UNDER SECRETARY OF DEFENSE
4000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-4000

PERSONNEL AND
READINESS

MAY 27 2020

The Honorable Elaine Luria
Chairwoman
Subcommittee on Disability Assistance and Memorial Affairs
Committee on Veterans' Affairs
U.S. House of Representatives
Washington, DC 20515

Dear Madam Chairwoman:

Thank you for your letter of March 11, 2020 to the Secretary of Defense requesting information on potential environmental exposure at Karshi-Khanabad Air Base in Uzbekistan. Responses to your specific questions are provided in the enclosed document.

Some of the documents enclosed contain information exempt from the disclosure provisions of the Freedom of Information Act (5 U.S.C. § 552). Should you require a publicly releasable version of any of the documents enclosed, it will be provided upon request. Additional classified documents are available for review by cleared staff upon request.

We fully support the efforts of the Department of Veterans Affairs to further research adverse health outcomes among Service members and veterans and any potential associated with environmental hazards.

An identical letter is being sent to the Ranking Member, Subcommittee on Disability Assistance and Memorial Affairs, Committee on Veterans' Affairs. Thank you for your continued support of the health and well-being of our Service members, veterans, and their families.

Sincerely,

Matthew P. Donovan

Enclosure:
As stated

Enclosure: Responses to Specific Questions

1. ***All unclassified or classified assessments of potential contamination or health hazards at K-2.***

We have located three occupational and environmental surveys. The baseline assessment was completed in November 2001. A follow-up survey was done in 2002, and a final (pre-closure) assessment was done in 2004. All assessments are classified in accordance with Central Command Guidance provided at the time the assessments were conducted. Electronic files of the assessments will be sent to your office using an appropriate secure method approved for transmission of classified information. To our knowledge, these three assessments were the only environmental surveys conducted by the Department of K-2. An unclassified information paper based on the original site assessment is enclosed (Enclosure One). The three classified occupational and environmental assessments, consisting of approximately 700 pages of material, are available for review by cleared staff upon request. A copy of the classified material was provided to the House Oversight and Reform Committee on March 18, 2020. The Department has no objection to cleared Subcommittee staff reviewing the classified materials with the House Oversight Committee.

2. ***All health evaluations or assessments conducted from 2001 to the present of personnel previously deployed to K-2.***

The only formal study of personnel previously deployed to K-2 is the October 2015 Army Public Health Center evaluation cited in your request. The study is enclosed (Enclosure Two). A separate publication by the same authors which explains the difficulties inherent in the study of post-deployment cancers among active duty personnel is also enclosed (Enclosure Three).

3. ***All guidance or instruction documents provided to medical personnel regarding conditions and potential health hazards at K-2.***

An information sheet for health care staff, entitled "Environmental Conditions at K-2: Information for Health Care Staff" is enclosed (Enclosure Four). This document, though undated, was produced when K-2 was still an operational air base, sometime between 2002 and 2004. The information sheet was intended to help prepare medical personnel for some of the more common questions they may encounter.

4. ***All guidance or briefing materials provided to Service members deployed to K-2 between 2001 and 2005 regarding health and hazard conditions at K-2.***

An information sheet for Service members and veterans, entitled "Environmental Conditions at K-2 Air Base, Uzbekistan: Information for Service Members and Veterans," was produced by the Army Public Health Center sometime after the closure of the K-2 base. This information sheet (Enclosure Five), along with the publically released Military Deployment Periodic Occupational and Environmental Monitoring Summary: K2 Airbase, Uzbekistan: 2001

to 2005 (Enclosure Six), are available on the Army Public Health Center's website, https://phc.amedd.army.mil.

5. ***All documents and communications including, but not limited to, communications with the Department of Veterans Affairs (VA), relating to U.S. Service member deployments to K-2 and the potential for exposure to hazardous materials at K-2.***

We were able to locate internal Deployment Health Support Staff meeting minutes from 2002 (Enclosure Seven) that noted a database for K-2 Service members was not planned. Additionally, we located an issue paper on potential exposures at K-2 from April 2002 responsive to your request (Enclosure Eight).

ENCLOSURE 1

MCHB-AE 28-Mar-02

Information Paper

SUBJECT: (U) Environmental Site Characterization and Operational Health Risk Assessment, Stronghold Freedom

1. (U) Purpose. To provide information regarding CHPPM efforts to characterize potential occupational and environmental health (OEH) threats and associated exposure pathways and recommendations to mitigate those risks to US and allied military personnel at Stronghold Freedom.

2. (U) References.

a. (U) Memorandum, USACHPPM-Europe, MCHB-AE, 15 February 2002, subject: Final Report, Environmental Site Characterization and Operational Health Risk Assessment, Stronghold Freedom, 27 October – 27 November 2001 (Original Document Classified).

b. (U) Memorandum, USACHPPM-Europe, MCHB-AE, 26 November 2001, subject: Interim Report, Environmental Site Characterization and Operational Health Risk Assessment, Stronghold Freedom, 27 October – 27 November 2001 (Original Document Classified).

c. (U) DoD Directive 6490.2, Joint Medical Surveillance, 20 August 1997.

d. (U) Joint Staff Memorandum, MCM-0006-02, 1 Feb 2002, subject: Updated Procedures for Deployment Health Surveillance and Readiness.

3. (U) Summary.

a. (U) CHPPM Europe initially deployed on 27 October 2001 in response to reports of adverse health effects resulting from potential petroleum odor exposures resulting from tent city construction efforts. CHPPM Europe rapidly characterized this health threat through collection and analysis of soil and air samples, comparison to relevant OEH and medical criteria, and provided (OEH) health countermeasures to the JSOTF and Stronghold Commanders to mitigate the health risks from this environmental contamination. This situation prompted a request from both the CENTCOM and the JSOTF commander to characterize the rest of the camp and targeted expansion areas for environmental and radiological contaminants/health threats.

b. (U) In support of this effort, CHPPM Europe collected over 200 discrete soil, air, water and radiological samples for laboratory analysis, in addition to conducting numerous field-screening tests using direct read instruments. A total of 9 potential environmental contamination sites at this location were investigated. The CHPPM laboratories performed rapid and exhaustive analysis of these samples for over 10,000

analytes, including pesticides, heavy metals, volatile and semi-volatile organic compounds, poly-chlorinated biphenyls (PCBs), radiological compounds, asbestos, explosives, and chemical agent breakdown products.

c. (U) On-site efforts also included exhaustive risk communication to ensure that Stronghold Freedom personnel were properly informed regarding the relevant health risks and health countermeasures. These efforts spanned a wide range of site personnel – from privates in perimeter fighting positions, their chain of command, Combat Camera personnel, local "mayors" for the tent city, National Imagery and Mapping Agency (NIMA) personnel, medical and non-medical staff officers, public affairs personnel, and NCO and officer leaders at all levels. As CHPPM Europe personnel worked outside the force protection berm the majority of the time, regular risk communication regarding this effort was initiated with soldiers manning fighting positions – as many of these positions also served as sampling locations.

d. (U) Formal risk communication efforts were held on 24-25 November 2001, which included three separate briefing sessions with command and staff, senior NCO's, and medics, respectively. Individual soldiers were encouraged through command channels to discuss any health concerns with the CHPPM Europe occupational health physician - and some did. Additionally, the CHPPM Europe team made every effort to provide accurate medical and scientific information based on emerging sampling results to multiple headquarters organizations to ensure that these efforts were documented in accordance with references c and d.

e. (U) As instances of misinformation regarding the nature of environmental contamination or health effects at the site appeared, the CHPPM Europe team rapidly and aggressively worked to correct these situations with information based on direct observation and measurement – to ensure that health risk assessments were accurate, defensible, and communicated in proper context. This was especially true regarding initial NIMA environmental contamination assessments published for this site that were based on aerial imagery and other sources. The CHPPM Europe team provided the ground truth that greatly refined these assessments and provided the leadership with an accurate characterization of the health risks.

f. (U) An interim report was published and distributed (reference b) to various command personnel prior to departing the area. This report was staffed with our higher HQ and provided a matrixed operational risk management (ORM) assessment of health risks. The overall health risk at this location based on data collected was characterized as LOW. This assessment was based upon an exposure duration of one year and assumed execution of/adherence to the recommended countermeasures. The report provided specific follow-up recommendations for health risk mitigation, additional sampling efforts to provide further OEH deployment surveillance, and on-going risk communication efforts to ensure that site personnel were adequately informed concerning health risks. This report was distributed in both hard copy and electronic (compact disk) format to numerous staff and command elements. Subsequently, the final report was published in February 2002 (reference a). The final report does not differ substantially

from the interim report, including the overall risk assessment performed by CHPPM-Main. Complete analytic sampling data was included in the final report, with no findings that would impact human health beyond interim findings. The overall risk assessment performed by CHPPM-Main was the same as previously reported.

g. (U) The CHPPM Europe team consisted of COL Brian Commons, REHS, environmental toxicologist and Commander, CHPPM Europe; LTC Bill Rice, MD, occupational medicine physician; MAJ Michael Dell'Orco, PE, environmental engineer; CPT Nicholas Henegan, PE, PG, environmental engineer; CPT Rick Chavez, health physicist; SGT Matthew Nicholls, preventive medicine specialist; and SPC James Winston, preventive medicine specialist. Outstanding rear echelon analytical support was provided by the CHPPM Europe Department of Laboratory Sciences, led by Dr. Charles Statham. CHPPM Main provided exceptional deployment support and ORM assessment, led by Mr. Jeffrey Kirkpatrick.

APPROVED: COL BRIAN COMMONS/ MCHB-AE/DSN 314-486-8084
Brian.Commons@amedd.army.mil

ENCLOSURE 2

DEPARTMENT OF THE ARMY
ARMY PUBLIC HEALTH CENTER (PROVISIONAL)
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND MARYLAND 21010-5403

MCHB-IP-MEM

16 May 2016

MEMORANDUM FOR Chief, Force Health Protection, HHC, U.S. Army Special Operations Command (AOMD/LTC Eric Kelly), Building 2929, Desert Storm Drive (Stop A), Fort Bragg, NC 28310-9110

SUBJECT: Technical Report No. S.0023939-15, Health Status of Personnel Formerly Deployed to Karshi-Khanabad (K2): A Comparative Assessment of Post-Deployment Medical Encounters

1. Enclosed is a copy of the Army Public Health Center (Provisional) report documenting results from a comparative assessment of acute and chronic disease up to ten years' post-deployment among U.S. military personnel who were deployed to Karshi-Khanabad in support of Operation Enduring Freedom.

2. The point of contact is Ms. Jessica Sharkey, Project Manager, at commercial 410-417-2876, DSN 867-2876, or e-mail at jessica.m.sharkey.civ@mail.mil.

FOR THE DIRECTOR:

Encl

WILLIAM A. RICE
COL, MC
Portfolio Director, Occupational & Environmental Medicine

ARMY PUBLIC HEALTH CENTER (Provisional)

5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010-5403

Technical Report No. S. 0023939-15, October 2015

Occupational and Environmental Medicine Portfolio
Environmental Medicine Program

Health Status of Personnel Formerly Deployed to Karshi-Khanabad (K2): A Comparative Assessment of Post-Deployment Medical Encounters

Prepared by:
Jessica M. Sharkey, MPH
Joseph H. Abraham, ScD, MS

Use of trademark name(s) does not imply endorsement by the U.S. Army but is intended only to assist in the identification of a specific product.

Table of Contents

Page

Appendices

Page

Tables

Technical Report No. S. 0023939-15
Health Status of Personnel Formerly Deployed to Karshi-Khanabad: A Comparative Assessment of Post-Deployment Medical Encounters

1 Summary

1.1 Purpose

Between 2001 and 2005, Active Duty members of the United States (U.S.) Armed Forces occupied Karshi-Khanabad Air Base (K2), Uzbekistan, in support of Operation Enduring Freedom (OEF). General conditions at K2 were substandard and raised concern among Army, Air Force, Navy, and Marine Corps personnel deployed to the site. In order to investigate environmental exposure concerns identified by individual Service members, a U.S. Central Command (CENTCOM) Force Health Protection Officer requested that the U.S. Army Public Health Command (USAPHC), now the Army Public Health Center, Provisional (APHC (Prov)), conduct an evaluation of health outcomes among Active Duty military personnel with a history of deployment to K2. The APHC (Prov) subsequently conducted a comparative health assessment using one year of post-deployment medical follow-up. The U.S. Army Special Operations Command (USASOC) Surgeon has since requested that the analysis be extended to incorporate up to ten years of follow-up, using all available post-deployment medical encounter data (Department of the Army (DA) Memorandum, Appendix B). In response to this request, a retrospective cohort study was conducted in order to assess post-deployment health status among Service members formerly deployed to K2. This was accomplished by linking K2 deployment rosters from 2001–2005 with post-deployment inpatient and outpatient medical records from 2001–2011. Additionally, a reference group of personnel stationed in South Korea during the same time frame was selected for comparison.

1.2 Results

Findings for several health outcomes had statistically significant elevated age-adjusted relative risks among Service members deployed to K2 compared to U.S. military personnel located in South Korea. Statistically significant elevated rates of two cancer groups were observed in the K2 cohort relative to South Korea: malignant melanoma and malignant neoplasms of lymphatic and hematopoietic tissue (RR: 3.68; 95% CI: 1.35-10.04 and RR: 5.64; 95% CI: 1.70-18.70, respectively). However, the relative risk of melanoma was attenuated and no longer statistically significant after additional adjustment for Service branch and race (RR: 2.15; 95% CI: 0.71-6.54).

The age-adjusted relative risk of all circulatory outcomes in the K2 group was 9 percent less than in the South Korea group (RR: 0.91; 95% CI: 0.87-0.96). Deployment to K2 was associated with a statistically significant 16 percent decrease in the age-adjusted relative risk of all respiratory outcomes when compared to those personnel stationed in South Korea (RR: 0.84; 95% CI: 0.77-0.94). Significantly lower age-adjusted relative risk of all mental health disorders was seen in military personnel stationed at K2 relative to military personnel stationed in South Korea (RR: 0.81; 95% CI: 0.79-0.84).

1.3 Limitations

Several limitations should be acknowledged in the interpretation of the findings. Acute changes in health status during deployment may have been missed and were not evaluated in this investigation. Likewise, changes in health status that may be delayed beyond the available follow-

up period are unobservable. Defining case status using medical encounter diagnosis codes can generate false positives (i.e., can identify illnesses when none were actually present). Also of consideration is loss to follow-up, which occurred in this investigation when personnel leave military service during the study period. Individual environmental exposure data were not available, although it is acknowledged that individual exposures can vary significantly among Service members. Residual confounding by factors which influence the risk of a health outcome and are also associated with, but not caused by, K2 deployment was also possible. Results for rare diseases, such as specific types of cancers, should be interpreted with caution due to the small case numbers observed. This investigation included the estimation of associations between K2 deployment and more than 20 health conditions; as the number of such comparisons increases, the greater the likelihood that the K2-deployed and South Korea-stationed groups will appear to differ with respect to at least one health outcome due to chance, even if there are truly no differences between the two groups.

