (uncooked refrigerated hamburger, sliced bologna, eggs, whole eviscerated frozen chicken, and frozen fish) from the recruit dining facility were cultured for *Campylobacter*.

Drinking water at Fort Knox was supplied by a common distribution system from two treatment plants featuring sand filtration with full chemical treatment, including chlorination and fluoridation. Overall pressure in the system was maintained by five elevated 500,000 gal (1.9 million L) storage tanks, one of which was located between the recruit reception area and the cadet barracks. During periods of increased demand, water was passively diverted to the distribution system from these tanks. For routine surveillance, tap water samples (100 mL) taken at sites throughout the post were checked for residual chlorine concentration and cultured for coliform bacteria using a membrane filter culture technique. Colony counts above 200 per 100 mL sample were considered "too numerous to count." During this outbreak, water sampling was increased in the affected areas. Samples were obtained from several buildings on 4 and 7 June. Also, tap water (1,000 cc) from several buildings and 10 pounds of ice from the ice machine in the recruit dining facility were cultured for *Campylobacter*.

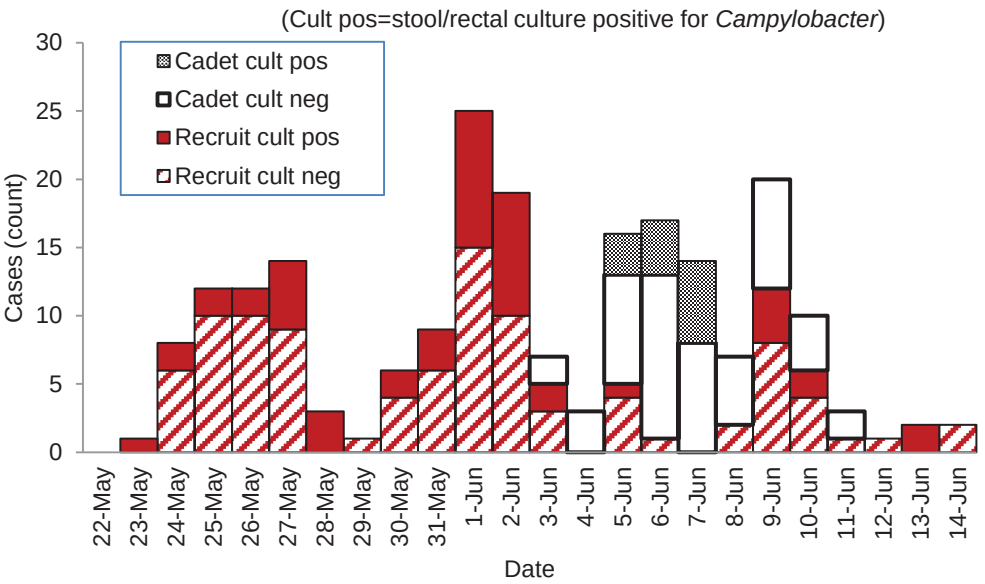
Recruits of one company (n=141) chosen because of its availability and a high diarrhea attack rate (69.5%), completed questionnaires regarding the type and amount of oral fluids (milk, water, soda, etc.) consumed in the reception area. The

survey was conducted on 14 June, 14–22 days after these recruits arrived on post.

Stool and rectal swab specimens were cultured for all common enteric bacterial pathogens. For isolation of *Campylobacter*, specimens were plated on Campy-BAP media, incubated under microaerophilic conditions, and serotyped by the Lior method.[18] Serum antibody titers were determined with an enzyme-linked immunosorbent assay (ELISA) utilizing an outer membrane protein antigen from *C. jejuni* Penner serotypes 1, 2, and 3.[20] Acute and convalescent sera from two subjects challenged with *C. jejuni* 81–176 (Penner 23/36, Lior 5) by Black et al.[21] were used as controls.

All data were entered into a computerized database and analyzed using EPI Info[22] and SAS (SAS Institute, Inc., Cary, NC). All statistical tests were two-tailed unless otherwise noted.

FIGURE 2. Acute gastroenteritis cases among recruits and JROTC cadets, Fort Knox, KY, May–June 1990



RESULTS

A total of 249 persons fit a case definition of acute gastroenteritis with onset between 22 May and 14 June. Cases were predominantly males (92%), and the average age was 20.2 (±5.4 SD) years; 86% were recruits or cadets. Other military and civilian personnel comprised the remainder of cases. **Figure 2** illustrates the progression of the outbreak from its origin among the recruits to the involvement of the cadets.

A total of 79 persons with gastroenteritis were admitted to the post hospital for a median of 3 days (range 1–13) during this period. Inpatients were more likely than outpatients to have stool or rectal swab cultures positive for *Campylobacter* (70% vs. 39%, p=0.0005), and more severe illness, with fever (44.6% vs. 19.6%, p<0.0001), and headache (36.5% vs. 23.1%, p=0.03).

Because groups of susceptible recruits arrived at Fort Knox throughout the outbreak, the attack rate for each cohort could be determined **(Table 1).** The earliest cohort experienced a much higher overall rate of diarrhea than later ones (chi-square test, p<0.001). Because the time of exposure to infection was unknown, exact incubation periods cannot be determined. However, because the earliest possible exposure for recruits and cadets was upon arrival, the interval between arrival date and onset of symptoms was used to estimate the maximum potential incubation period. For cadets, the median interval was 3 days (range 1–8 days). For recruits, this interval varied among cohorts **(Table 1)**. Because exposure may have occurred any time after arrival, longer intervals experienced by some members of the earliest recruit cohort may represent delayed exposures, rather than longer incubation periods. Multiple exposures to *Campylobacter* while in the reception area may have resulted in the higher attack rate for this cohort.

