Short Communication

Investigation of Incident HIV Infections Among U.S. Army Soldiers Deployed to Afghanistan and Iraq, 2001–2007

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Abstract

The U.S. Army initiated an investigation in response to observations of a possible increase in HIV incidence among soldiers deployed to combat. Human immunodeficiency virus (HIV)-infected U.S. Army soldiers are not eligible to deploy. Combat presents a health hazard to HIV-infected soldiers and they pose a threat to the safety of the battlefield blood supply and their contacts. All soldiers are routinely screened for HIV every 2 years and those who deploy are also screened both prior to and after deployment. Seroconversion rates were estimated for all soldiers who deployed to Afghanistan or Iraq in the period 2001–2007 and all active duty soldiers who did not. Seroconverters with an estimated date of infection, based on calculation of the midpoint between the last seronegative and first seropositive test date, that was either before or during deployment were eligible for inclusion. Confidential interviews and medical record reviews were conducted to determine the most likely time, geographic location, and mode of infection. Reposed predeployment samples were tested for HIV ribonucleic acid. The HIV seroconversion rate among all soldiers who deployed was less than the rate among those who did not deploy: 1.04 and 1.42 per 10,000 person-years, respectively. Among 48 cases, most were determined to have been infected in the United States or Germany and prior to deployment ($n=20$, 42%) or during rest and relaxation leave ($n=13$, 27%). Seven seronegative acute infections were identified in the predeployment period. Subtype was determined for 40 individuals; all were subtype B infections. All were acquired through sexual contact. These findings can inform development of preventive interventions and refinement of existing screening policy to further reduce HIV-infected deployed soldier person time.

THE PREVALENCE OF HIV INFECTION in the U.S. Army population remains at approximately 0.02%,¹ and is significantly lower than that of the general U.S. population. The epidemic in the Army is similar to that in the U.S. general population; HIV infection disproportionately affects blacks and males and also disproportionately affects certain regions of the country including the South and Northeast.^{2–4} By regulation, all U.S. soldiers are subject to periodic serologic screening for HIV every 2 years. In addition, soldiers who deploy to combat are also screened both prior to and after returning from deployments. HIV-infected soldiers are excluded from overseas missions.^{5,6} Requirements for U.S. Army soldiers who deployed to Afghanistan or Iraq from

October 2001 to December 2007 were for serologic screening for HIV infection within 365 days before deployment and within 30 days after the end of deployment. HIV force screening began in 1986 with the purpose of enhancing the safety of blood products obtained in urgent donation settings, such as a battlefield, preventing potentially fatal complications from administration of military-required, live vaccines, and monitoring HIV-infected troops for continuing physical qualification for duty.⁷

Approximately 5 years ago observations by Army investigators suggested that there may be an increase in HIV incidence among soldiers associated with combat deployments.^{8–10} On July 14, 2007, the U.S. Army Surgeon General ordered an

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investigation to describe the location, time, and mode of transmission of HIV infections among U.S. Army soldiers who had deployed to Afghanistan and Iraq after October 1, 2001.

Soldiers with HIV seroconversions were identified using archived personnel, deployment, and HIV screening surveillance data from the Defense Medical Surveillance System (DMSS).¹¹ The rate of HIV seroconversion among soldiers who deployed to Afghanistan or Iraq was compared to the rate among active duty soldiers who did not deploy to Afghanistan or Iraq at any time during the study period. The midpoint between the last seronegative and first seropositive test date was estimated to be the date of HIV infection. Soldiers with an HIV-positive test who had deployed to Iraq or Afghanistan at any time during the study period were eligible for inclusion. Those who had a midpoint date either prior to or during deployment were included in this investigation. Soldiers were confirmed as cases after they individually verified their deployment dates.

All confirmed cases were invited to participate in a detailed epidemiologic interview and to permit a review of existing personnel and medical records. Soldiers were reminded of the protections from adverse action and confidentiality of the information obtained as part of epidemiologic interviews required by Army regulation.⁵ To avoid the potential for favorable reporting, soldiers were not required to participate. Veterans who had separated from the Army were asked to provide informed consent and permission to release existing medical records. A single military infectious disease physician, who conducted interviews at U.S. Military Treatment Facilities, administered a questionnaire that guided the interviews and elicited individual health, social, and military occupational history including medical encounters and potential exposures to HIV.