Finally, although this investigation was conducted in response to a query by USASOC, Special Operations Forces (SOF) personnel could not be identified. SOF was not, therefore, evaluated as an independent risk factor or as a potential modifier of the associations between deployment and post-deployment health status. The results of this study may not be generalizable to populations with different prevalence or magnitude of modifiers of the associations between K2 deployment and health outcomes. Unfortunately, whether these results are generalizable to formerly deployed SOF personnel is a matter of speculation.

In light of these limitations, the results of this investigation should be considered preliminary. Within the context of other scientific evidence relevant to the relationship between military deployment and subsequent cancer incidence, these findings may motivate further investigation. However, the observed associations in no way imply causality; the investigators caution against using the relative risk estimates observed in this analysis as the basis for decision-making.

1.4 Recommendations

The APHC (Prov) recommends the following as a follow-up to this evaluation:

a. Conduct epidemiologic investigations to evaluate associations between deployment in support of OEF, Operation Iraqi Freedom (OIF), and Operation New Dawn (OND) and subsequent development of cancer among current and former U.S. Armed Forces personnel. Ideally, this recommendation will be implemented in partnership with the other Services and the Department of Veterans Affairs (VA). These investigations should leverage regularly-collected administrative, deployment, and medical data maintained by the Department of Defense (DOD) and the VA and include, but not be limited to, the specific cancers for which personnel deployed to K2 had increased risk (i.e., malignant melanoma and neoplasms of lymphatic and hematopoietic tissue).

b. Collaborate with USASOC Surgeon's Office and Special Operations Command (SOCOM) Surgeon's Office to identify whether, and how, current and former SOF personnel can be included in the study population(s) of the epidemiologic investigations recommended above.

c. In evaluating associations between deployment and cancer incidence, evaluate SOF as an independent cancer risk factor and potential modifier of associations between deployment and cancer.

2 References

See Appendix A for a listing of the references used in this report.

3 Background

After the attacks on the United States on September 11, 2001, the U.S. military sought to identify a regional base from which to support OEF. At the time, Uzbekistan appeared to be an advantageous partner, particularly for its air base located approximately 100 miles from the Afghanistan border, near the towns of Karshi and Khanabad.[1] From late 2001 through June 2005, the U.S. military used the Karshi-Khanabad Air Base (K2) as a logistics and air base providing support for OEF.

In the late 1970s, the Soviet military used K2 to support its operations in Afghanistan. During that time, the Soviet Air Force maintained a fleet of various bomber aircraft at K2, necessitating an underground fuel distribution system. Furthermore, construction of military equipment (including missiles) in the Soviet era used materials such as asbestos and radioactive material. In November 2001, the U.S. Army Center for Health Promotion and Preventive Medicine–Europe (now APHC (Prov)–Europe) performed an Environmental Baseline Survey (EBS)[2] at K2 that found underground jet-fuel plumes, surface dirt contaminated with asbestos, and radioactive uranium. Periodic high levels of dust and other particulate matter (PM) in the air due to seasonal dust storms were also noted. Although the EBS highlighted these findings, it is important to note that 1) measured fuel vapor levels were below Minimal Risk Levels established by the Agency for Toxic Substances and Disease Registry; 2) asbestos was not detected in the air and therefore likely not inhaled by Service members at K2; 3) the levels of radiation found were not substantial enough to penetrate the skin; radioactive dust was not found and thus not inhaled by Service members at K2; and Service members were not living or working directly over the radioactive areas of concern on the site; and 4) common symptoms from acute exposure to high levels of ambient PM typically resolve quickly when PM levels stabilize. Furthermore, chronic respiratory conditions and severe, long-term health effects of air pollution are generally not expected in the relatively young and healthy Service member population.

Despite the survey's conclusion that health effects from the short-term, low-dose exposures present at K2 were unlikely, efforts to remediate the environmental health risks were undertaken (e.g., covering contaminated areas with clean dirt and declaring them "off-limits"), since exposure to any of the constituents mentioned above during deployment to K2 was plausible and because long-term, chronic health effects had not yet been investigated. As such, the current investigation focused on identifying the frequency of post-deployment medical encounters for health outcomes consistent with exposure to the toxicants identified by the EBS, with a particular emphasis on cancer. Medical encounters for respiratory and circulatory diseases as well as for mental health disorders were also summarized.[3-12]

4 Authority

a. This investigation is being conducted at the request of the USASOC.

b. Department of Defense Instruction (DoDI) 6490.03, Deployment Health,[13] establishes the requirement to identify and assess occupational and environmental health hazards during deployments, to mitigate the short- and long-term health risk to the extent feasible in an

operational environment, and to monitor and track health conditions that may result from those exposures.

c. In accordance with Army Regulation (AR) 40–5, Preventive Medicine,[14] the APHC (Prov) will provide and support comprehensive health surveillance for the U.S. Army and DOD and will review, interpret, and respond to assessment and surveillance data for the purpose of identifying, preventing, and controlling new or evolving health problems.

5 Methods

5.1 Objectives

The objective of this analysis was to estimate the frequency of a specified set of post-deployment health conditions (see Table 1), as documented by diagnosis in post-deployment medical records (inpatient and outpatient encounters) among Service members formerly deployed to K2, and to assess the relative frequency of post-deployment health conditions among personnel who had deployed to K2 in support of OEF, compared to a population of Active Duty Service members who had been stationed in South Korea.

5.2 Data Sources

Data from three sources were used to conduct the retrospective cohort study: the Coalition Forces Land Component Command (CFLCC), the Defense Manpower Data Center (DMDC), and the Defense Medical Surveillance System (DMSS). The CFLCC supplied K2 deployment roster information; DMDC provided both military personnel location and demographic data; and DMSS contained both inpatient and outpatient post-deployment medical diagnosis records. Data from the DMDC and DMSS databases were received from the Division of Data and Analysis within the Armed Forces Health Surveillance Center, now the Armed Forces Health Surveillance Branch (AFHSB); the APHC (Prov) maintains the CFLCC roster.

5.3 Study Population

The study population consisted of Active Duty U.S. military personnel who had been deployed to K2 between 2001 and 2005 and, for comparison, a group of Active Duty personnel who had been stationed in South Korea during the same time frame. Deployment rosters and military personnel location data were linked with both demographic data and up to ten years of post-deployment inpatient and outpatient medical encounter records for these individuals. Personnel who were deployed to K2 and also stationed in South Korea during the time frame of the study were assigned to the K2 group only, and individuals who spent less than 30 days at the location of interest (either K2 or South Korea) were excluded.

The CFLCC roster included the following data: social security number, Service branch, arrival and departure dates, and location code. The roster did not identify whether or not Service members were SOF personnel. Although the investigators do not know with certainty, it is likely that SOF personnel were not enumerated in the CFLCC roster due to mission classification and additional Force Protection measures. As such, this evaluation did not include identification of SOF as a specific risk factor.

5.4 Research Design

A retrospective cohort study using existing electronic databases was conducted. In order to assess the frequency of post-deployment health conditions among personnel deployed to K2 during the years 2001–2005, up to 10 years of inpatient and outpatient medical encounter records were identified and analyzed. In order to provide an estimate of relative disease frequency of post-deployment health outcomes among K2-based personnel had they never been deployed to K2, the frequency of post-deployment health outcomes among a sample of Active Duty military personnel formerly stationed in South Korea during the same period of time was also assessed.

Health outcome case status was defined according to qualifying International Classification of Diseases–Clinical Modification, 9th Revision (ICD-9-CM) encounter codes as well as diagnostic procedure codes (hospitalization data), current procedural terminology (CPT) codes (outpatient data), and supplemental classification of factors influencing health status and contact with health services codes (V-codes), when applicable (Table 1). Whenever possible, standard case definitions defined by the AFHSB were utilized in order to promote consistency across epidemiologic analyses throughout the DOD (http://www.afhsc.mil/Home/CaseDefinitions).

A single medical encounter with a qualifying diagnosis code was considered positive for that health outcome. Repeated instances for diagnoses in the same health outcome category were excluded, such that a single individual could contribute, at most, one health outcome in each category. Defined secondary analyses were used to assess the impact on the results of using relatively sensitive case definitions in the primary analysis.

In addition to assessing the frequency of the four groups of health conditions defined below, the frequency and relative frequency of specific medical encounters for different types of cancers were determined.

Table 1. Health Outcome Case Definitions

Health Outcome Category	Health Outcome	ICD-9-CM Code(s)	V-Code(s)	CPT Code(s)	Procedure Code(s)	Sensitive Case Definition	Specific Case Definition
Cancer	Malignant Melanoma	172		11100, 11101, 11600-11604, 11606, 11620-11624, 11626, 11640-11644, 11646, 11300-11303, 11305-11308, 11310-11313, 11703, 17310-17315, 38500, 38505, 38510, 38520, 38525, 38530, 38792, 39542, 41100-41108, 67810, 68100, 69100, 69105, 78195, 92225, 92226, 96904	40.3-40.5, 86.1, 86.4, 91.6	One (1) medical encounter with a defining diagnosis in the first diagnostic position	Two (2) or more medical encounters with a defining diagnosis in the first diagnostic position following at least one medical encounter with a diagnostic procedure commonly used to evaluate clinically suspicious lesions - OR - Five (5) or more medical encounters with a defining diagnosis in the first diagnostic position
	Malignant Neoplasms of Lip, Oral Cavity, and Pharynx	140-149	V58.0-V58.12			One (1) medical encounter with a defining diagnosis in the first or second diagnostic position	One (1) inpatient medical encounter with a defining diagnosis in the first diagnostic position (or in the second diagnostic position if the first code was a V-code indicating radiotherapy or chemotherapy treatment) - OR - Three (3) or more outpatient medical encounters with a defining diagnosis in the first or second diagnostic position
	Malignant Neoplasm of Digestive Organs and Peritoneum (excluding Colon and Rectum Neoplasms)	150-152, 154.2-154.8, 155-158, 159.1-159.9					
	Malignant Neoplasms of the Colon and Rectum	153-154.1, 159.0					
	Malignant Neoplasm of Respiratory and Intrathoracic Organs (excluding Neoplasm of Lung and Bronchus)	160, 161, 162.0, 163-165					
	Malignant Neoplasm of the Lung and Bronchus	162.2-162.5, 162.8, 162.9					
	Malignant Neoplasms of Bone, Connective Tissue, Skin, and Breast (excluding Melanoma and Female Breast Neoplasms)	170, 171, 173, 175, 176					
	Malignant Neoplasm of the Female Breast	174					
	Malignant Neoplasms of Genitourinary Organs (excluding Cervical, Prostate, and Testis Neoplasms)	179, 181-184, 187.1-189					
	Cervical Cancer	180					
	Prostate Cancer	185					
	Malignant Neoplasm of Testis	186					
	Malignant Neoplasms of Other and Unspecified Sites	190, 192-195					
	Brain Cancer	191					
	Malignant Neoplasms of Lymphatic and Hematopoietic Tissue (excluding Non-Hodgkin Lymphoma and Leukemia)	201, 202.3-202.7, 203					
	Non-Hodgkin Lymphoma	200, 202.0-202.2, 202.8-202.9					
	Leukemia	204-208					
	Malignant Neoplasms of Plasma Cells	238.6					
Diseases of the Circulatory System		401-405, 410-417, 420-438, 440-449, 451-453, 457-459				One (1) medical encounter with a defining diagnosis in any diagnostic position	One (1) inpatient medical encounter - OR - Two (2) outpatient medical encounters with a defining diagnosis in the first or second diagnostic position
Diseases of the Respiratory System		416, 460-466, 470-478, 480-488, 490-496, 500-508, 510-519				One (1) medical encounter with a defining diagnosis in any diagnostic position	One (1) inpatient medical encounter - OR - Two (2) outpatient medical encounters with a defining diagnosis in the first or second diagnostic position
Mental Health Disorders		290-298, 300-301, 303-305, 307-312, 316				One (1) medical encounter with a defining diagnosis in any diagnostic position	One (1) inpatient medical encounter - OR - Two (2) outpatient medical encounters with a defining diagnosis in the first or second diagnostic position

5.5 Data Analysis

SAS/STAT software, Version 9.2 of the SAS System for Windows (Copyright 2002–2008, SAS Institute Inc., Cary, NC, USA), was used for all data management and analysis. The cumulative incidence of health outcomes was adjusted for factors which were thought to affect the risk of the selected health conditions that were likely to be unequally distributed between the K2 and South Korea-based personnel, to the extent that information was available on these factors. These potential confounders included age, gender, Service branch, rank, and calendar period of deployment. We also stratified the analyses by duration of time spent at the respective location. Modification of the association between K2 deployment and the medical encounters by these factors was also assessed. To estimate the relative frequency of medical encounters among the K2 and South Korea personnel, we conducted univariate and stratified analysis (PROC FREQ), as well as multivariate modeling [Binomial regression (PROC GENMOD)]. Age-adjusted relative risks and 95% confidence intervals were calculated using the Mantel-Haenszel method to pool estimates across age strata. Though limited by small cancer case counts, multivariate-adjusted relative risk estimates comparing K2 to South Korea personnel were obtained by exponentiating the beta coefficient corresponding to the deployment location variable in each model. In addition to age, relative risk estimates for selected cancer outcomes were adjusted for Service branch (Army vs. non-Army) and race (Caucasian vs. non-Caucasian).

In primary analysis, only the first qualifying incidence of a medical encounter for a given health outcome was included and used to define an incident outcome event (a case). Subsequent follow-up time for cases was censored in analyses of that specific health outcome, but cases remained in the risk pool for the other health conditions assessed in this investigation. In sensitivity analyses, increasingly strict case criteria were applied, such that multiple medical encounters were required in order for an incidence to be considered a case.

6 Results

6.1 Summary of Demographic and Service-related Characteristics

Table 2 summarizes the demographic and Service-related covariates of the study population. A total of 35,029 Service members were identified for inclusion in the study, 7,005 of whom met the inclusion criteria for the K2-deployed group. The South Korea group consisted of 28,024 Service members. Notably, the K2-deployed group was disproportionately composed of U.S. Air Force airmen. Age, race, and rank profiles also differed between the K2-deployed and South Korea-stationed groups.

6.2 Adjusted Relative Risks for All Health Outcomes

Location-specific age-adjusted relative risks for all health outcomes are presented in Table 3. Statistically significant elevated rates of two groups of cancers were observed in the K2 cohort relative to the personnel formerly stationed in South Korea: malignant melanoma and neoplasms of lymphatic and hematopoietic tissue (RR: 3.68; 95% CI: 1.35-10.04 and RR: 5.64; 95% CI: 1.70-18.70, respectively). (Refer to the blue shaded areas in Table 3.)

The relative risk of melanoma was attenuated after additional adjustment for Service branch and race, and no longer statistically significant (RR: 2.15; 95% CI: 0.71-6.54). The relative risk of

neoplasms of lymphatic and hematopoietic tissue was qualitatively similar after additional adjustment for Service branch and race (RR: 6.50; 95% CI: 2.08-20.28).