The highest attack rate among cadets occurred in Company E. A total of 55 cadets (32.3%) in this company had acute gastroenteritis, while 9.3% of Company C and 3.25% of Company B were affected. Within Company C, the attack rate was much lower among first and second platoons (one ill of 58, 1.7%) than among third and fourth platoons (11 of 70, 15.7%). Third and fourth platoons ate at the same dining facility in building No. 6891 **(Y, Figure 1)** as Company E, while the first two platoons ate with Company B in building No. 6824 **(Z, Figure 1)**. Unlike Company C, for platoons within Companies B and E, there

TABLE 1. Acute enteritis among successive cohorts of recruits in reception area, by week of arrival, Fort Knox, KY, 1990

Week	Dates of arrival	No. in cohort	AR (%)	Maximum potential incubation period, days[a]		
				Mean[b] (±SD)	Median	(Range)
1	20–26 May	173	41.6	5.9 (±3.6)	5	(<1–18)
2	27 May–2 June	201	12.4	4.1 (±2.8)	3	(1–13)
3	3–8 June	248	7.3	3.9 (±2.0)	4	(1–8)
	Total	622	18.5			

[a]Days between earliest possible exposure (date of arrival) and onset of symptoms
[b]p=0.01 for difference among means, Kruskal-Wallis one-way ANOVA
AR=attack rate; SD=standard deviation

was no difference in platoon-specific attack rates.There also was no difference in sleeping barracks-specific attack rates among the cadets.

Stool or rectal swabs from 81 of 163 persons cultured were positive for *Campylobacter*. No other bacterial pathogens were isolated. *C. jejuni* was cultured from persons with onset of illness between 24 May and 13 June. A total of 17 isolates remained viable for serotyping; all were found to be Lior serotype 5. This serotype was isolated from four recruits present in the reception area for only the first week of the outbreak, two whose earliest possible exposure occurred much later (5 June), three cadets, and a soldier from another unit at Fort Knox who visited the reception area on 7 June, drank from a water fountain there, and developed diarrhea within 48 hours.

Eight of 32 asymptomatic persons (25%) cultured in the course of the study tested positive, suggesting that infection without symptoms was common. Serologic results from recruits and cadets also suggested that asymptomatic infection occurred during this outbreak, even among those who had negative cultures. Of 71 persons for whom complete symptom histories, cultures, and serologic results were all obtained 52 (73%) had diarrhea, 44 (62%) had positive cultures, and 52 (73%) exhibited a positive serum antibody response **(Table 2)**.

There were no increased diarrhea rates outside the recruit and cadet areas on Fort Knox or in adjacent communities. All persons with positive *Campylobacter* cultures had been present in the recruit reception area or the cadet camp before 9 June, the day all dining facilities in these areas were closed and water use banned.

Food recall histories did not implicate any meal or food item as potential sources of infection. All milk, meat, poultry, and eggs were purchased in bulk from commercial sources. Items served in the implicated dining facilities were also distributed to 23 other dining facilities and the post commissary. The dining facilities had no staff in common and did not share utensils or leftover foods. Cultures of the food, ice, and surfaces in the dining facilities were negative for *Campylobacter*.

Three food handlers in the recruit dining facility had diarrhea. One food handler had diarrhea on 26 May and worked while ill that day; another developed diarrhea at the end of her last work shift 3 June. Rectal swab cultures from both were positive for *Campylobacter*. A third cook became ill on 27 May but did not work while sick. Although none of the staff of the cadet dining facilities were ill, one of the workers at the cadet facility associated with the higher attack rates had a positive culture.

Two water samples taken from the recruit dining facility on 4 June were negative for bacteria and had residual content of 0.4 and 0.5 mg chlorine per liter, respectively. Specimens taken on 7 June from this and the other dining facilities in the affected areas had no residual chlorine. Coliform bacteria (>200 colonies per 100 mL at two sites) were cultured from these and repeated samples the following day, although no *Campylobacter* were isolated from water. As part of routine drinking water surveillance, water samples taken from other areas of Fort Knox during that week had chlorine residuals and were negative for bacteria. An informal survey of workers in the recruit barracks area revealed several who reported diarrhea but denied eating in any of the dining facilities. On 8 June, a ban on drinking tap water was imposed in the affected area.

The water distribution system in several buildings in the involved areas was examined by maintenance personnel. There was no evidence of either sewage cross connections or back-siphoning of wastewater into the distribution system.

FIGURE 3. Water storage tank in reception battalion area, Fort Knox, KY, May–June 1990

Photo credit: WRAIR Department of Field Studies

The elevated water storage tank in the recruit area **(Figure 3)** was inspected and partially drained by maintenance workers late in the evening of 8 June. Starlings were observed flying in and around an open tank access door. A 60-cm-thick sludge layer inside the tank was reported to contain the

TABLE 2. Relationship of serologic (ELISA) and *Campylobacter* culture results with symptoms in recruits, cadets, and staff (n=71),[a] Fort Knox, KY, May–June 1990

	Had diarrhea n=52		No diarrhea[b] n=19	
	Culture		Culture	
	Pos.	Neg.	Pos.	Neg.
ELISA + (Pos)[c]	33	8	7	4
ELISA - (Neg)	4	7	0	8
Totals	37	15	7	12

[a]All were present in the cadet or recruit reception areas during the outbreak and were potentially exposed to infection.