For each case, archived serum remaining from the last seronegative HIV test performed prior to deployment was obtained from the Department of Defense Serum Repository (DoDSR)¹¹ and subjected to confirmatory HIV serologic testing^{2,12} and nucleic acid amplification testing (NAAT, AmpliCor HIV-1 Monitor v 1.5, Roche). Acute HIV infection (AHI) in an individual was identified by an HIV-seronegative sample that was NAAT positive. Whole blood specimens were collected at the time of epidemiologic interview for genotyping. Nucleic acid was extracted from plasma and serum using the QiAmp Viral RNA mini kit (QIAGEN Inc., Valencia, CA). HIV genotyping and sequence analysis were performed, as previously described, using a multiregion hybridization assay (MHA) for subtype B/non-B (MHAbnb) and partial length sequencing.^{2,13}

The most likely time, geographic location, and mode of acquisition of HIV infection were determined using all available data. A timeline of events in the period of risk prior to HIV infection was generated for each participant and included self-assessment of the most likely time, location, and mode of infection; self-reported behavioral and occupational exposures; medical encounter and laboratory test records; and the dates and locations of all deployments, rest and relaxation (R&R) activities, and military assignments. Cases of probable, acute retroviral syndrome were identified using clinical histories and compatible medical encounter data. Where possible, administrative and medical records data were used to validate participant self-reports.

Approval of this investigation was obtained from the Division of Human Subjects Protections and Institutional Review Board of the Walter Reed Army Institute of Research (WRAIR #1678).

Among the 1,134,001 soldiers who deployed to Afghanistan or Iraq during the study period, 131 seroconverted (1.04/10,000 person years). By comparison, 258 of the 1,816,901 soldiers who did not deploy to Afghanistan or Iraq during the study period seroconverted (1.42/10,000 person-years).

Of the 131 seroconverters who deployed, 67 were not included because their midpoint date did not meet the inclusion criteria or due to misclassification of infection status or history of deployment. Of the 64 who were eligible for inclusion, nine declined participation, one was deceased, and one did not respond. Five others were excluded because the actual deployment dates individually verified by the soldier were different from those obtained from archived surveillance data such that their midpoint date was not prior to or during deployment. Thus, 48 confirmed cases participated. Compared to the overall deploying Army, cases were older, of higher rank, and were more frequently black and unmarried (Table 1).

Of the 48 confirmed cases, 20 (42%) were determined to have been infected before deployment, 13 (27%) during leave for R&R, and one (2%) while deployed. Determination of the most likely time of infection for four of the soldiers could be narrowed to only two time periods because exposure histories spanned more than one period. Five (10%) were determined to have been infected in the period between their deployment end date and postdeployment HIV serologic screening. For five other soldiers, there were insufficient existing data or exposure histories obtained in the interview to narrow the most likely time of infection down to even two periods (Fig. 1).

Most were determined to have been infected in the continental United States or Germany. Most (13/20) of the soldiers who were determined to have acquired their HIV-1 infection prior to deployment were infected in the last 6 months prior to departing for Afghanistan or Iraq (Fig. 2). Seven soldiers' predeployment samples were HIV seronegative and NAAT positive. These samples were collected between 290 and 41 days (median 76) prior to deployment. HIV subtype was determined by MHA or partial length sequencing for 40 of 48 participants and all were subtype B. For eight participants, samples were either not available or nontypeable.

High-risk exposures in the period at risk included unprotected sex with opposite and same sex partners; unprotected sex with strangers and other high-risk partners including commercial sex workers, injection drug users, and persons subsequently identified as HIV-infected; unprotected sex with multiple partners; and unprotected sex after alcohol use. None were emergency blood transfusion donors or recipients. One individual refused to provide a history of exposures.

Twenty-three individuals (48%) had a clinically apparent illness consistent with acute retroviral syndrome (ARS). Five were medically evacuated for evaluation of lymphadenopathy and one for evaluation of a febrile illness. Two soldiers contracted a sexually transmitted infection in addition to HIV during the period between when they were determined to have been infected and the end of their deployment. No participant experienced any vaccine adverse events.

This is the first report of HIV infections among U.S. Army soldiers deployed in support of combat operations. Overall, the rate of new HIV infections among those who deployed did

TABLE 1. CHARACTERISTICS OF HIV-INFECTED CASES (N=48) COMPARED TO ALL HIV-UNINFECTED ACTIVE ARMY PERSONNEL WHO DEPLOYED IN THE PERIOD 2001–2007

Variable	All deploying active Army personnel n (%)	Investigation participants n (%)
Year of operation		
2002	56,226 (5)	2 (4)
2003	276,178 (24)	16 (33)
2004	230,695 (20)	14 (29)
2005	215,326 (19)	9 (19)
2006	162,507 (14)	6 (13)
2007	186,181 (16)	1 (2)
Age group ^{a,b}		
20–24	390,256 (34)	8 (17)
25–29	236,806 (21)	14 (29)
30–39	303,381 (27)	16 (33)
40+	138,370 (12)	10 (21)
Sex		
Male	1,019,894 (90)	47 (98)
Female	114,107 (10)	1 (2)
Race ^b		
Black	209,168 (18)	32 (67)
Other	924,869 (82)	16 (33)
Component		
Active	Not applicable	33 (69)
Reserve	Not applicable	15 (31)
Grade ^b		
E1–E4	537,927 (47)	18 (38)
E5+	596,090 (53)	30 (62)
Marital status ^{b,c}		
Married	590,549 (52)	22 (46)
Single	486,144 (43)	21 (44)
Other	57,344 (5)	5 (10)
Education		
Master degree	Not available	4 (8)
Associate/Bachelor degree		11 (23)
Some College		22 (46)
<High School		11 (23)
Occupation		
Combat arms	Not available	14 (29)
Combat support		23 (48)
Medical		4 (8)
Other support		7 (15)

^a <20 age group (6% of deploying Army personnel) not shown.