The age-adjusted relative risk of all circulatory outcomes in the K2 group was 9 percent lower than in the South Korea group (RR: 0.91; 95% CI: 0.87-0.96). Deployment to K2 was associated with a statistically significant 16-percent decrease in the age-adjusted relative risk of all respiratory outcomes when compared to those personnel stationed in South Korea (RR: 0.84; 95% CI: 0.77-0.94). Significantly lower age-adjusted relative risk of all mental health disorders was seen in military personnel stationed at K2 relative to military personnel stationed in South Korea (RR: 0.81; 95% CI: 0.79-0.84). (Refer to the blue shaded areas in Table 3.)

Table 2. Demographic and Military Characteristics of the Study Population

	K2	Korea
	n (%)	n (%)
	7,005	28,024
Age		
<20 years	198 (2.8)	3,335 (11.9)
20-29 years	4,031 (57.5)	15,642 (55.8)
30-39 years	2,200 (31.4)	7,139 (25.5)
40+ years	576 (8.2)	1,908 (6.8)
Sex		
Male	6,339 (90.5)	23,344 (83.3)
Female	666 (9.5)	4,680 (16.7)
Race		
Asian	197 (2.8)	1,270 (4.5)
African American	874 (12.5)	7,054 (25.2)
Caucasian	5,096 (72.7)	15,701 (56.0)
Hispanic	472 (6.7)	2,518 (9.0)
Indian	59 (0.8)	198 (0.7)
Other	74 (1.1)	471 (1.7)
Unspecified	233 (3.3)	812 (2.9)
Rank		
E1-E4	2,991 (42.7)	16,280 (58.1)
E5-E9	2,684 (38.3)	8,780 (31.3)
O1-O3 or WO1-WO2	1,005 (14.3)	2,113 (7.5)
O4-O10 or WO3-WO5	324 (4.6)	849 (3.0)
Unspecified	1 (0.0)	2 (0.0)
Service Branch		
Army	1,192 (17.0)	19,896 (71.0)
Air Force	5,711 (81.5)	7,493 (26.7)
Marine Corps	89 (1.3)	438 (1.6)
Navy	13 (0.2)	197 (0.7)
Service Component		
Active Duty	6,960 (99.4)	27,519 (98.2)
National Guard	20 (0.3)	228 (0.8)
Reserve	25 (0.4)	277 (1.0)
Time at Location		
0-3 months	1,943 (27.7)	13,840 (49.4)
3-6 months	4,317 (61.6)	5,859 (20.9)
6-9 months	684 (9.8)	2,695 (9.6)
9-12 months	29 (0.4)	2,544 (9.1)
12+ months	32 (0.5)	3,086 (11.0)

Legend:
E – enlisted; O – officer; WO – warrant officer

Table 3. Age-Adjusted Relative Risks and Corresponding 95% Confidence Intervals for Health Outcomes, Comparing U.S. Military Personnel Deployed to K2 to U.S. Military Personnel Stationed in South Korea

Outcome	K2 N = 7,005 Age* Young n	K2 N = 7,005 Age* Young %	K2 N = 7,005 Age* Old n	K2 N = 7,005 Age* Old %	Korea N = 28,024 Age* Young n	Korea N = 28,024 Age* Young %	Korea N = 28,024 Age* Old n	Korea N = 28,024 Age* Old %	Age-Adjusted Relative Risk (RR)	Age-Adjusted 95% Confidence Intervals (CI)
Cancer Outcomes										
All Cancer	11	0.39	50	1.21	41	0.28	133	1.00	1.23	0.92-1.65
Brain Cancer	1	0.04	4	0.10	0	0.00	8	0.06	2.04	0.68-6.09
Cervical Cancer	0	0.00	0	0.00	1	0.01	0	0.00	0.00	--
Leukemia	0	0.00	1	0.02	5	0.03	4	0.03	0.43	0.05-3.63
Malignant Melanoma	1	0.04	7	0.17	3	0.02	5	0.04	3.68	1.35-10.04
Neoplasm of Bone/Connective Tissue/Skin/Breast	1	0.04	3	0.07	5	0.03	9	0.07	1.06	0.35-3.22
Neoplasm of Colon/Rectum	2	0.07	3	0.07	2	0.01	9	0.07	1.60	0.57-4.51
Neoplasm of Digestive Organs/Peritoneum	0	0.00	1	0.02	1	0.01	6	0.05	0.48	0.06-3.95
Neoplasm of Female Breast	1	0.04	3	0.07	1	0.01	9	0.07	1.35	0.43-4.24
Neoplasm of Genitourinary Organs	1	0.04	4	0.10	2	0.01	8	0.06	1.74	0.60-5.03
Neoplasm of Lip/Oral Cavity/Pharynx	1	0.04	3	0.07	0	0.00	6	0.05	2.18	0.64-7.49
Neoplasm of Lung/Bronchus	0	0.00	4	0.10	0	0.00	0	0.00	--	--
Neoplasm of Lymphatic and Hematopoietic Tissue	2	0.07	5	0.12	6	0.01	0	0.00	5.64	1.70-18.70
Neoplasm of Respiratory/Intrathoracic Organs	0	0.00	0	0.00	0	0.00	2	0.02	0.00	--
Neoplasm of Testis	1	0.04	2	0.05	8	0.05	12	0.09	0.57	0.17-1.91
Non-Hodgkin Lymphoma	0	0.00	3	0.07	4	0.03	9	0.06	0.89	0.25-3.26
Prostate Cancer	0	0.00	4	0.10	0	0.00	18	0.14	0.71	0.24-2.10
Neoplasm of Other and Unspecified Sites	0	0.00	3	0.07	3	0.02	27	0.20	0.33	0.10-1.09
Neoplasm of Uncertain Behavior (Plasma Cells)	0	0.00	0	0.00	0	0.00	0	0.00	--	--
Circulatory Disease Outcomes	282	9.75	1,025	23.77	1,259	8.43	3,856	27.70	0.91	0.87-0.96
Respiratory Disease Outcomes	189	6.51	270	6.43	965	6.44	1,160	8.58	0.84	0.77-0.94
Mental Health Disorder Outcomes	1,536	43.72	1,820	37.14	10,073	50.86	8,330	48.27	0.81	0.79-0.84

Notes:
*Age was stratified on the median, 25 years of age, where the "young" category is defined as any Service member 25 years of age or younger, and the "old" category is defined as any Service member 26 years of age or older.
Values shaded in blue represent statistically significant results (as described in paragraph 6.2).

7 Discussion

A retrospective cohort design was implemented in order to evaluate the post-deployment health status among Service members formerly deployed to K2. This was accomplished by linking K2 deployment rosters from 2001–2005 with post-deployment inpatient and outpatient medical records from 2001–2011. A reference group of personnel stationed in South Korea during the same time frame was selected for comparison because these Service members are stationed overseas for an extended period of time and are more likely to have a baseline health status similar to that of OEF-deployed personnel, relative to never-deployed personnel stationed in the Continental U.S.

This investigation focused on identifying the frequency of post-deployment medical encounters for health outcomes consistent with the toxicants (jet fuel, radiation, asbestos, and high levels of dust and particulate matter) identified as potential exposures by an Occupational and Environmental Baseline Survey performed at K2 in November 2001. We particularly emphasized cancer due to concerns of a number of personnel previously stationed at K2. Medical encounters for respiratory and circulatory diseases as well as for mental health disorders were also summarized.

Several limitations should be acknowledged in the interpretation of the findings. The analysis conducted was based on healthcare encounter diagnoses following redeployment. As a result, any acute changes in health status during deployment related to the outcomes evaluated that were due to exposures in theater may have been missed. Likewise, changes in health status that may be delayed beyond the available follow-up period are unobservable, particularly cancers with longer

latency periods. The use of medical encounter diagnosis codes for case definition can also result in false positives. Also of noteworthy consideration is loss to follow-up, which occurs when personnel leave military service during the study period. Individual environmental exposure data were not available, although it is acknowledged that individual exposures can vary significantly among Service members, despite their having been deployed to the same location. Residual confounding by factors which influence the risk of a health outcome and are also associated with, but not caused by, K2 deployment was also possible. For example, the risk of melanoma may be higher among Caucasian personnel than among personnel of other races and the proportion of Caucasian Service members is higher among K2 personnel compared to South Korea-stationed personnel. However, relative rate estimates from models adjusting for age, race, and Service branch were qualitatively similar to those from models adjusting only for age.

Similarly, information on individual risk factors that could potentially confound the observed associations was unavailable. For example, if the prevalence of smoking was higher among personnel based at K2 relative to South Korea-stationed personnel than relative rate estimates would be biased upwards for outcomes where smoking increases the risk. Furthermore, results for rare diseases, such as specific types of cancers, should be interpreted with caution due to small case numbers observed. For example, although the underlying groups are large, the relative rate estimates for melanoma and neoplasms of lymphatic and hematopoietic tissue were based on a total of 16 and 13 cases, respectively. This investigation included the estimation of associations between K2 deployment and more than 20 health conditions. It is noted that, in general, as the number of such comparisons increases, the greater the likelihood that the K2-deployed and South Korea-stationed groups will appear to differ with respect to at least one health outcome due to chance, even if there are truly no differences between the two groups.

Finally, although this investigation was conducted in response to a query by USASOC, SOF personnel could not be identified. SOF was not, therefore, evaluated as an independent risk factor or as a potential modifier of the associations between deployment and post-deployment health status. The results of this study may not be generalizable to populations with different prevalence or magnitude of modifiers of the associations between K2 deployment and health outcomes. Unfortunately, whether these results are generalizable to formerly deployed SOF personnel is a matter of speculation.

In this exploratory investigation, elevated age-adjusted relative risks were observed for approximately half of the cancer outcomes evaluated (i.e., 9 of 19 estimated risk ratios were greater than 1), comparing the K2 deployers to the Service members located in South Korea, though only two of these observed associations were statistically significant. Because of the small number of incident cancers evaluated in this investigation (61 and 174 cancer cases in the K2 and South Korea cohorts, respectively) as well as the other limitations noted above, the results of this investigation should be considered preliminary. Within the context of other scientific evidence relevant to the relationship between military deployment and subsequent cancer incidence, these findings may motivate further investigation. However, the observed associations in no way imply causality; the investigators caution against using the relative risk estimates observed in this analysis as the basis for decision-making.

8 Recommendations

The APHC (Prov) recommends the following as a follow-up to this evaluation:

a. Conduct epidemiologic investigations to evaluate associations between deployment in support of OEF, OIF, and OND and subsequent development of cancer among current and former U.S. Armed Forces personnel. Ideally, this recommendation will be implemented in partnership with the other Services and the VA. These investigations should leverage regularly collected administrative, deployment, and medical data maintained by the DOD and the VA, and should include, but not be limited to, the specific cancers for which personnel deployed to K2 had increased risk (i.e., malignant melanoma and neoplasms of lymphatic and hematopoietic tissue).

b. Collaborate with the USASOC Surgeon's Office and SOCOM Surgeon's Office to identify whether, and how, current and former SOF personnel can be included in the study population(s) of the epidemiologic investigations recommended above.

c. In evaluating associations between deployment and cancer incidence, evaluate SOF as an independent cancer risk factor and potential modifier of associations between deployment and cancer.

9 Point of Contact

The APHC (Prov) point of contact is Ms. Jessica Sharkey, Epidemiologist, Environmental Medicine Program, commercial 410-417-2876 or e-mail at jessica.m.sharkey.civ@mail.mil.

JESSICA M. SHARKEY, MPH
Epidemiologist
Environmental Medicine Program

Approved:

COLEEN P. BAIRD
Program Manager
Environmental Medicine Program

Appendix A

References

1. Pike, J. 2005. Khanabad, Uzbekistan Karshi-Khanabad (K2) Airbase Camp Stronghold Freedom [cited 2015]. Available from: http://www.globalsecurity.org/military/facility/khanabad.htm.

2. DoD Deployment Health Clinical Center. 2002. Environmental Conditions at Karshi Khanabad (K-2) [cited 2015]. Available from: http://www.pdhealth.mil/clinicians/downloads/GIS.02-09-09a.K-2-ServiceMember.pdf.

3. Harris, D.T., D. Sakiestewa, D. Titone, R.F. Robledo, R.S. Young, and M. Witten. 2000. Jet fuel-induced immunotoxicity. *Toxicol Ind Health,* 16(7-8):261-65.

4. LeVan, T.D., W.P. Koh, H.P. Lee, D. Koh, M.C. Yu, and S.J. London. 2006. Vapor, dust, and smoke exposure in relation to adult-onset asthma and chronic respiratory symptoms: the Singapore Chinese Health Study. *Am J Epidemiol,* 163(12):1118-28.

5. Ling, S.H. and S.F. van Eeden. 2009. Particulate matter air pollution exposure: role in the development and exacerbation of chronic obstructive pulmonary disease. *Int J Chron Obstruct Pulmon Dis,* 4:233-43.

6. Marshall, A.C. 2008. Gulf war depleted uranium risks. *J Expo Sci Environ Epidemiol,* 18(1):95-108.

7. Nogueira, J.B. 2009. Air pollution and cardiovascular disease. *Rev Port Cardiol,* 28(6):715-33.

8. O'Toole, T.E., D.J. Conklin, and A. Bhatnagar. 2008. Environmental risk factors for heart disease. *Rev Environ Health,* 23(3):167-202.

9. Periyakaruppan, A., F. Kumar, S. Sarkar, C.S. Sharma, and G.T. Ramesh. 2007. Uranium induces oxidative stress in lung epithelial cells. *Arch Toxicol,* 81(6):389-95.

10. Pleil, J.D., L.B. Smith, and S.D. Zelnick. 2000. Personal exposure to JP-8 jet fuel vapors and exhaust at air force bases. *Environ Health Perspect,* 108(3):183-92.

11. Polichetti, G., S. Cocco, A. Spinali, V. Trimarco, and A. Nunziata. 2009. Effects of particulate matter (PM(10), PM(2.5) and PM(1)) on the cardiovascular system. *Toxicology,* 261(1-2):1-8.

12. Ritchie, G., K. Still, J. Rossi III, M. Bekkedal, A. Bobb, and D. Arfsten. 2003. Biological and health effects of exposure to kerosene-based jet fuels and performance additives. *J Toxicol Environ Health B Crit Rev,* 6(4):357-451.

13. Department of Defense. 2006 [Certified Current as of September 30, 2011]. DoDI 6490.03, *Deployment Health.* http://www.dtic.mil/whs/directives/corres/pdf/649003p.pdf.

14. Department of the Army. 2007. AR 40–5, *Preventive Medicine.* http://armypubs.army.mil/epubs/pdf/r40_5.pdf.

Appendix B

Department of the Army Memorandum for USAPHC Environmental Medicine Program

DEPARTMENT OF THE ARMY
HEADQUARTERS, UNITED STATES ARMY
SPECIAL OPERATIONS COMMAND
2929 DESERT STORM DRIVE (STOP A)
FORT BRAGG, NORTH CAROLINA 28310-9110

REPLY TO ATTENTION OF

AOM.