[b]Of 19 (89%) persons tested, 17 had no gastrointestinal symptoms (diarrhea, nausea, vomiting, abdominal cramps).

[c]A single ELISA titer of 1.4 optical density (OD) units (three SD above the mean OD for the negative controls), or a 2-fold increase in OD between acute and convalescent sera.

remains of several birds. Skeletal remains of birds also were observed in the drainage area at the base of the tank. The tank was flushed, disinfected, and refilled. Unfortunately, no sludge or water from the tank was available for culture for *Campylobacter*.

A total of 141 recruits completed the survey; 90 (63.8%) had diarrhea with onset 48 hours or more after arrival at Fort Knox, the time frame used to define cases for this part of the analysis. A total of 29 (32.2%) of these cases were positive by culture and/or had serologic evidence of recent infection with *Campylobacter*.

Responses from 87 cases and 47 controls were sufficiently complete for analysis. Each day in the reception area, they drank a median of 14 8-oz (250 mL) glasses of water, or drinks made with tap water, such as non-carbonated soft drinks.

Cases reported higher total daily intake of these fluids (mean 16 glasses, $p<0.001$), water (mean 13.8 glasses, $p<0.001$), and water at the dining facility (mean 4.8 glasses, $p<0.001$).

There were no differences in glasses of milk (1.6 vs. 1.7 per day), water in the barracks (4.3 vs. 3.6 glasses per day), or ice use (1.8 vs. 1.4 times per day) between cases and non-cases.

The attack rates for diarrhea were higher among those who drank larger amounts of water while in the reception area. **Table 3** shows the association between daily intake of water and diarrhea attack rate (chi-square test for trend, $p<0.001$).

EDITORIAL COMMENT

Foodborne transmission in this outbreak was probably of minor significance. Although infected food handlers and contaminated food preparation surfaces have been implicated in several small outbreaks of *Campylobacter* enteritis,[23–25] the duration of transmission was usually limited to several hours. By continuing to work while ill, infected food handlers in this outbreak may have aided transmission for up to several days. However, infections occurring in recruits arriving on post over the 3 weeks of apparent risk suggest repeated exposures to a common source. Despite the failure to isolate *Campylobacter* from water, this continuous or intermittent exposure and other characteristics of the outbreak support waterborne transmission from the contaminated storage tank. Isolation of a single serotype from 17 persons at Fort Knox suggests a common source of infection.[14] A dose-response relationship between amount of water consumed and attack rate of *Campylobacter* enteritis has been reported.[2, 4, 9–11, 17] The relatively large amount of water consumed by the recruits may reflect the emphasis on fluid intake for heat injury prevention during basic training. A similar relationship between a large amount of water consumed and risk of infection was found in shop workers in Quebec who drank more than 10 glasses of water per day.[10]

Birds have been implicated in several waterborne *Campylobacter* outbreaks.[4,6, 12,13,15] Although most outbreaks occurred in non-chlorinated water systems, others involved systems where chlorine was present but was apparently inadequate to prevent infection.[4,14,16]

C. jejuni survives longer in colder water.[26] Most outbreaks have implicated cold water sources such as ground water,[8, 16, 17] mountain streams or lakes,[5] or snow melt.[9] However, survival in warmer water also occurs, as shown by one outbreak in Florida in which birds had access to an open water treatment tower.[4] Similar conditions may have been present at Fort Knox.

Campylobacter had not been recognized as a public health problem at Fort Knox before this outbreak. A total of 13 unrelated cases of *Campylobacter* enteritis had occurred on Fort Knox in the previous 18 months. The highest monthly case total during this time was four, in February and September 1989.

Symptoms of the last known case of enteritis associated with this outbreak began on 14 June. During the next 2 months, cultures from five persons with diarrhea (of 206 at Fort Knox who were cultured) were positive for *Campylobacter*; one was serotyped (Lior type 1). Only four of 563 stool cultures obtained throughout 1991 grew *Campylobacter*. Continued increased drinking water surveillance in the affected areas did not indicate any subsequent contamination or lapses in chlorination.

Perhaps the water tank in the recruit area had been recently contaminated. Also, all cadet barracks and many recruit barracks had been recently opened after months of vacancy. Restoration of water circulation and increased flow in these areas would have disturbed sediment in pipes that may have been previously inoculated from the tank, increasing the chlorine demand and causing depletion of free chlorine.

The large volume of water used for drinking and food preparation may help explain the association of infection with dining facilities. The two dining facilities associated with high diarrhea attack rates (the recruit dining facility and the cadet dining hall in building No. 6891) are located closest to the implicated water tank (236 and 305 m, respectively). Water contaminated from the tank may have been diluted from the remainder of the distribution system before reaching the other cadet dining hall (building No. 6824, 381 m).

The risk of exposure through community water supplies remains. In a study of 262 outbreaks of *Campylobacter* reported in the U.S. between 1997 and 2008, Taylor

TABLE 3. Diarrhea attack rate among recruits, by reported daily water consumption while assigned to reception battalion, Fort Knox, KY, May–June 1990

Daily water intake (No. of glasses)[a]	Cases[b]	Non-cases	Total	Attack rate[c]
0–6	6	11	17	35.3%
7–12	32	23	55	58.2%
13 or more	49	13	62	79.0%

[a]8 ounces (250 mL) equivalent.

[b]Cases are defined as recruits reporting acute diarrhea with onset at least 48 hours after arrival at Fort Knox, KY.