^b Differences were statistically significant ($p < 0.05$, χ^2 /Fisher's exact tests).

^c Other includes divorced, separated, widowed, unknown.

not exceed the rate among nondeploying soldiers and infection while deployed in Afghanistan and Iraq was extremely rare. Single, male, and black soldiers were overrepresented among the soldiers with new HIV infections who deployed. This was not unexpected as these findings are consistent with those in a previous report of the epidemic of HIV in the U.S. Army and Air Force.² However, these data demonstrate that HIV infection results in short-term morbidity and lost duty time in the combat environment. The realities of the current combat environment support the rationale that served as a basis for implementing force-wide screening policies 25 years

FIG. 1. Numbers of cases with determination of most likely time of infection occurring during particular periods in relation to deployment ($n=48$). R&R locations: 11 continental United States, 1 South America, 1 unknown. *The most likely time of infection could be narrowed to only one of two time periods because exposure histories spanned more than one period.

ago.⁷ Deployment and the battlefield present potential exposures to blood-borne pathogens including HIV. In addition to sexual transmission^{14,15} there is potential contact with the battlefield supply of non-FDA-approved blood products,^{16,17} occupational combat exposures, and casualty care with infection control measures limited by austere field conditions.^{18,19} The probability of any transfusion-transmitted (TT) infection in combat settings is relatively low, while the potential impact is high. Underscoring this is a recent report of the first documented case of TT hepatitis C virus infection in a U.S. military recipient of a battlefield transfusion of non-FDA licensed, fresh whole blood,¹⁶ as well as a recent report of TT HIV infection in the United States.²⁰

Optimal HIV-related policy development and decision making rely on both knowledge of the current epidemiology and careful consideration of the technical, fiscal, and operational costs associated with each potential strategy. The observed, small number of HIV-infected soldiers in the combat theater of operations suggests that periodic force screening and perideployment screening using serological diagnostic algorithms to identify HIV infection are highly successful and effectively decrease HIV-infected deployed soldier person time. These findings contributed to an interim change in deployment screening policy that shortened the required HIV testing interval from 365 days to 90 prior to deployment in order to increase case finding, referral for clinical care, and exclusion from deployment eligibility. They may also inform further refinement of screening policy and laboratory methodology.

These data identify potential time period targets for the delivery of preventive interventions. As part of soldier readiness processing, soldiers preparing to deploy receive country-specific threat briefs that include information about potential disease, environmental, and occupational health hazards, and individual countermeasures available to stay healthy. These briefs include specific information and prevention messages about HIV/HIV-related infections. These data also reinforce the need to maintain a highly sensitive, readily adaptable, state-of-the-art capacity to determine HIV

FIG. 2. Days from determination of most likely time of acquisition of HIV infection to start of deployment for soldiers infected prior to deployment ($n=20$).

infection status when the tempo of military operations is high. Identification of acute HIV infection is a rare event.²¹ By using an enhanced diagnostic algorithm that included HIV NAAT testing in this investigation that exceeded the sensitivity and time of earliest detection of the routine deployment serology-only screening diagnostic algorithm in place during the study period, we identified seven HIV infections that were RNA positive and serology negative. These results indicated that infection occurred as early as 5–22 days prior to sample collection.²² The finding of acute infection occurring in close proximity to predeployment HIV screening suggests that there may be an association between mobilization for deployment and HIV infection acquisition.

Predeployment HIV testing is one part of the soldier readiness processing and training that occurs prior to deployment. This testing, performed in addition to the periodic HIV testing of the entire force, is conducted only among soldiers preparing to deploy. It is possible then that there is a relationship between incident HIV infection and deployment. There was no control group so additional study is warranted to investigate the possibility that deployment is associated with changes in behavior and exposures associated with HIV infection.

Future study is also warranted of soldiers who had incident HIV infections and deployed but were not compliant with deployment screening interval regulations and were not included in this investigation. A limitation of this study is that the inclusion criteria excluded those who have an estimated

date of infection that was after the end of deployment. Due to the variability in compliance with predeployment and post-deployment and periodic HIV screening interval requirements, these inclusion criteria potentially excluded soldiers who may have contributed HIV infected person time while deployed and also eliminated description of the epidemiology of postdeployment incident HIV infection. Additional study of those soldiers with deployment exposure and post-deployment HIV infection is warranted. And on-going surveillance efforts of and reporting requirements for HIV screening compliance should continue. Findings from these studies would inform development and optimal timing for delivery of preventive interventions.

This study supports the utility of perideployment HIV screening. The findings of this investigation can advance the objectives of a force-wide HIV screening program to improve individual and force health, prevent the deployment of HIV-infected soldiers, and protect the safety of the battlefield blood supply.

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