04 March 20..

MEMORANDUM FOR USAPHC, Institute of Public Health Environmental Medicine Program, MCHB-IT-MDM, 5158 Blackhawk Rd, APG, MD

SUBJECT: Comparative Health Assessment of Deployers to Karshi-Khanabad Air Base, Uzbekistan

1. In the past several years, it has been observed that a number of personnel assigned or attached to US Army Special Operations Command who were deployed to Karshi-Khanabad (K2) Air Base, Uzbekistan, have developed various types of cancer.

2. In an effort to better understand if possible exposures at K2 could be related to the health status of USASOC personnel we request an expansion of the comparative assessment of acute and chronic disease in K2 deployers up to ten years post deployment.

3. This memorandum confirms the intent of USASOC to support the conduct of the aforementioned study by the USAPHC Institute of Public Health Environmental Medicine Program.

4. [illegible] DSN 239-9804 or [illegible]

[illegible]
PETER J. BENSON
[illegible]

ENCLOSURE 3

Evaluation of Postdeployment Cancers Among Active Duty Military Personnel

Jessica M. Sharkey, MPH
Joseph H. Abraham, ScD

Surpassed only by heart disease, cancer is the second highest cause of all deaths, accounting for 1 in every 4 deaths in the United States. According to the American Cancer Society, there will be more than 1.66 million new cancer diagnoses and an estimated 590,000 Americans will die of cancer in 2015.[1] These figures are similar to those reported by the Surveillance, Epidemiology, and End Results Program for 2014.[2] In its most recent Cancer Trends Progress Report – 2011/2012 Update, the National Cancer Institute reports that death rates for the 4 leading types of cancer as well as all cancers combined have been declining, yet incidence rates of some cancers are on the rise.[3] Worldwide, cancer is a leading cause of both morbidity and mortality, with approximately 14 million newly diagnosed cases and more than 8 million deaths attributed to cancer in 2012.[4]

The evidence indicating a connection between occupational and environmental exposures and cancer has been growing in recent years.[5] This is of particular concern because such cancers are theoretically avoidable, as measures can be taken to avoid these nongenetic risk factors. The World Health Organization estimates that 19% of all cancers are attributed to environmental factors, accounting for 1.3 million deaths per year.[6]

The military population presents a unique opportunity to study links between environmental exposures and cancer. Advantageous aspects of studying cancer among military personnel include well characterized person-time, occupation, and, though not always the case, environmental hazards. Access to routine healthcare including recommended cancer screenings at no cost to the service member and robust electronic medical record systems also facilitate assessments of cancer outcomes in the military population. Furthermore, exposures associated with military deployments may influence cancer risk among military personnel.[7] Possible deployment-related exposures have been documented by the Department of Defense,[8,9] to include potential carcinogens (eg, industrial solvents, jet fuel, air pollution, radiation). Behavioral changes during deployment, such as increased tobacco use, have also been documented.[10] It is thus plausible that military deployment and associated exposures may be risk factors for subsequent cancer among warfighters.

Cancer in the Military

Vietnam War

Historically, there has been concern regarding military service-related hazards and potential long-term health implications following military deployment. Postdeployment cancer risk is often at the forefront of the issue, as was the case after the Vietnam War.[11-12] As Richards describes in an article reviewing responses to military-associated environmental and occupational exposures:

> During the latter half of the 20th Century, medical knowledge of and concern about carcinogens grew, and human experimentation guidelines became more stringent. During the Vietnam era, concern for troop exposure to environmental contaminants evolved beyond acute exposures and experimentation to encompass long-term occupational and environmental hazards encountered on the battlefield.[13]

By far, the most prominent exposure in terms of health concern generated during this conflict is the herbicide commonly referred to as Agent Orange. Many veterans of the Vietnam conflict between 1965 and 1972 attribute poor postdeployment health outcomes, including rare cancers, to 2,3,7,8-Tetrachlorodibenzodioxin, an extremely toxic dioxin compound that contaminated one of the compounds used to make the herbicide Agent Orange.[14] The scientific evidence linking postdeployment cancer to Agent Orange exposure during the Vietnam War varies. Some studies have not found higher rates of mortality for outcomes such as soft tissue sarcomas,[15] Hodgkin's disease,[16] non-Hodgkin lymphoma, or testicular cancer in Vietnam veterans.[17,18] Another study of participants of the Agent Orange Registry had similar results, showing no difference in prevalence for any type of cancer when comparing Vietnam veterans to non-Vietnam veterans.[17] However, the CDC Selected Cancer Study reported a higher risk of non-Hodgkin's lymphoma among Vietnam veterans when compared to other men.[19] Frumkin summarized the existing literature on Agent Orange and cancer, reporting consistent

to fairly consistent negative results for increases of soft tissue sarcomas, Hodgkin's disease, and gastrointestinal and brain cancers, but inconsistent results of increases in respiratory and prostate cancers among Vietnam veterans.[20] Still yet, in the current Institute of Medicine Report of the health effects of herbicides used in Vietnam, *Veterans and Agent Orange: Update 2012*,[21] the committee found sufficient evidence of an association between soft tissue sarcomas, non-Hodgkin lymphoma, chronic lymphocytic leukemia, and Hodgkin lymphoma, and limited/suggestive evidence of an association with laryngeal, lung, bronchus, trachea, and prostate cancers as well as multiple myeloma.

1991 Gulf War

Similar to those of the Vietnam conflict, many veterans of the 1991 Gulf War are also concerned about the specter of cancer and possible links to hazards associated with their deployment. Notable hazards of concern to service members during the Gulf War include depleted uranium, petroleum products, pesticides, and chemical and biological warfare agents.[22] However, scientific literature shows mixed findings regarding potential associations between Gulf War exposure and postdeployment cancer risk. A particular exposure event of interest during the Gulf War was the destruction of chemical munitions at Khamisiyah, Iraq. While Bullman et al indicated an increased risk of brain cancer mortality among US Army Gulf War veterans who were potentially exposed to low-level chemical warfare agents at Khamisiyah when compared to Gulf War veterans who were not exposed,[23] a later study by Young et al found no excess in brain cancer.[24] In his report on a study on testicular cancer following Gulf War deployment, Levine stated:

> ...testicular cancer was found to be the only significantly increased malignancy among deployed Persian Gulf War veterans. The increase became apparent 2 to 3 years after the Persian Gulf War and peaked 4 to 5 years afterward.[11]

Yet, Knoke et al found that although there was an initial increase in testicular cancer immediately following deployment among Gulf War veterans compared to nondeployed Gulf War era veterans, the difference was no longer observed by 4 years postdeployment.[25] Kang et al described "very small rate differences (less than 1.0%) between Gulf veterans and non-Gulf veterans" for both skin cancer and other cancers, with higher rates among the Gulf War veterans.[26] Kang and Bullman reported

> ...no significant excess of overall cancer deaths or deaths from cancer at any specific site among Gulf veterans compared with non-Gulf veteran controls.[27]

In a 2005 report, *Gulf War and Health*, an Institute of Medicine committee found sufficient evidence of an association between combustion products and lung cancer and limited/suggestive evidence of an association between combustion products and nasal, oral, laryngeal, and bladder cancers and between hydrazines and lung cancer. There was inadequate/insufficient evidence to support conclusions regarding potential associations between fuels, combustion products, hydrazines, and nitric acid for numerous types of cancers.[28]

Operations Enduring and Iraqi Freedom

Deployment-related exposures are now causing the same concerns regarding cancer among service members following support of Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF). Since 2001, in excess of 2 million US military personnel have deployed to Southwest Asia,[29,30] with environmental hazards including but not limited to pollutants from local industry; military-produced exhaust from vehicles, machinery, and generators; open air burn pit emissions and fumes from fires; high levels of indigenous ambient particulate matter; munitions and weapons; depleted uranium; and radiation.[7,31-39] Potential relationships between exposures in theater and cancer diagnoses subsequent to deployment are again a priority for researchers and public health professionals in the military community.

Baseline Cancer Rates

In the population of OIF and OEF veterans, one expects a certain amount of cancer to occur, irrespective of deployment history and associated deployment-related environmental exposures. Understanding baseline rates of cancer in the military population is useful when evaluating whether cancer among service members with a history of deployment in support of OIF and/or OEF occurs at excessive rates. Cancer investigations in military populations typically focus on specific types of cancer or are specific to a single service branch. This was the case when Yamane reported on cancer incidence from 1989-2002 among Airmen. In comparison to the general US population, he found standardized incidence ratios for all cancers to be lower than expected among male Air Force service members and as expected among female Air Force service members.[40] Zhu et al later compared incidence rates of a select group of cancers (lung, colorectal, prostate, breast, testicular, and cervical cancers) across the military to US civilians. The authors reported lower incidence rates of colorectal, lung, and cervical cancers, and higher rates of prostate and breast cancers.[7] Although these comparisons provide valuable information, knowledge of rates across all service branches for all types of cancers is important.

In June 2012, the Armed Forces Health Surveillance Center published a report describing incident diagnoses of cancers and cancer-related deaths in active duty

military personnel from 2000-2011. Results for the 12-year surveillance period showed a crude incident rate of 55.2 per 100,000 person-years, with the lowest annual incidence rate of 50.3 per 100,000 person-years occurring in 2003 and the highest annual incidence rate of 60.1 per 100,000 person-years occurring in 2009. The data indicated no apparent increasing or decreasing trends in overall or site-specific incident cancer diagnoses. Of note, rates of cancer diagnoses among active duty military members have remained stable since 2000.[41]

Identifying Carcinogens

More than 900 agents have been evaluated by the International Agency for Research on Cancer for determination of potential to cause cancer. A group of four different categories is utilized to classify every agent: carcinogenic to humans (Group 1), probably or possibly carcinogenic to humans (Group 2A and Group 2B, respectively), unclassifiable as to carcinogenicity in humans (Group 3), and probably not carcinogenic to humans (Group 4). In excess of 125 agents have been classified into Group 1.[42] It is suspected or known that some of these environmental carcinogens can be found in the deployment environment.

Identifying Cancers

The concern for postdeployment cancer due to potential exposure environmental carcinogens in theater has been raised by service members and veterans alike, as demonstrated by advocacy groups such as Burnpits360 and Operation Purple Heart, which allow for self-reported cancer diagnoses on website registries.[43,44] While these concerns are reasonable and recognized by public health professionals in the military community, they have yet to be supported by epidemiologic studies using appropriate populations and suitable comparison groups. However, there are many factors that should be considered when approaching a study intended to establish whether a history of deployment in support of OIF or OEF is associated with subsequent incidence of postdeployment cancer.

Age

Age is an important factor to consider when designing any epidemiologic investigation pertaining to postdeployment cancers among service members and veterans. Incidence rates of many types of cancers are known to increase with age. As pointed out by the Armed Forces Health Surveillance Center, generally speaking, US military personnel are younger than the general population.[41] When focused on a chronic disease such as cancer that is known to increase with age, in a younger population, priority should be given to cancers that typically occur with highest incidence falling during the young adult years.

Latency Periods

The empirical latent period for cancers consists of 2 parts: an induction period ranging from the time between the action of a given component cause (ie, an exposure of interest) and the action of the last causal component (ie, biological onset of the cancer) and a subsequent period ranging from the biological onset of the cancer to the clinical detection of the cancer. Minimum empirical latency periods must be taken into account when deciding which cancers to evaluate in service members and veterans postdeployment, as they must be consistent with study hypotheses. Latency periods vary by different type of cancer of interest, with some cancers having a typical latency period of 15 to 20 years or longer, while some cancers typically have latency periods that are considerably shorter. In the former, these types of cancers would be better suited for postdeployment cancer evaluations among veteran populations of wars that occurred at least that far in the past, such as Vietnam or the first Gulf War, yet they would not be appropriate for OIF/OEF veterans as that much time has not yet passed since exposure. On the other hand, it would be prudent to study the latter types of cancers in a population of OIF/OEF deployed service members because time since deployment and typical latency periods align.

Biologic Plausibility

When selecting cancer outcomes of interest, the focus should be on cancers that are biologically plausible. For example, the following cancers were selected for an upcoming collaborative study between the US Army Public Health Command, the Navy and Marine Corps Public Health Center, and the Department of Veterans Affairs: melanoma, leukemia, lymphoma, and brain, thyroid, testicular, and breast cancers. Those cancers have peak incidence during young adult years, which matches the demographics of our service members with potential exposure(s) of interest.[45] These selections were also made based on suspected or known occupational or environmental risk factors.[46-49] The latent periods of these cancers are also in accordance with investigating the association between in-theater environmental exposures and postdeployment cancer among service members formerly deployed to OIF or OEF.[50,51]

Karshi-Khanabad: An Example

Recent efforts to understand possible associations between environmental exposures in theater and postdeployment cancer diagnoses include an investigation conducted at the US Army Public Health Command, which explored multiple cancer outcomes among service members formerly deployed to Karshi-Khanabad, an air base located in southeastern Uzbekistan used to support missions in neighboring Afghanistan during OEF.[39] Active

duty members of the US armed forces were located at the Karshi-Khanabad Air Base, also known as K2 or Camp Stronghold Freedom, between 2001 and 2005. General conditions were known to be harsh. Historically, the site was used by the Soviet military to support operations in Afghanistan in the late 1970s. During this time, the Soviet Air Force maintained a fleet of various bomber aircraft at K2, which required an underground fuel distribution system. Furthermore, construction of military equipment (including missiles) in the Soviet era used materials such as asbestos and radioactive material. An occupational and environmental survey performed at K2 in November 2001 by the Center for Health Promotion and Preventive Medicine-Europe.found underground jet-fuel plumes and surface dirt contaminated with asbestos and radioactive uranium.[38] Periodic high levels of dust and other particulate matter (PM) in the air due to seasonal dust storms was also noted.

Although efforts for remediation of the environmental health risks present at K2 were made (eg, covering the contaminated areas with clean soil and declaring these areas "off-limits"), exposure to the toxicants mentioned above during deployment to K2 was plausible. In other settings, exposure to jet fuel plumes, asbestos-contaminated soil, radioactive materials, and/or dust and PM have resulted in documented adverse health outcomes, including both acute and chronic disease. As such, this investigation focused on identifying the frequency of postdeployment medical encounters for health outcomes consistent with exposure to the identified toxicants, with an emphasis on cancer due to the various types among personnel previously deployed to K2.[52-61]

At the request of a US Central Command Force Health Protection Officer, an evaluation of health outcomes among active duty military personnel with a history of deployment to K2 was conducted to address concerns for exposure(s) of health consequence among Army, Air Force, and Marine Corps personnel deployed to the air base. The Army Public Health Command subsequently conducted a comparative health assessment using one year of postdeployment medical follow-up. In the context of the above discussion regarding latency periods for cancer outcomes, the US Army Special Operations Command Surgeon later requested that the original analysis be repeated to incorporate up to 10 years of follow-up, using all available postdeployment medical encounter data. In response to this request, a retrospective cohort study was conducted in order to assess postdeployment health status among service members formerly deployed to K2. This was accomplished by linking K2 deployment rosters from 2001-2005 with postdeployment inpatient and outpatient medical records from 2001-2011. Additionally, a reference group of personnel stationed in South Korea during the same period was selected for comparison. The results are presented in the Table.