[c]Chi-square test for trend, $p<0.001$

et al.[27] found that, although drinking water accounted for only 9% of the outbreaks during the interval, 24% of the cases were caused by water. Drinking water was implicated in 20 (83%) of the waterborne cases and recreational water contact in the remaining 17%. A contaminated public water supply was identified as the source of infection in 13 (65%) of the drinking water outbreaks.

Despite the fact that there have been no subsequent events similar to the one in 1990 at Fort Knox on U.S. military installations, the potential for waterborne *Campylobacter* transmission must always be considered in sudden outbreaks, even when infection initially appears associated with food or dining facilities.

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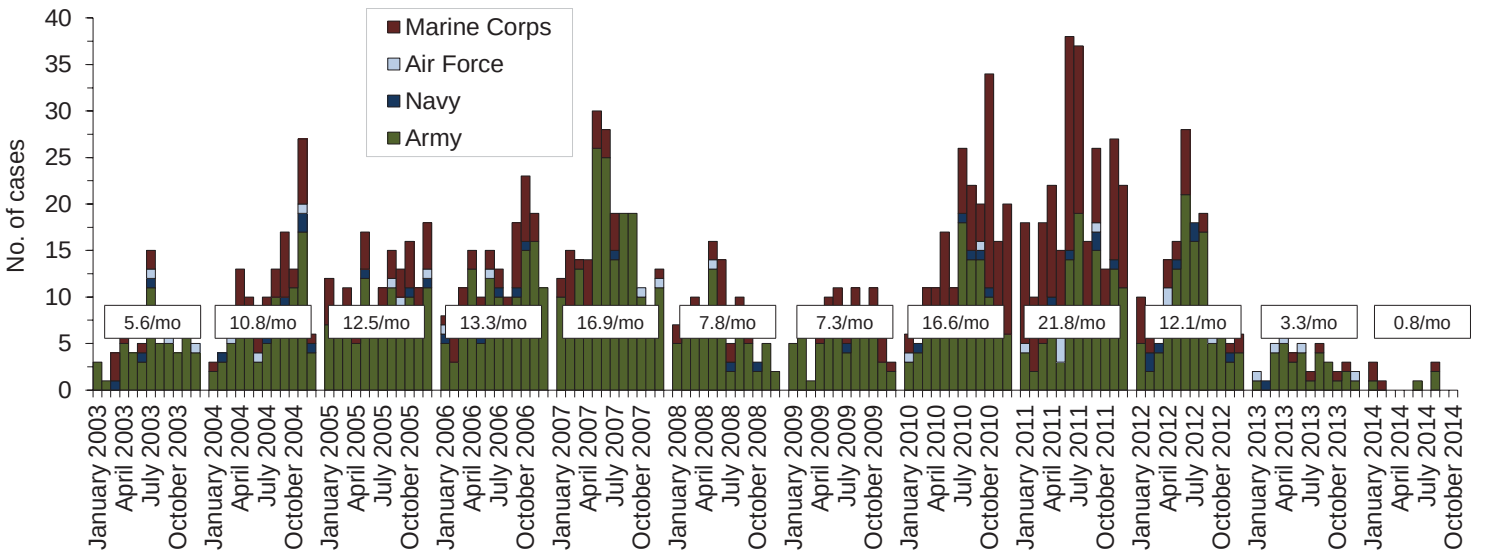
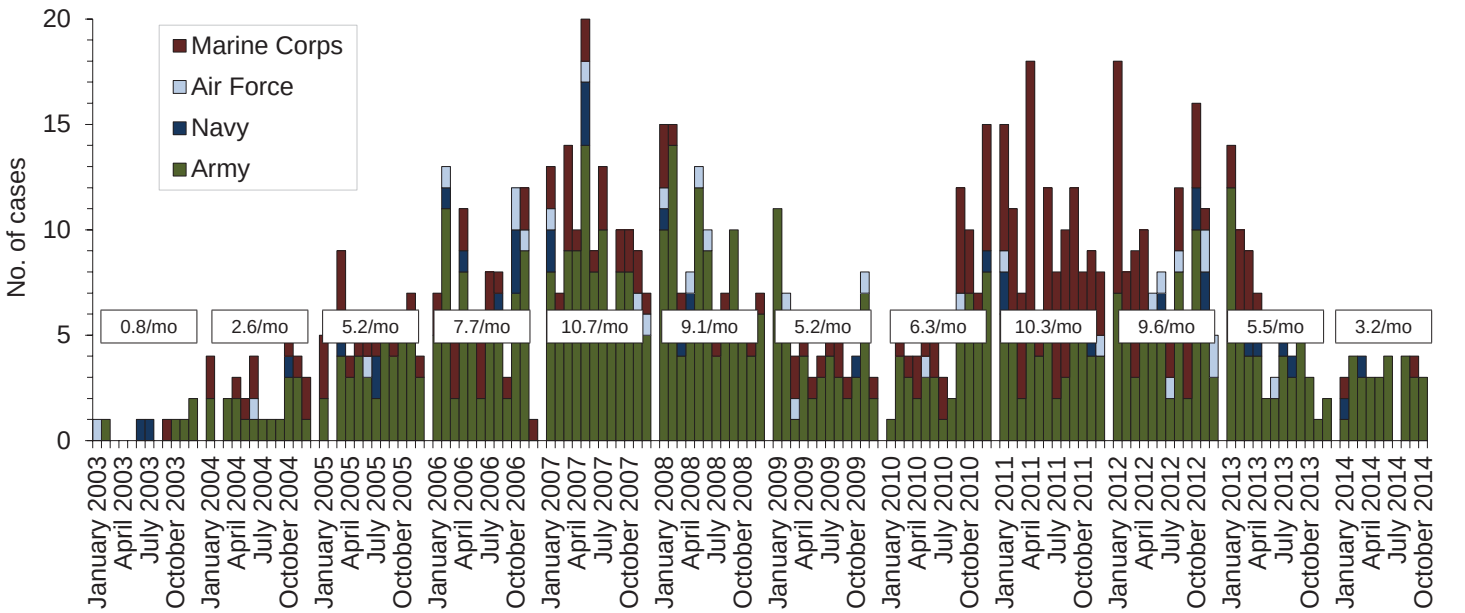
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–October 2014 (data as of 18 November 2014)