The results of this analysis are somewhat mixed, with relative risks lower than one for about half of the specific cancer type outcomes and relative risks higher than one for the other half. The only statistically significant findings were for malignant melanoma and neoplasms of lymphatic and hematopoietic tissues (excluding Non-Hodgkin Lymphoma and Leukemia; highlighted in bluein the Table), indicating a risk approximately 3.7 times greater and 5.6 times greater among those deployed to K2 compared to those stationed in Korea. Concern for postdeployment cancer at K2 is warranted, given the relative risks above one, irrespective of statistical significance and the limitations of this particular analysis. Although the environmental hazard risk profile may differ somewhat between K2 and other OIF/OEF locations, these results bolster the rationale for conducting broader studies to evaluate incidence of cancers following military deployment.

Challenges and Limitations

Long latency periods, low incidence rates of most types of cancer, and appropriate selection of nondeployed controls present challenges for investigators wishing to evaluate postdeployment cancer risk. Only very recently has a sufficient amount of time elapsed in order to assess cancer incidence following OIF and OEF deployments. Given the low incidence rates of most types of cancers, researchers must take care to ensure that study sample sizes are large enough to provide adequate statistical power to detect associations, should they exist. Epidemiologic studies comparing cases to controls with respect to OIF/OEF deployment status presents a challenge due to a high prevalence of deployment for any military personnel serving between 2001 and 2014. As such, a large well-powered study is imperative.

Additional challenges include a lack of data on individual environmental exposures over time as well as a lack of exact locations of each service member during military deployments. As a result, deployment in general is typically used as a proxy for deployment-associated exposures. Also limiting to epidemiologic studies such as these is the lack of information on behavioral habits such as smoking, which can have significant effects on certain types of cancer.

Cancer case definitions are often based on ICD-9-CM coded medical encounter data from military medical record databases. Using administrative records to

Age-Adjusted Relative Risks and Corresponding 95% Confidence Intervals for Cancer Outcomes, Comparing US Military Personnel Deployed to K2 to US Military Personnel Stationed in Korea

Outcome	K2				Korea				Age-Adjusted*	
	Age				Age					
	Young		Old		Young		Old			
	n	%	n	%	n	%	n	%	RR	95% CI
All cancer	11	0.39	50	1.21	41	0.28	133	1.00	1.23	0.92-1.65
Brain cancer	1	0.04	4	0.10	0	0.00	8	0.06	2.04	0.68-6.09
Cervical cancer	0	0.00	0	0.00	1	0.01	0	0.00	0	--
Leukemia	0	0.00	1	0.02	5	0.03	4	0.03	0.43	0.05-3.63
Malignant melanoma	1	0.04	7	0.17	3	0.02	5	0.04	3.68	1.35-10.04
Neoplasm of bone/connective tissue/skin/breast	1	0.04	3	0.07	5	0.03	9	0.07	1.06	0.35-3.22
Neoplasm of colon/rectum	2	0.07	3	0.07	2	0.01	9	0.07	1.6	0.57-4.51
Neoplasm of digestive organs/peritoneum	0	0.00	1	0.02	1	0.01	6	0.05	0.48	0.06-3.95
Neoplasm of female breast	1	0.04	3	0.07	1	0.01	9	0.07	1.35	0.43-4.24
Neoplasm of genitourinary organs	1	0.04	4	0.10	2	0.01	8	0.06	1.74	0.60-5.08
Neoplasm of lip/oral cavity/pharynx	1	0.04	3	0.07	0	0.00	6	0.05	2.18	0.64-7.49
Neoplasm of lung/bronchus	0	0.00	4	0.10	0	0.00	0	0.00	--	--
Neoplasm of lymphatic and hematopoietic tissue	2	0.07	5	0.12	6	0.04	0	0.00	5.64	1.70-18.70
Neoplasm of respiratory/intrathoracic organs	0	0.00	0	0.00	0	0.00	2	0.02	0	--
Neoplasm of testis	1	0.04	2	0.05	8	0.05	12	0.09	0.57	0.17-1.91
Non-Hodgkin lymphoma	0	0.00	3	0.07	4	0.03	8	0.06	0.89	0.25-3.26
Prostate cancer	0	0.00	4	0.10	0	0.00	18	0.14	0.71	0.24-2.10
Neoplasm of other and unspecified sites	0	0.00	3	0.07	3	0.02	27	0.20	0.33	0.10-1.09
Neoplasm of uncertain behavior (plasma cells)	0	0.00	0	0.00	0	0.00	0	0.00	--	--

*RR indicates relative risk. CI indicates confidence intervals.

ascertain cancer cases may result in false positives. For example, not only are some cancers not well defined, but some require several encounters, sometimes with multiple specialists or requiring different medical procedures, in order to make a definitive diagnosis. In such circumstances, an ICD-9-CM code may reflect a true case of cancer or the medical encounter may signify that a patient is in the process of fulfilling diagnostic evaluations necessary to rule out cancer. Using medical encounter data for case ascertainment presents another limitation of this study: whereas medical encounter data capture is complete for service members who remain in service, the same cannot be said for personnel who leave military service. This becomes particularly problematic when studying chronic health outcomes such as cancer, with the latency periods often years after exposure, beyond the average time of military service. Investigators are currently attempting to establish methodology for linking medical encounter records from military service with medical encounter records from the Veterans Administration (VA) in order to minimize loss of follow up due to attrition from military service. However, this methodology will still fail at perfect case capture, as a certain portion of veterans are not VA beneficiaries or simply choose to obtain healthcare services outside the VA health system. It has been suggested that state cancer registries be used as additional sources of data in postdeployment cancer studies, however, the feasibility of this approach has yet to be explored.

Although many challenges are presented to researchers seeking to determine whether or not cancer incidence is elevated among military service members and veterans formerly deployed in support of OIF and OEF relative to personnel without a history of deployment, it is an important topic that is worthy of public health efforts and resources.

REFERENCES

1. American Cancer Society. Cancer Facts and Figures 2015 [internet]. Available at: http://www.cancer.org/acs/groups/content/@editorial/documents/document/acspc-044552.pdf. Accessed February 25, 2015.
2. National Cancer Institute. Surveillance, Epidemiology, and End Results Program. SEER Stat Fact Sheets: All Cancer Sites [internet]. Available at: http://seer.cancer.gov/statfacts/html/all.html. Accessed February 25, 2015.
3. National Cancer Institute. Cancer Trends Progress Report – 2011/2012 Update. Available at: http://progressreport.cancer.gov/sites/default/files/archive/report2011.pdf. Accessed February 25, 2015.

4. World Health Organization. Cancer. Fact Sheet No 297 [internet]. 2015. Available at: http://www.who.int/mediacentre/factsheets/fs297/en/. Accessed February 25, 2015.
5. National Cancer Institute President's Cancer Panel. 2008-2009 Annual Report. Reducing Environmental Cancer Risk: What We Can Do Now [internet]. 2010. Available at: http://deainfo.nci.nih.gov/advisory/pcp/annualReports/pcp08-09rpt/PCP_Report_08-09_508.pdf. Accessed February 25, 2015.
6. World Health Organization. Environmental and Occupational Cancers. Fact Sheet No 350 [internet]. 2011. Available at: http://www.who.int/mediacentre/factsheets/fs350/en/. Accessed February 25, 2015.
7. Zhu K, Devesa SS, Wu H, et al. Cancer incidence in the U.S. military population: comparison with rates from the SEER program. *Cancer Epidemiol Biomarkers Prev.* 2009;18(6):1740-1745.
8. Defense Occupational and Environmental Health Readiness System [internet, limited access]. Available at: https://doehrs-ih.csd.disa.mil/Doehrs/. Accessed February 25, 2015.
9. US Army Public Health Command. The Periodic Occupational and Environmental Monitoring Summary (POEMS) – History Intent, and Relationship to Individual Exposures and Health Outcomes. Technical Information Paper 64-002-1110 [internet]. 2014. Available at: http://www.pdhealth.mil/dcs/deploymentexposure.asp. Accessed June 5, 2015.
10. Smith B, Ryan MAK, Wingard DL, Patterson TL, Slymen DJ, Macera CA. Cigarette smoking and military deployment: a prospective evaluation. *Am J Prev Med.* 2008;35(6):539-546.
11. Levine PH. Is testicular cancer related to Gulf War deployment? Evidence from a pilot population-based study of Gulf War era veterans and cancer registries. *Mil Med.* 2005;170(2):149-153.
12. Institute of Medicine. *Veterans and Agent Orange: Health Effects of Herbicides Used in Vietnam.* Washington, DC: National Academies Press; 1994. Available at: http://www.iom.edu/Reports/1994/Veterans-and-Agent-Orange-Health-Effects-of-Herbicides-Used-in-Vietnam.aspx. Accessed February 23, 2015.
13. Richards EE. Responses to Occupational and Environmental Exposures in the U.S. Military – World War II to the Present. *Mil Med.* 2011;176(7):22-8.
14. Department of Veterans Affairs. Agent Orange home page [internet]. Available at: http://www.publichealth.va.gov/exposures/agentorange/index.asp. Accessed February 24, 2015.
15. The Selected Cancers Cooperative Study Group. The association of selected cancers with service in the US military in Vietnam. II. Soft-tissue and other sarcomas. *Arch Intern Med.* 1990;150(12):2485-2492.
16. The Selected Cancers Cooperative Study Group. The association of selected cancers with service in the US military in Vietnam. III. Hodgkin's disease, nasal cancer, nasopharyngeal cancer, and primary liver cancer. *Arch Intern Med.* 1990;150(12):2495-2505.
17. Young AL, Cecil PF Sr. Agent orange exposure and attributed health effects in Vietnam veterans. *Mil Med.* 2001;176(7):29-34.
18. Department of Veterans Affairs. Vietnam Veterans and Agent Orange: Independent Study Course [internet]. Available at: http://www.publichealth.va.gov/docs/vhi/VHIagentorange_text508.pdf. Accessed February 24, 2015.
19. The Selected Cancers Cooperative Study Group. The association of selected cancers with service in the US military in Vietnam. I. Non-Hodgkin's lymphoma. *Arch Intern Med.* 1990;150(12):2473-2483.
20. Frumkin H. Agent Orange and cancer: an overview for clinicians. *CA Cancer J Clin.* 2003;53(4):245-255.
21. Institute of Medicine. *Veterans and Agent Orange: Update 2012.* Washington, DC: National Academies Press; 2012. Available at: http://www.iom.edu/Reports/2013/Veterans-and-Agent-Orange-Update-2012.aspx. Accessed February 23, 2015.
22. Baird C. The basis for and uses of environmental sampling to assess health risk in deployed settings. *Mil Med.* 2011;176(7):84-90.
23. Bullman TA, Mahan CM, Kang HK, Page WF. Mortality in US Army Gulf War veterans exposed to 1991 Khamisiyah chemical munitions destruction. *Am J Public Health.* 2005;95(8):1382-1388.
24. Young HA, Maillard JD, Levine PH, Simmens SJ, Mahan CM. Investigating the risk of cancer in 1990-1991 US Gulf War veterans with the use of state cancer registry data. *Ann Epidemiol.* 2010;20(4):265-272.
25. Knoke JD, Gray GC, Garland FC. Testicular cancer and Persian Gulf war service. *Epidemiology.* 1998;9(6):648-653.
26. Kang HK, Mahan CM, Lee KY, Magee CA, Murphy FM. Illnesses Among United States veterans of the Gulf War: a population-based survey of 30,000 veterans. *J Occup Environ Med.* 2000;42(5):491-501.
27. Kang HK, Bullman TA. Mortality among US veterans of the Persian Gulf war: 7-year follow-up. *Am J Epidemiol.* 2001;154(5):399-405.

28. Institute of Medicine. *Gulf War and Health: Volume 3. Fuels, Combustion Products, and Propellants.* Washington, DC: National Academies Press; 2005. Available at: http://www.nap.edu/openbook.php?isbn=0309095271. Accessed February 24, 2015.
29. Bonds TM, Baiocchi D, McDonald LL. *Army Deployments to OIF and OEF.* Santa Monica, CA: RAND Corp; 2010. Available at: http://www.rand.org/pubs/documented_briefings/DB587.html. Accessed February 23, 2015.
30. Tan M. 2 million troops have deployed since 9/11. *Marine Corps Times.* December 18, 2009. Available at: http://www.marinecorpstimes.com/article/20091218/NEWS/912180312/2-million-troops-deployed-since-9-11. Accessed February 23, 2015.
31. Teichman R. Exposures of Concern to Veterans Returning from Afghanistan and Iraq. *J Occup Environ Med.* 2012;54(6):677-681.
32. Helmer DA, Rossignol M, Blatt M, Agarwal R, Teichman R, Lange G. Health and exposure concerns of veterans deployed to Iraq and Afghanistan. *J Occup Environ Med.* 2007;49(5):475-480.
33. Brown KW, Bouhamra W, Lamoureux DP, Evans JS, Koutrakis P. Characterization of particulate matter for three sites in Kuwait. *J Air Waste Manag Assoc.* 2008;58:994-1003.
34. Engelbrecht JP, McDonald EV, Gillies JA, Jayanty RK, Casuccio G, Gertler AW. Characterizing mineral dusts and other aerosols from the Middle East-part I: ambient sampling. *Inhal Toxicol.* 2009;21:297-326.
35. Mosher DE, Lachman BE, Greenberg MD, Nichols T, Rosen B, Willis HH. *Green Warriors: Army Environmental Considerations for Contingency Operations from Planning Through Post-Conflict.* Santa Monica, CA: RAND Corp; 2008. Available at: http://www.rand.org/pubs/monographs/MG632.html. Accessed June 5, 2015.
36. Weese CB, Abraham JH. Potential health implications associated with particulate matter exposure in deployed settings in southwest Asia. *Inhal Toxicol.* 2009;21:291-296.
37. Abraham JH, Eick-Cost A, Clark LL, et al. A retrospective cohort study of military deployment and postdeployment medical encounters for respiratory conditions. *Mil Med.* 2014;179(5):540-546.
38. Deployment Health Clinical Center, et al. Environmental conditions at Karshi Khanabad [internet]. Available at: http://www.pdhealth.mil/clinicians/downloads/CIS.02-09-09a.K-2-Provider.pdf. Accessed February 25, 2015.
39. Globalsecurity.org. Khanabad, Uzbekistan, Karshi-Kanabad (K2) Airbase, Camp Stronghold Freedom [internet]. Available at: http://www.globalsecurity.org/military/facility/khanabad.htm. Accessed February 25, 2015.
40. Yamane GK. Cancer incidence in the U.S. Air Force: 1989-2002. *Aviat Space Environ Med.* 2006;77(8):789-794.
41. Armed Forces Health Surveillance Center. Incident diagnoses of cancers and cancer-related deaths, active component, U.S. Armed Forces, 2000-2011. *MSMR.* 2012;19(6):18-22.
42. International Agency for Research on Cancer. Agents Classified by the IARC Monographs. Volumes 1-111 [internet]. 2014. Available at: www.monographs.iarc.fr. Accessed February 27, 2015.
43. Torres R. Burnpits360 [internet]. 2014. Available at: http://www.burnpits360.org/. Accessed February 26, 2015.
44. Stuart R. Operation Purple Heart [internet]. 2014. Available at: http://operationpurpleheart.blogspot.com/. Accessed February 26, 2015.
45. Bleyer A, Barr R, Hayes-Lattin B, Thomas D, Ellis C, Anderson B. The distinctive biology of cancer in adolescents and young adults. *Nat Rev Cancer.* 2008;8(4):288-298.
46. Wrensch M, Bondy ML, Wiencke J, Yost M. Environmental risk factors for primary malignant brain tumors: A review. *J Neurooncol.* 1993;17(1):47-64.
47. Miligi L, Seniori Costantini A, Crosignani P, et al. Occupational, environmental, and life-style factors associated with the risk of hematolymphopoietic malignancies in women. *Am J Ind Med.* 1999;36(1):60-69.
48. Zheng T, Blair A, Zhang Y, Weisenburger DD, Zahm SH. Occupation and risk of non-Hodgkin's lymphoma and chronic lymphocytic leukemia. *J Occup Environ Med.* 2002;44(5):469-474.
49. Mester B, Behrens T, Dreger S, Hense S, Fritschi L. Occupational causes of testicular cancer in adults. *Int J Occup Environ Med.* 2010;1(4):160-170.
50. Armenian HK, Lilienfeld AM. The distribution of incubation periods of neoplastic diseases. *Am J Epidemiol.* 1974;99(2):92-100.
51. Howard J. Minimum latency and types or categories of cancer. centers for disease control and prevention [internet]. 2013. Available at: http://www.cdc.gov/wtc/pdfs/wtchpminlatcancer2013-05-01.pdf. Accessed February 26, 2015.
52. Harris DT, Sakiestewa D, Titone D, Robledo RF, Young RS, Witten M. Jet fuel-induced immunotoxicity. *Toxicol Ind Health.* 2000;16(7-8):261-265.
53. LeVan TD, Koh WP, Lee HP, Koh D, Yu MC, London SJ. Vapor, dust, and smoke exposure in relation to adult-onset asthma and chronic respiratory symptoms: the Singapore Chinese Health Study. *Am J Epidemiol.* 2006;163(12):1118-1128.

54. Ling SH, van Eeden SF. Particulate matter air pollution exposure: role in the development and exacerbation of chronic obstructive pulmonary disease. *Int J Chron Obstruct Pulmon Dis*. 2009;4:233-243.

55. Marshall AC. Gulf war depleted uranium risks. *J Expo Sci Environ Epidemiol*. 2008;18(1):95-108.

56. Nogueira JB. Air pollution and cardiovascular disease. *Rev Port Cardiol*. 2009;28(6):715-733.

57. O'Toole TE, Conklin DJ, Bhatnagar A. Environmental risk factors for heart disease. *Rev Environ Health*. 2008;23(3):167-202.

58. Periyakaruppan A, Kumar F, Sarkar S, Sharma CS, Ramesh GT. Uranium induces oxidative stress in lung epithelial cells. *Arch Toxicol*. 2007;81(6):389-395.

59. Pleil JD, Smith LB, Zelnick SD. Personal exposure to JP-8 jet fuel vapors and exhaust at air force bases. *Environ Health Perspect*. 2000;108(3):183-192.

60. Polichetti G, Cocco S, Spinali A, Trimarco V, Nunziata A. Effects of particulate matter (PM(10), PM(2.5) and PM(1)) on the cardiovascular system. *Toxicology*. 2009;261(1-2):1-8.

61. Ritchie G, Still K, Rossi J III, Bekkedal M, Bobb A, Arfsten D. Biological and health effects of exposure to kerosene-based jet fuels and performance additives. *J Toxicol Environ Health B Crit Rev*. 2003;6(4):357-451.

AUTHORS

Ms Sharkey and Dr Abraham are Epidemiologists, Environmental Medicine, US Army Public Health Command, Aberdeen Proving Ground, Maryland.

ENCLOSURE 4

Environmental Conditions at Karshi Khanabad (K-2)

Information for Health Care Staff

A Collaborative Effort of DHCC, AFIERA, NEHC, and USACHPPM

American troops began working at K-2 (Stronghold Freedom) in Oct 01. K-2 is at the site of an old, Soviet-era air base in Uzbekistan and general conditions are harsh. It is a very active site supporting OPERATION Enduring Freedom. Thousands of service members (mostly Army and Air Force, but some Marines) from various Guard, Reserve, and active duty units have worked at K-2 or are scheduled to go there soon. Some people who worked there are concerned that the environmental conditions may have affected their health. This information sheet prepares medics for some of the more common questions.

What are conditions like at K-2?

This is a bare bones, rustic site, as is often the case with contingency operations. The most common complaint was of a bad smell coming from a trench near the tent city. Others talked about "black goo" while digging or mentioned high levels of disease, like TB.

What kind of assessment was done at K-2?

At any new site, an occupational and environmental baseline (EBS) survey is a required part of the health risk assessment process. In Nov 01, the U.S. Army Center for Health Promotion and Preventive Medicine-Europe (USACHPPM-EUR) did an EBS. They found widespread jet fuel plumes, usually 1-3 meters under ground, most likely from a leaking Soviet-era underground fuel distribution system. This was the cause of the odor and pooling associated with digging.

They also found smaller, localized areas of surface dirt contaminated with asbestos and low-level radioactive processed uranium, both from the destruction of Soviet missiles several years ago.

Finally, the amount of dust and other particles in the air was often high, varying with the season and weather, e.g., dust storms.

How would these exposures affect health?

Although the odor is unpleasant, the fuel vapor level found in the area of the trench is well below the Minimal Risk Level developed by the Agency for Toxic Substances and Disease Registry. Noses are marvelously sensitive and can detect chemicals at low levels that are not harmful to health.

Asbestos was present. However, it was not detected in the air and would not be inhaled, so any health risk from asbestos is very small. The level of radioactivity found cannot get through the skin, so the only health risk would be from breathing radioactive dust in the air or by living or working directly over the most radioactive areas. Neither of these situations was detected at K-2.

Dust is a respiratory irritant that bothers some people more than others. Symptoms such as cough, sneezing, sinus irritation, increased posterior nasal drainage, and sore throat are common during peak periods. People with asthma or allergies may notice that their usual symptoms worsen. These effects usually resolve as the local environmental conditions improve. Permanent health effects are uncommon.

Long-term health effects from the short-term, low-dose exposures possible at K-2 seldom if ever occur. A few scientists and clinicians, however, hypothesize that low doses of one or more environmental agents may cause a wide variety of symptoms in certain sensitive people. Unfortunately, there is conflicting evidence and not everyone agrees. Reported symptoms might include depression, anxiety, or unexplained physical symptoms such as fatigue, subjective memory and concentration problems, chronic pain, or an irritable bowel. Such symptoms can appear for many reasons and most commonly occur in people without any known exposure to environmental contaminants. Any new information about K-2 exposures or associated health effects will be sent to health care providers and service members right away.

What protective steps were taken?

The air base leadership quickly took protective action in Nov 01. They filled the trench with clean soil to create a cap to hold the vapors underground. They also covered the areas of radioactive soil and asbestos with a thick layer of clean dirt to keep people safe. These areas remain off-limits to everyday activity, and both permission and protective equipment are required before any digging can occur.

Air monitoring and other follow-up sampling are ongoing to ensure that conditions do not change and that these measures remain effective.

What about chemical warfare agents?

News media in Jun 02 reported that trace amounts of nerve and blister agents were detected in some areas of the K-2 complex. However, extensive confirmatory testing of new samples using specialized testing equipment was completely negative for chemical warfare agents. The initial tests using less specific equipment apparently gave false positive results most likely due to contaminants from recent painting and other refurbishing activities. Monitoring continues at K-

2 to ensure service members remain protected and to provide early detection and reporting if conditions change.

What did post-deployment surveys show?

Service members are supposed to fill out a post-deployment survey (DD Form 2796) before leaving the theater. This is one of the ways the services monitor the conditions experienced by deployed troops. Of those surveys in which service members reported exposure concerns, the most common concerns were depleted uranium, petroleum products, tuberculosis, radio-frequency exposure, and general radiation exposure.

What should I expect from returning K-2 personnel?

Service members may ask about any of the above topics or others that we don't know about yet. Some may believe they were exposed to dangerous chemicals and that they haven't been told the truth. They may have symptoms that they think are the result of these exposures, or they may feel well now, but report concerns regarding their future health.

Available indications are that the protective risk control measures in place since November 2001 remain effective. However, rumors and conflicting reports have circulated, and your reassurances may not lessen their level of concern. Listen actively, show that you care about them and their concerns, and promise to do your best to help them. Avoid any temptation to contradict them.

What should I do in the clinic?

The best advice for the medical staff is to show respect and appreciation for the patient's recent service to his or her country. It often helps rapport if you thank them for that service. Show them care and concern at all times.

A complete and thorough history and focused physical examination is always appropriate. Be sure to book extra time for these patients and spend more time than usual gaining their perspective regarding possible K-2 exposures and other health concerns. Similarly, take more time than you normally would to explain all options and follow-up plans.

Follow-up evaluations and clinical continuity are essential to the care of any patients, but can be difficult, especially for reservists and National Guard members. Still, a single primary care provider that guides the patient through the evaluation process, knows patient concerns, and can track his or her care is ideal and it shows care, concern, and commitment to the patient. Try to provide this service whenever possible.

Another option for the reservists and National Guard members is the VA. Recent legislation allows the VA to provide health care at no cost to all combat veterans for any illnesses that are at least conceivably related to military service. This includes such things as potential health effects from possible environmental exposures that occurred during deployment. The service is available to all combat veterans for a period of two years after their separation from military service, and the veteran is not required to prove any connection to military service. Veterans in this current deployment will be covered. Be sure and pass this information on.

It is common for individuals in these circumstances to express overt mistrust, anger, and even outrage at any reassurances you might offer. It is never appropriate to confront these individuals or to suggest that their symptoms are minor, exaggerated, or faked. Never diagnose symptoms as "psychogenic" or "somatoform." All complaints deserve your complete professionalism. Always give these individuals the benefit of the doubt in your clinical conclusions, documentation efforts, administrative determinations, and education efforts.

Are there special evaluations I should do?

Let your clinical suspicion based on the history and physical direct your testing. Under the circumstances, you should have a low clinical threshold for ordering labs and clinical consultations. However, exhaustive (so-called "no stone unturned") evaluations trying to "rule out" every remote possibility are inappropriate, often lead to false positive findings that can increase patient concern and may have other harmful effects.

Some people may ask for or demand specific tests they have heard about. These might include:

- *Volatile organic compounds (VOCs) in blood.* All of us have VOCs in our blood from exposure to fresh paints, gasoline at local filling stations, and other common exposures. VOCs are cleared from blood in less than a day, so test results would reflect only recent exposure. Testing is only useful if exposures are more recent and extensive than the exposures suspected at K-2. Finally, testing has no prognostic value.
- *RBC cholinesterase levels.* This test is used to monitor chronic or acute exposures in people who work with pesticides. There are variations in test results between different individuals. Pre-exposure baselines are therefore necessary for accurate interpretation. RBCs are constantly turning over in the body. Consequently, this test is no longer useful an average of only 30 days after an exposure. RBC cholinesterase levels did not correlate with symptoms in the Tokyo subway nerve agent attack. Perhaps most importantly, since all available evidence suggests exposures did not occur, the likelihood that a positive test would be a true positive is essentially zero.

Can mental health consultation help?

Consultation to mental health is encouraged under appropriate clinical circumstances, since psychological conditions are among the most common of clinical

conditions, they are often disabling, and treatment is typically effective. However, mental health consultation deserves special attention because it is almost always threatening to the patient. It often signals to the patient that you think their problem is "psychogenic" or "imaginary." In addition, the patient may feel that the military is trying to shift blame away from itself and onto the patient.

In the first visit, it is recommended that you use the following statements to lay the groundwork for later consultation, if needed: "It would not be unusual to have concerns about possible chemical exposures at K-2. How are you and your loved ones coping with all of this? Do you have adequate support during this difficult time? Seeing a mental health provider can help. Let me know if you think this would be helpful for you."

If the patient reacts negatively, leave the issue alone and come back to it at a later visit. If the patient is receptive, further discussion is necessary. Never refer a patient to mental health care without carefully explaining the reason for referral and getting the patient's perspective and consent to obtain the referral. Always schedule a follow-up visit after the mental health consultation so that the patient does not feel discounted or rejected. Consultations purely to determine if symptoms are "organic or psychogenic" are discouraged.

When dealing with military-related illness and exposure concerns, never force a patient into psychiatric care unless you think the situation is emergent or life threatening (e.g., involves suicidal or violent ideation).

What can I do to build trust and rapport?

Patients undergoing evaluations for suspected military or deployment-related exposures are usually highly concerned. They may mistrust your statements and opinions, particularly if they view them as falsely reassuring. They may interpret seemingly positive news as confusing, incredible, or even as evidence of a cover-up. Remember, these patients have recently returned from a hostile environment where they were told they were probably exposed to environmental contaminants. Do not take their mistrust and apprehension personally. There are many other potential reasons for this mistrust such as well-known limits to the confidentiality of military health records and the possible impact of health problems on one's future military career.

It is worth mentioning a few ways of reducing mistrust and building rapport. You can invite patients to bring their spouse or 'significant other' to a follow-up appointment. Loved ones often are as concerned as the patient and may be even more mistrustful. Involving them in the visits is informative for them, and it often improves patient-provider trust.

Another way to foster trust is to see the patient every 6-8 weeks, making sure to follow-up on all concerns and test results. This is an important and visible evidence of your compassion and commitment to the patient. If concerns do not resolve, consultation is probably appropriate.

What can they do to protect their health?

The most common killers are preventable. Never miss the opportunity to reemphasize the importance of maintaining a healthy lifestyle (avoid tobacco, exercise regularly, follow a nutritious diet, drive safely, play smart, and drink alcohol in moderation, if at all).

Additionally, individuals should remain alert to work, home, and recreational environments, correcting hazards within their control and reporting unsafe conditions to appropriate officials.

Summary of key messages.

The most important messages to communicate are:

- There were no K-2 exposures of health consequence.
- The protective risk control measures were effective.
- Ongoing monitoring ensures continued protection.
- Show care and commitment during clinical care.

This Information Was Assembled In Collaboration With AFIERA, NEHC, USACHPPM

Where can I get more information?