Amputations (ICD-9-CM: 887, 896, 897, V49.6 except V49.61–V49.62, V49.7 except V49.71–V49.72, PR 84.0–PR 84.1, except PR 84.01–PR 84.02 and PR 84.11)[a]



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: amputations. Amputations of lower and upper extremities, U.S. Armed Forces, 1990–2004. *MSMR*. Jan 2005;11(1):2–6.
[a]Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from deployment.

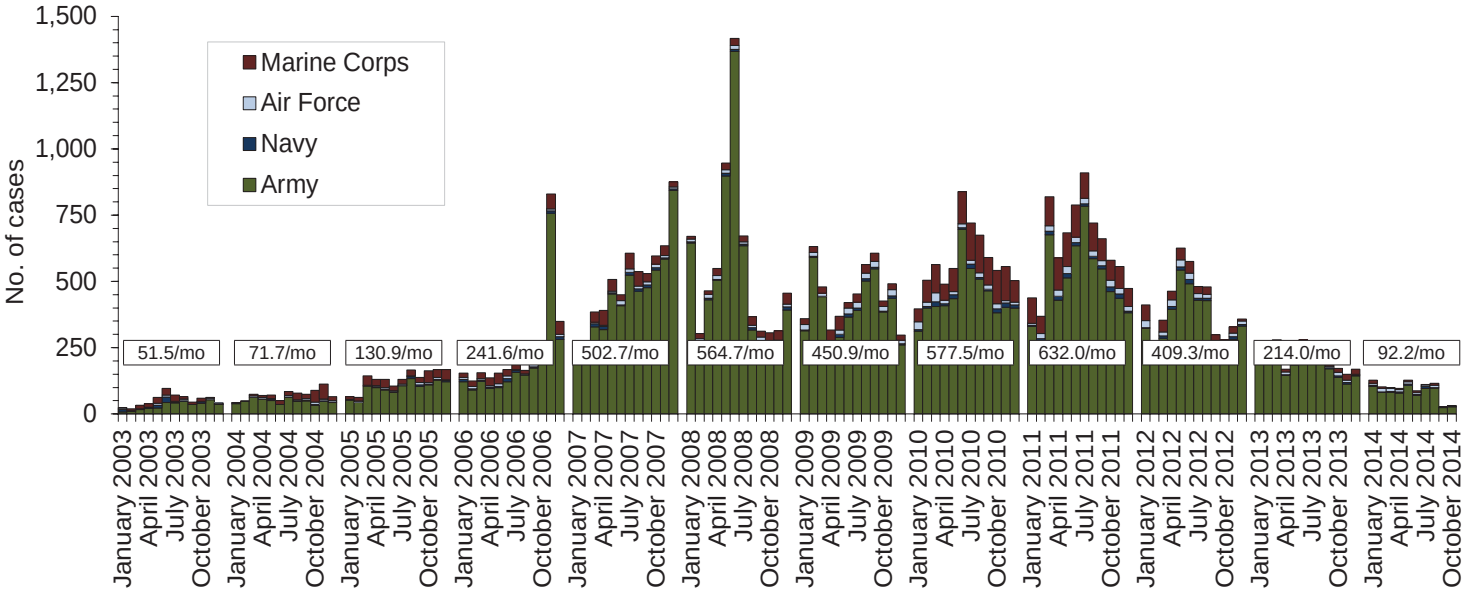
Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)[b]



Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002–2007. *MSMR*. Aug 2007; 14(5):7–9.
[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 365 days of returning from deployment.

Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–October 2014 (data as of 18 November 2014)

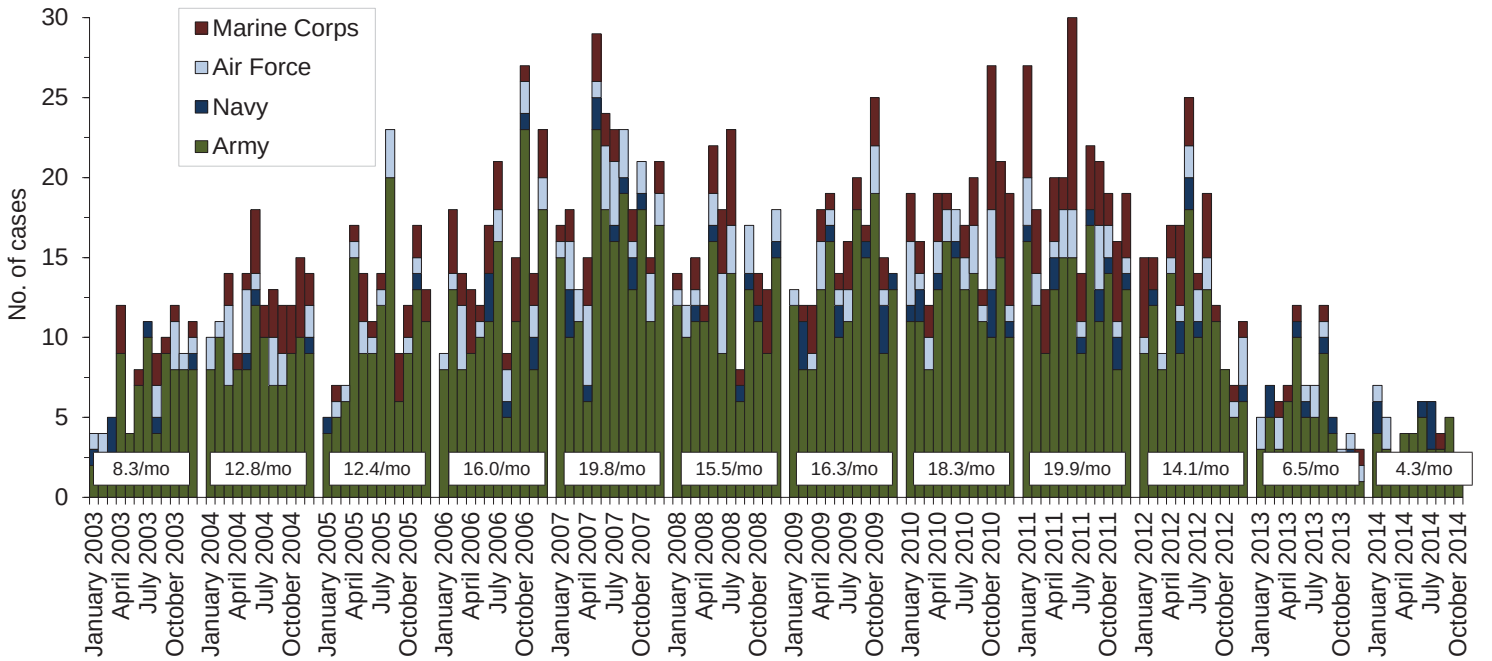
Traumatic brain injury (TBI) (ICD-9: 310.2, 800–801, 803-804, 850–854, 907.0, 950.1–950.3, 959.01, V15.5_1–9, V15.5_A–F, V15.52_0–9, V15.52_A–F, V15.59_1–9, V15.59_A–F)[a]



Reference: Armed Forces Health Surveillance Center. Deriving case counts from medical encounter data: considerations when interpreting health surveillance reports. *MSMR*. 2009; 16(12):2–8.

[a]Indicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from deployment (includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 4,600 deployers who had at least one TBI-related medical encounter any time prior to deployment).

Deep vein thrombophlebitis/pulmonary embolus (ICD-9: 415.1, 451.1, 451.81, 451.83, 451.89, 453.2, 453.40–453.42 and 453.8)[b]



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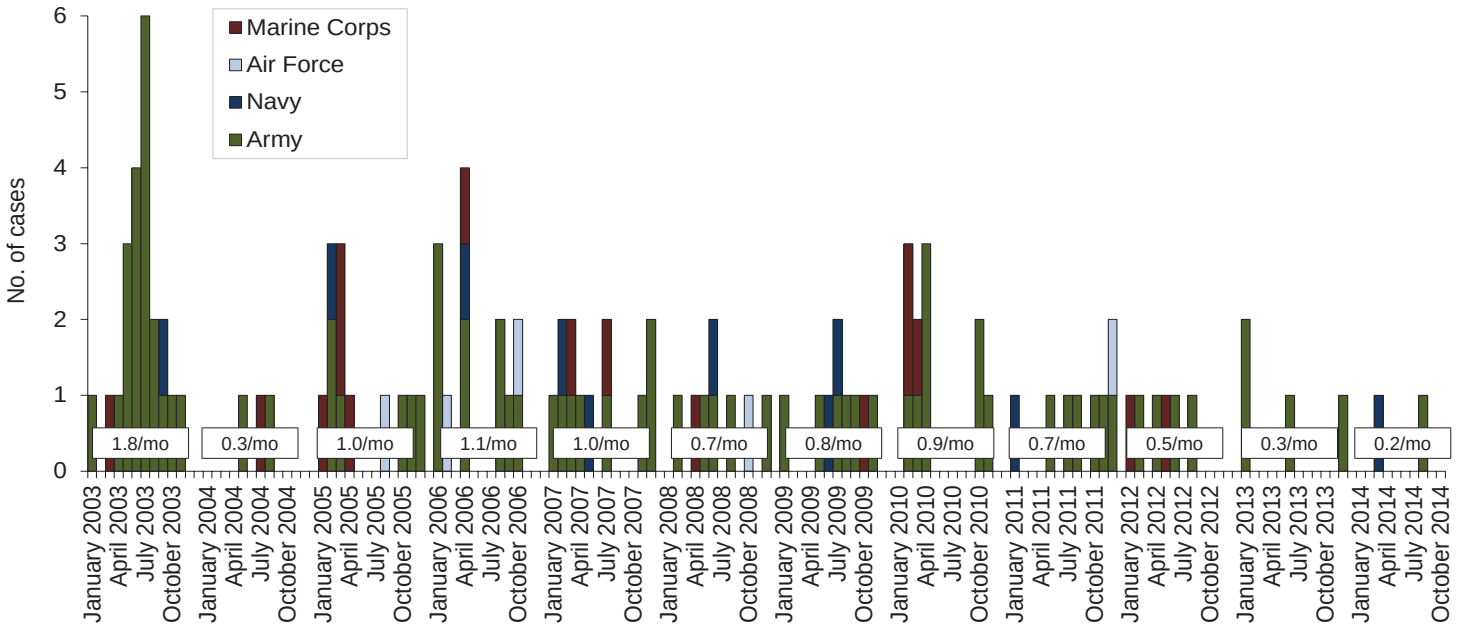
[b]One diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 90 days of returning from deployment.