- **U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM)**
  Phone: 800.222.9698 Internet URL: http://chppm-www.apgea.army.mil
  Environmental sampling & risk assessment: Mr. Jeff Kirkpatrick 410-436-8155.
  General medical information: Dr. Coleen Weese 410-436-2578
- **Air Force Institute for Environment, Safety and Occupational Health Risk Analysis (AFIERA)**
  Phone: 888.232.ESOH (3764) Internet URL: http://afiera.afms.mil
  General medical information: Lt Col (Dr.) Kenneth L. Cox 210-536-1788
- **Navy Environmental Health Center (NEHC)**
  Phone: 757.953.0764 Internet URL: http://www-nehc.med.navy.mil
  General medical information: CDR (Dr.) Alan Philippi
- **Deployment Health Clinical Center (DHCC)**
  Phone: 866.559.1627 Internet URL: http://www.pdhealth.mil/
  Post-deployment health care information: LTC (Dr.) Charles Engel
- **Department of Veterans Affairs** Internet URL www.va.gov/environagents

ENCLOSURE 5

Environmental Conditions at Karshi Khanabad (K-2) Air Base, Uzbekistan

Information for Service Members and Veterans

FACT SHEET 64-038-0617
Replaces previous DHCC unnumbered Fact Sheet

American Service members began working at K-2 (Stronghold Freedom) in October 2001, and the air base was vacated in November 2005. K-2 was located on a portion of an old, Soviet-era air base in Uzbekistan. It was a very active site supporting Operation Enduring Freedom. Thousands of Service members (mostly Army and Air Force, but some Marines) from various Guard, Reserve, and Active Duty units were stationed at K-2. Currently, K-2 Airbase is home to the 60th Separate Mixed Aviation Brigade of the Uzbek Air Force. This updated information sheet provides background information and answers to some questions regarding environmental exposures at K-2 and risk of potential long-term adverse health effects associated with being at K-2.

What were conditions like at K-2?

K-2 was a deployment site located in the Qashqadaryo Province in southeastern Uzbekistan near the border with Tajikistan. Frequently reported exposures at K-2 were heat, noise, and poor air quality (usually elevated levels of particulate matter). The most frequent complaint by Service members assigned there in 2001 was of a bad smell coming from a trench near the original tent city.

What kind of assessment was done at K-2?

In accordance with Department of Defense deployment health policy, an Environmental Site Characterization and an Operational Health Risk Assessment was completed in November 2001, and follow-up Deployment Occupational and Environmental Health Site Assessments were completed in 2002 and 2004. Notable findings included:

Jet fuel. Widespread jet fuel plumes were found, usually 1-3 meters underground, most likely from a leaking Soviet-era underground fuel distribution system. This was the cause of the odor and pooling of "black goo" while digging.

Asbestos and Depleted Uranium. Localized areas of surface dirt contaminated with asbestos and low-level radioactive depleted uranium (DU) were also found; both were from the destruction of Soviet missiles several years before U.S. forces occupied K-2. Also, the 2004 Final Deployment Occupational and Environmental Health Site Assessment stated previous operational health risk assessments identified several structures (i.e., 416th AEG Vehicle maintenance Facility, Counterintelligence/ Force Protection/Judge Advocate General [CI/FP/JAG] Building and its gazebo, and Military Police Headquarters Building) with friable asbestos containing material (ACM) tiled roofs. However, the 2004 site assessment identified only one structure with ACM tiled roofs, the CI/FP/JAG Building's gazebo. The site assessment concluded airborne friable asbestos did not pose a health threat.

Particulate matter (PM). There were often high levels of dust and other particulate matter in the air. Levels of dust and PM in the air varied depending on the season and weather conditions. Levels of dust in the air can be significantly high during dust storms.

Noise. Operational noise evaluation indicated combined sources which generated noise levels equivalent to a large city or industrial facility. Major noise sources were the prime power generation station, subsistence/storage refrigeration trailer area, the refrigeration trailers located next to the base camp's dining facility and flight operations.

Could these exposures adversely affect my health?

Jet fuel vapor. Although the odor was unpleasant, air samples revealed that volatile organic compounds (VOCs) in the jet fuel vapor did not exceed Military Exposure Guidelines (MEGs) or other health exposure criteria. Adverse long-term health effects are not expected from exposure to the fuel vapors.

Asbestos. Although asbestos was present in the roof tiles of buildings used by U.S. and coalition forces and in localized areas of surface dirt, long-term adverse health effects would not be expected as air samples did not detect the presence of any airborne asbestos fibers. This indicates that personnel were not exposed to inhalable asbestos fibers. Additional protective measures are mentioned below.

If you have questions regarding this document please contact:
Army Public Health Center, Environmental Medicine Division,
DSN 312-584-2714; COMM 410-436-2714;
or email usarmy.apg.medcom-aphc.mbx.emp@mail.mil
5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010-5403

Depleted Uranium. DU was present in localized areas, but long-term adverse health effects would not be expected from depleted uranium contamination based on site assessments and the proper use of protective measures by personnel to prevent DU exposure.

Particulate matter. The evidence to date is inconclusive regarding increased risk of chronic respiratory conditions associated with military deployment to the CENTCOM AOR, which includes K-2. Some previously deployed personnel may however experience persistent symptoms or develop chronic respiratory conditions which may be due to their combined deployment exposures, unique experiences, and/or individual susceptibilities. The DOD acknowledges the concern regarding potential respiratory health effects associated with deployment and is collaborating with the VA and independent researchers to further evaluate and quantify potential long-term health risks related to deployment exposures.

Noise. Personnel could have been exposed to hazardous levels of noise that may lead to hearing loss. This risk is higher for individuals working near major noise sources without proper hearing protection.

What protective measures were taken?

The jet fuel contaminated trench was filled with clean soil to create a cap to hold the vapors underground. Areas contaminated with depleted uranium and asbestos were covered with a thick layer of clean dirt to mitigate exposure. These areas remained off-limits to everyday activity with restricted access, and both permission and protective equipment were required before any digging could occur. Air monitoring and other follow-up sampling continued to ensure that conditions did not change and that these protective measures remained effective.

What about chemical warfare agents?

In June 2002, news media reported that trace amounts of nerve and blister agents were detected in hardened aircraft shelters of the K-2 complex. After extensive confirmatory testing of new samples using specialized testing equipment, there were negative results for chemical warfare agents (CWA). The initial field tests using less specific equipment gave false positive results most likely due to contaminants from recent painting and other refurbishing activities. Under these circumstances, it is not unusual to get false positive CWA test results from initial field testing. There was ongoing monitoring at K-2 to ensure Service members remained protected and to provide early detection and reporting if conditions changed.

Should I get a medical examination?

You do not need to get a medical examination or have additional medical screenings just because you were at K-2. If you have any concerns about your health, including medical conditions related to deployments, you should speak with your primary health care provider. If you are a Veteran and you believe your medical condition(s) was caused or aggravated by your military service, you can file a claim with the Department of Veterans Affairs (VA). Additionally, you can contact your nearest VA Environmental Health Coordinator via the following website to discuss any exposure related health concerns: http://www.publichealth.va.gov/exposures/coordinators.asp.

What can I do to protect my health?

There are no specific health recommendations related to a deployment at K-2. In general, you can reduce your risk of developing medical conditions and experiencing injuries by following a healthy lifestyle. The Performance Triad is designed to optimize sleep, activity, & nutrition in order to maximize health. Prevention measures, such as driving safely, playing smart, using personal protective and safety equipment and drinking alcoholic beverages in moderation will also reduce risk. Avoiding known health risks such as tobacco/nicotine products, risky behaviors and unsafe conditions is also important. Following the Performance Triad guidelines and prevention recommendations will contribute to your overall health throughout life.

The Military Deployment Periodic Occupational and Environmental Monitoring Summary (POEMS): Karshi-Khanabad Airbase, Uzbekistan: 2001 to 2005, contains more detailed information about exposure data and health risks at K-2. This POEMS is available on the Army Public Health Center website via http://phc.amedd.army.mil/topics/envirohealth/hrasm/POEMS%20Documents/U_UZB_Karshi-Khanabad%20POEMS%202001-2005_Public%20Release%20Review.pdf.

Service members and Veterans whose only deployment was to K-2 are currently not eligible for the Airborne Hazards and Open Burn Pit Registry (https://veteran.mobilehealth.va.gov/AHBurnPitRegistry), but should check with the Department of Veterans Affairs (VA) periodically for future eligibility.

ENCLOSURE 6

Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS): Karshi-Khanabad Airbase, Uzbekistan: 2001 to 2005

AUTHORITY: This periodic occupational and environmental monitoring summary (POEMS) has been developed in accordance with Department of Defense (DoD) Instructions 6490.03, 6055.05, and JCSM (MCM) 0028-07, *See REFERENCES.*

PURPOSE: This POEMS documents the DoD assessment of Occupational and Environmental Health (OEH) risk for Camp Stronghold Freedom at Karshi-Khanabad (K2) Airbase, Uzbekistan. It presents a qualitative summary of health risks identified at these locations and their potential medical implications. The report is based on information collected from October 2001 through April 2005 to include deployment OEHS sampling and monitoring data (e.g. air, water, and soil), field investigation and health assessment reports, as well as country and area-specific information on endemic diseases.

This assessment assumes that environmental sampling at K2 during this period was performed at representative exposure points selected to characterize health risks at the *population–level*. Due to the nature of environmental sampling, the data upon which this report is based may not be fully representative of all the fluctuations in environmental quality or capture unique occurrences. While one might expect health risks pertaining to historic or future conditions at this site to be similar to those described in this report, the health risk assessment is limited to October 2001 through April 2005.

The POEMS can be useful to inform healthcare providers and others of environmental conditions experienced by individuals deployed to K2 during the period of this assessment. However, it does not represent an individual exposure profile. Individual exposures depend on many variables such as; how long, how often, where and what someone is doing while working and/or spending time outside. Individual outdoor activities and associated routes of exposure are extremely variable and cannot be identified from or during environmental sampling. Individuals who sought medical treatment related to OEH exposures while deployed should have exposure/treatment noted in their medical records on a Standard Form (SF) 600 (Chronological Record of Medical Care).

SITE DESCRIPTION: Karshi-Khanabad is located at on old Soviet-era airbase in the arid Qashqadaryo Province near the border with Tajikistan. K2 is one square mile of flat to rolling terrain. The elevation of K2 is 416 meters above sea level. The U.S. Air Force occupied the base between 2001 and 2005. In July 2005, the Uzbekistan government asks the U.S. to withdraw military operations from Khanabad. The U.S. vacated in November 2005. Currently, K2 Airbase is home to the 60th Separate Mixed Aviation brigade of the Uzbek Air Force.

SUMMARY: Conditions that may pose a moderate or greater health risk are summarized in Table 1. Table 2 provides population based risk estimates for identified OEH conditions at K2. As indicated in the detailed sections that follow Table 2, controls established to reduce health risk were factored into this assessment. In some cases, e.g. ambient air, specific controls are noted, but not routinely available/feasible.

Table 1: Summary of Occupational and Environmental Conditions with MODERATE or Greater Health Risk

Short-term health risks & medical implications:

The following hazards may be associated with potential acute health effects in some personnel during deployment at K2, Uzbekistan:

Inhalable coarse particulate matter less than 10 micrometers in diameter (PM_{10}); food/waterborne diseases (e.g., bacterial diarrhea, Hepatitis A, Typhoid fever, Brucellosis, diarrhea-protozoal, Hepatitis E); other endemic diseases (cutaneous leishmaniasis, Crimean-Congo hemorrhagic fever, plague, Leptospirosis, Tuberculosis (TB), Rabies, Anthrax, Q fever), heat stress, and continuous noise. For food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, Typhoid fever, Brucellosis, diarrhea-protozoal, Hepatitis E), if ingesting local food and water, the health effects could have temporarily incapacitate personnel (diarrhea) or result in prolonged illness (Hepatitis A, Typhoid fever, Hepatitis E, and Brucellosis). For heat stress, risk can be greater for susceptible persons including those older than 45, of low fitness level, who are unacclimatized, or with underlying medical conditions. Risks from food/waterborne diseases and heat stress may have been reduced with preventive medicine controls and mitigation, which includes Hepatitis A and Typhoid fever vaccinations. For other vector-borne endemic diseases (cutaneous leishmaniasis, Crimean-Congo hemorrhagic fever, plague), these diseases may constitute a significant risk due to exposure to biting vectors. For water contact diseases (Leptospirosis) activities involving extensive contact with surface water increase risk. For respiratory diseases (Tuberculosis (TB)), personnel in close-quarter conditions could have been at risk for person-to-person spread. Animal contact diseases (Rabies, Anthrax, Q fever), pose year-round risk. For continuous noise exposure, the risk is to individuals working near major noise sources. Risk may have been reduced to the majority of personnel and to individuals working near major noise sources by using proper hearing protection. For PM_{10}, exposures may result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel while at this site. For PM_{10}, certain subgroups of the deployed forces (e.g., those with pre-existing asthma/cardio-pulmonary conditions) are at greatest risk of developing notable health effects. Although most effects from exposure to particulate matter should have resolved post-deployment, providers should be prepared to consider the relationship between deployment exposures and current complaints. Some individuals may have sought treatment for acute respiratory irritation during their time at Karshi-Khanabad Airbase. Personnel who reported with symptoms or required treatment while at this site should have exposure/treatment noted in medical record on a Standard Form (SF) 600 (Chronological Record of Medical Care).

Long-term health risks & medical implications:

The following hazards may be associated with potential chronic health effects in some personnel during deployment at K2, Uzbekistan:

For continuous noise exposure, the long-term risk is to individuals working near major noise sources. Risk may have been reduced to the majority of personnel and to individuals working near major noise sources by using proper hearing protection. It is considered possible that some otherwise healthy personnel who were exposed for a long-term period to airborne particulate matter could develop certain health conditions (e.g., reduced lung function, cardiopulmonary disease). Personnel with a history of asthma or cardiopulmonary disease could potentially be more likely to develop such chronic health conditions. While particulate matter exposures are documented and archived, at this time there are no specific recommended, post-deployment medical surveillance evaluations or treatments. Providers should still consider overall individual health status (e.g., any underlying conditions/susceptibilities) and any potential unique individual exposures (such as burn pits, or occupational or specific personal dosimeter data) when assessing individual concerns. Certain individuals may need to be followed/evaluated for specific occupational exposures/injuries (e.g., annual audiograms as part of the medical surveillance for those enrolled in the Hearing Conservation Program; and personnel covered by Respiratory Protection Program and/or Hazardous Waste/Emergency Responders Medical Surveillance).