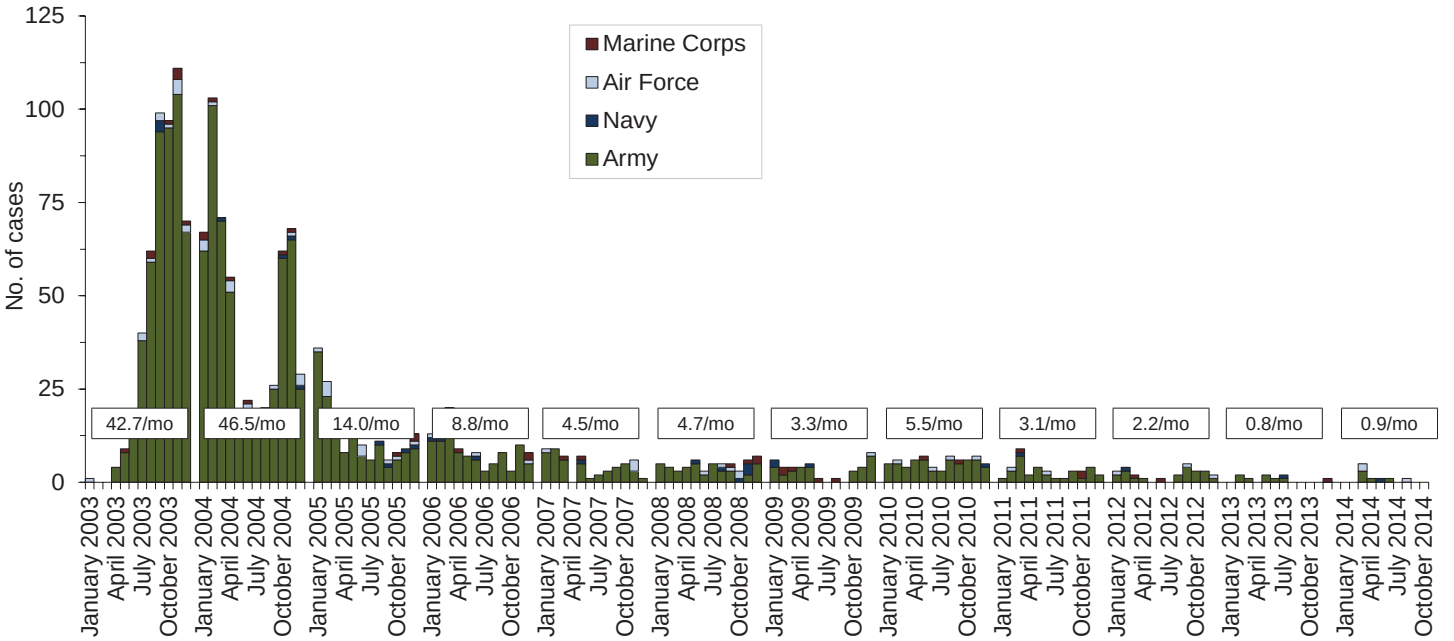
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–October 2014 (data as of 18 November 2014)

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



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: severe acute pneumonia. Hospitalizations for acute respiratory failure (ARF)/acute respiratory distress syndrome (ARDS) among participants in Operation Enduring Freedom/Operation Iraqi Freedom, active components, U.S. Armed Forces, January 2003–November 2004. *MSMR*. Nov/Dec 2004;10(6):6–7.
[a]Indicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF/OND.

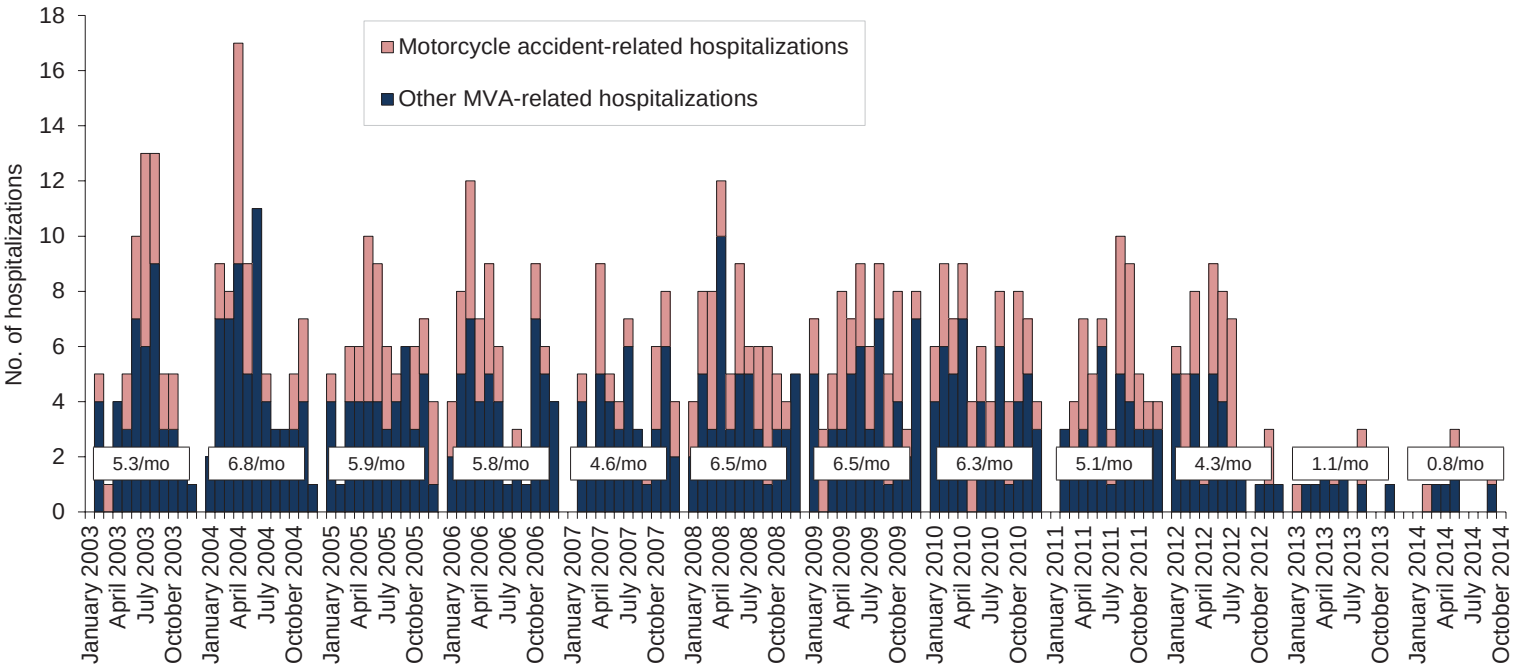
Leishmaniasis (ICD-9: 085.0–085.9)[b]



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003–November 2004. *MSMR*. Nov/Dec 2004;10(6):2–4.
[b]Indicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF/OND.

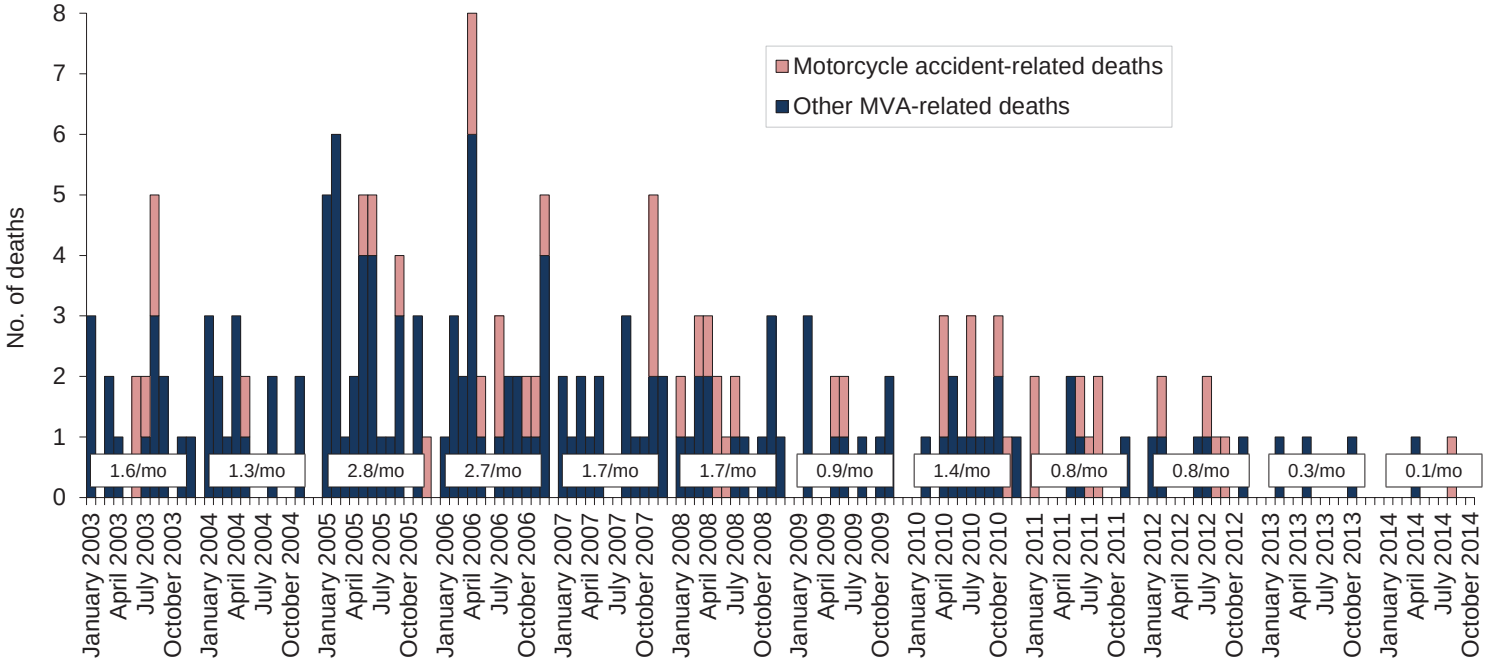
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–October 2014 (data as of 18 November 2014)

Hospitalizations outside of the operational theater for motor vehicle accidents occurring in non-military vehicles (ICD-9-CM: E810–E825; NATO Standard Agreement 2050 (STANAG): 100–106, 107–109, 120–126, 127–129)



Note: Hospitalization (one per individual) while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany, within 10 days of another motor vehicle accident-related hospitalization.

Deaths following motor vehicle accidents occurring in non-military vehicles and outside of the operational theater (per the DoD Medical Mortality Registry)



Reference: Armed Forces Health Surveillance Center. Motor vehicle-related deaths, U.S. Armed Forces, 2010. *MSMR*. Mar 2011;17(3):2–6.
Note: Death while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany, within 10 days prior to death.

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