Table 2. Population-Based Health Risk Estimates – Karshi-Khananbad Airbase, Uzbekistan [1, 2]

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
AIR			
PM_{10}	Short-term: Low to High, Daily levels vary, acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects are possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: Low to none, Daily levels vary, acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects are possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).
	Long-term: No health guidelines		Long-term: No health guidelines
WATER			
Water for Other Purposes	Short-term: Low	Water treated in accordance with standards applicable to its intended use	Short-term: Low
	Long-term: None identified		Long-term: None identified
Military Unique			
Depleted Uranium (DU)	Short-term: Low. Inhalation of contaminated dust from activities and events (i.e., driving/resuspension dust storms) was a potential concern.		Short-term: Low. Inhalation of contaminated dust from activities and events (i.e., driving/resuspension dust storms) was a potential concern.
	Long-term: None identified.		Long-term: None identified.
ENDEMIC DISEASE			
Food borne/Waterborne (e.g., diarrhea-bacteriological)	Short-term: High, (Bacterial diarrhea, Hepatitis A, Typhoid fever) to Moderate (Diarrhea-protozoal, Brucellosis, Hepatitis E) to Low (Diarrhea-cholera, Tularemia). If ingesting local food/water, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (Hepatitis A, Typhoid fever, Brucellosis, Hepatitis E).	Preventive measures include Hepatitis A and Typhoid fever vaccination and consumption of food and water only from approved sources.	Short-term: Low to none
	Long-term: Not an identified source of health risk.		Long-term: No data available
Arthropod Vector Borne	Short-term: Moderate, (Leishmaniasis-cutaneous, Crimean-Congo hemorrhagic fever, Plague) to Low (Malaria, Lyme disease, Tick-borne encephalitis (TBE), typhus-murine, Leishmaniasis-visceral, California group viruses, Rickettsioses, Sindbis, Sandfly fever, and West Nile fever).	Preventive measures include proper wear of treated uniform, application of repellent to exposed skin and bed net use.	Short-term: Low
	Long-term: Low (Leishmaniasis-visceral infection)		Long-term: No data available

Water-Contact (e.g. wading, swimming)	Short-term: Moderate for Leptospirosis.	Recreational swimming in surface waters not likely in this area of Iraq during this time period.	Short-term: Low to none Leptospirosis.
	Long-term: No data available		Long-term: No data available
Respiratory	Short-term: Moderate [Tuberculosis (TB)] and Low (Meningococcal meningitis).	Providing adequate work and living space; medical screening, and vaccination.	Short-term: Low to none
	Long-term: No data available		Long-term: No data available
Animal Contact	Short-term: Moderate (Rabies, Q-fever, Anthrax), Low (H5N1 Avian Influenza)	Prohibiting contact with, adoption, or feeding of feral animals IAW CENTCOM General Order 1B. Risks are further reduced in the event of assessed contact by prompt post-exposure rabies prophylaxis IAW the CDC's ACIP guidelines.	Short-term: Low to none
	Long-term: Low (Rabies)		Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Moderate to High; Risk of heat injury in unacclimatized personnel.	Work-rest cycles, proper hydration and nutrition, and Wet Bulb Globe Temperature (WBGT) monitoring.	Short-term: Moderate to High mitigated to Low.
	Long-term: Low, However, the health risk may be greater to certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions.		Long-term: Low; However, the risk may be greater to certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions.
Cold	Short-term: Low	Risks from cold stress reduced with protective measures such as use of the buddy system, limiting exposure during cold weather, proper hydration and nutrition, and proper wear of issued protective clothing.	Short-term: Low risk of cold stress/injury.
	Long-term: Low, Long-term health implications from cold injuries were rare but could occur, especially from more serious injuries such as frostbite.		Long-term: Low; Long-term health implications from cold injuries were rare but could occur, especially from more serious injuries such as frostbite.
NOISE			
Continuous (Flightline, Power Production)	Short-term: High to Low, High risk to individuals working near major noise sources without proper hearing protection.	Risks reduced by the use of hearing protection and noise barriers.	Short-term: High to Low mitigated to Low risk to the majority of personnel and to individuals working near major noise sources who use proper hearing protection.
	Long-term: High to Low, High risk to individuals working near major noise sources without proper hearing protection.		Long-term: High to Low mitigated to Low risk to the majority of personnel and to individuals working near major noise sources who use proper hearing protection.

Unique Incidents/ Concerns			
Fuel/Petroleum Products/Industrial Chemical Spills	Short-term: Low		Short-term: Low to None
	Long-term: Low		Long-term: Low to None
Asbestos	Short-term: Low		Short-term: Low to None
	Long-term: Low		Long-term: Low to None
Pesticides/Pest Control	Short-term: Low		Short-term: Low health risk from pesticide exposure.
	Long-term: Low		Long-term: Low health risk from pesticide exposure.

IAW: in accordance with
CDC: Centers for Disease Control and Prevention
ACIP: Advisory Committee on Immunizations Practice

[1] This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the general ambient and occupational environment conditions at K2. It does not represent a unique individual exposure profile. Actual individual exposures and health effects depend on many variables. For example, while a chemical may be present in the environment, if a person does not inhale, ingest, or contact a specific dose of the chemical for adequate duration and frequency, then there may be no health risk. Alternatively, a person at a specific location may experience a unique exposure which could result in a significant individual exposure. Any such person seeking medical care should have their specific exposure documented in an SF600.

[2] This assessment is based on specific data and reports obtained from the October 2001 through April 2005 timeframe. It is considered a current representation of general site conditions but may not reflect certain fluctuations or unique exposure incidents. Acute health risk estimates are generally consistent with field-observed health effects.

[3] This Summary Table is organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at K2. The health risks are presented as Low, Moderate, High or Extremely High for both short- and long-term health effects. The health risk level is based on an assessment of both the potential severity of the health effects that could be caused and probability of the exposure that would produce such health effects. Details can be obtained from the APHC/AIPH. Where applicable, "None Identified" is used when though an exposure was identified, no health risk of either a specific short- or long-term health effects were determined. More detailed descriptions of OEH exposures that were evaluated but determined to pose no health risk are discussed in the following sections of this report.

[4] Health risks in this Summary Table are based on quantitative surveillance thresholds (e.g. endemic disease rates; host/vector/pathogen surveillance) or screening levels, e.g. Military Exposure Guidelines (MEGs) for chemicals. Some previous assessment reports may provide slightly inconsistent health risk estimates because quantitative criteria such as MEGs may have changed since the samples were originally evaluated and/or because this assessment makes use of all historic site data while previous reports may have only been based on a select few samples.

1 Discussion of Health Risks at K2 Airbase, Uzbekistan by Source

The following sections describe the major source categories of potential health risk that were evaluated at K2, Uzbekistan. For each category, the evaluation process includes identifying what, if any, specific sub-categories/health concerns are present. This initial step results in "screening out" certain health concerns that pose no identifiable health risk (for example if all data is below screening levels). While these sections may include sub-categories that have been determined to present no identifiable health risk, the summary table on the previous page only contains those sub-categories that were determined to pose some level of potential health risk.

2 Air

2.1 Site-Specific Sources Identified

Personnel deployed to Camp Stronghold Freedom were exposed to various airborne contaminants as identified by monitoring and sampling efforts between October 2001 and April 2005. Windblown dust and sand contribute to particulate matter (PM) exposures above health-based MEGs at K2. A number of industrial activities may have contributed to air contaminants. Primarily the operation of an airport but also construction, fuel storage and distribution, water and wastewater treatment were located on and around K2. Information pertaining to off-base industries is not available. The most common complaint was of a bad smell coming from a trench. During the 2001 Environmental Site Characterization and Operational Health Risk Assessment, widespread subsurface jet fuel plumes were discovered. The plumes, most likely the results of a leaking Soviet-era underground fuel distribution system, were the cause of the odor. The jet fuel source is assessed in Section 10 (Other Unique Occupational Hazards). The summary of results follows.

There was no sampling data for 2001 and 2003.

2.2 Particulate Matter, less than 10 microns (PM_{10})

2.2.1 Sample data/Notes:

Exposure Guidelines:

Short Term (24-hour) PM_{10} micrograms per cubic meter ($\mu g/m^3$):

- Negligible MEG = 250
- Marginal MEG = 420
- Critical MEG = 600

Long-term PM_{10} MEG ($\mu g/m^3$):

- Not defined and not available.

A total of 76 valid PM_{10} air samples were collected from January 2002-April 2005. The range of 24-hour PM_{10} concentrations was 6 $\mu g/m^3$ –791 $\mu g/m^3$ with an average concentration of 125 $\mu g/m^3$. For 96% of the time during this period the PM_{10} levels indicated there was not a hazard. Other risk levels observed during this time were low (approximately 1%), and high (approximately 3%). The 2005 sampling results were eliminated during the pre-screen because PM_{10} did not exceed the 24-hour Negligible MEG.

2.2.2 Short-term health risk:

Variable (Low to High): The short-term PM_{10} health risk assessment estimate was low to high based on typical and peak PM_{10} concentrations, and the likelihood of exposure at these hazard severity levels. A low short-term health risk assessment estimate for typical PM_{10} exposure concentrations at K2 suggested the expected losses have little or no impact on accomplishing the mission. A high health risk assessment estimate for peak PM_{10} exposure concentrations suggested a significant degradation of mission capabilities with the inability to accomplish all parts of the mission, or the inability to complete the mission to standard if hazards occur during the mission (Reference 16, Table 3-2).

The hazard severity was negligible for average PM_{10} sample concentrations. The results suggested that a few personnel may experience notable mild eye, nose, or throat irritation; most personnel may experience only mild effects. Pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.

The hazard severity was critical for the highest observed PM_{10} sample concentrations. During peak exposures at the critical hazard severity level, most, if not all, personnel may have experienced very notable eye, nose and throat irritation respiratory effects. Some personnel may not be able to perform assigned duties. Some lost-duty days may be expected. Those with a history of asthma or cardiopulmonary disease may experience more severe symptoms.

2.2.3 Long-term health risk:

Not evaluated because there are no available health guidelines. The EPA retracted its long-term National Ambient Air Quality Standard (NAAQS) for PM_{10} due to an inability to link chronic health effects with chronic PM_{10} exposure levels.

2.3 Particulate Matter, less than 2.5 microns ($PM_{2.5}$)

2.3.1 Sample data/Notes:

$PM_{2.5}$ samples were not collected. $PM_{2.5}$ was not evaluated.

2.3.2 Short- and Long term health risk

Not evaluated because samples were not collected.

Note: It is considered possible that some otherwise healthy personnel who were exposed for a long period to $PM_{2.5}$ could develop certain health conditions (reduced lung function, cardiopulmonary disease). However, no sampling data was collected on $PM_{2.5}$ to prove there was no risk from it. By definition, $PM_{2.5}$ is considered a subset of PM_{10}, which was evaluated and did rise to the level of HIGH risk at times (See previous Section 2.2). Consequently, while it is acknowledged that there was no data collected on $PM_{2.5}$, or on what proportion the $PM_{2.5}$ represented of the overall PM_{10}, there is no proof that it did not comprise a major proportion (i.e., "Absence of proof is not proof of absence."). Hence, because there are no data to prove it is not a problem, it is included in the medical summary as a potential short and long-term health risk for conservative prudent public health measures. Because the actual data collected was on PM_{10}, the more general 'particulate matter' term was used in the medical summary.

2.4 Airborne Metals from PM_{10}

2.4.1 Sample data/Notes:

Degree of risk was estimated based on comparison of metals results from 57 total air samples to specified MEGs. Samples were taken from January 2002–April 2005. None of the analyzed metals in the samples were found at concentrations above a short- or long-term MEG.

2.4.2 Short and Long-term health risks:

None identified based on the available sampling data. Confidence in the risk estimate is low.

2.5 Volatile Organic Compounds (VOCs)

2.5.1 Sample data/Notes:

Between January 2002 and September 2004, 82 samples were analyzed for organic chemical pollutants [70 Volatile Organic Compounds (VOCS) and 12 Polycyclic Aromatic Hydrocarbons (PAHs)]. None of the analyzed organic chemical pollutants was found at concentrations above a short- or long-term MEG. However, MEGs are not available for all analytes detected so the risk may be underestimated. Additionally, some chemicals were not evaluated. This may also influence the uncertainty in these conclusions.

2.5.2 Short and long-term health risk:

None identified based on available sampling data. For some analytes, the analytical limit of quantitation (LOQ) was above the military exposure guidelines, which may cause inaccurate population exposure point concentrations, and as a result, the risk may be underestimated. Confidence in risk estimate is low due to unavailable health guidelines for some chemicals.

3 Soil

3.1 Site-Specific Sources Identified

Karshi-Khanabad is located in the arid Qashqadaryo Province near the border with Tajikistan. K2 is one square mile of flat to rolling terrains. Several years prior to the U.S. occupying K2, Soviet missiles were destroyed there. This event contaminated some areas of surface dirt with low-level radioactive depleted uranium and asbestos. Eight soil samples were collected at Camp Stronghold Freedom between June 2002 and September 2004. Depleted Uranium is assessed in Section 5 (Military Unique). Asbestos is assessed in Section 10 (Other Unique Occupational Hazards).

3.1.1 Sample data/Notes:

Analytical data for the eight soil samples collected at K2 was assessed for metals, inorganics and organics chemicals. Of the eight soil samples in the areas identified, no parameters exceeded the TG 230 MEGs.

3.1.2 Short and Long-term health risk:

None identified based on available sampling data. Currently, sampling data for soil is not evaluated in acute risk assessment and all detected contaminants were below applicable 1-year negligible MEG.

4 Water

In order to assess the risk to U.S. personnel from exposure to water in theater, the Army Institute of Public Health (AIPH) identified the most probable exposure pathways based on available information. The water exposures considered were the ingestion of water used for drinking and the use of water for non-drinking purposes (such as personal hygiene, or showering).

4.1 Drinking Water

4.1.1 Sample data/Notes

Samples collected from drinking water supplies were sent to PHRC-Europe (formally USACHPPM-Europe) for analysis. No drinking water samples [bottled water or Reverse Osmosis Water Purification Unit (ROWPU)-treated water] were submitted to USAPHC for analysis.

4.1.2 Short and Long-term health risk

Not evaluated because samples were not available.

4.2 Water: Used for Other Purposes (Personal Hygiene, Showering, etc.)

4.2.1 Sample data/Notes

The ROWPU-treated water supply and the raw well water supply at Camp Stronghold Freedom were used for non-drinking purposes (i.e., cooking, personal hygiene, and showering, etc.) by U.S. personnel. Five water samples used for non-drinking purposes were collected and submitted to a laboratory for analysis. Samples were received in 2002, 2003, and 2004 from ROWPU-treated water sources and in 2004 from untreated, raw well water sources. Note that gross alpha and gross beta radiological results were collected for these water samples but were not included in the health risks assessment because gross radiological MEGS were unavailable.

4.2.2 Short-term health risk:

Low. After the pre-screen the hazards identified were chloride, chromium, magnesium, and sulfate. The maximum concentrations for these chemicals did not exceed the short-term MEGs, therefore there is no short-term health risk associated with the non-drinking water samples collected from K2. Confidence in risk estimate is low.

4.2.3 Long-term health risk:

None identified based on available data. Long term MEGs are not available for chloride, chromium, magnesium, and sulfate, therefore long-term health risk associated with these chemicals could not be evaluated. Confidence in risk estimate is low.

5 Military Unique

5.1 Chemical Biological, Radiological Nuclear (CBRN) Weapons:

In June 2002, a routine inspection revealed the possible presence of nerve and chemical agents in some areas of K2. However, confirmatory samples using specialized testing equipment were negative for chemical warfare agents. The false positive results were likely due to contaminants from recent painting and other refurbishing activities.

Short and Long-term health risk: None identified based on available data. Confidence in risk estimate is medium.

5.2 Depleted Uranium (DU):

Several years prior to the U.S. occupying K2, Soviet missiles were destroyed there. This event contaminated some areas of surface/subsurface dirt with low level radioactive depleted uranium. A 2001 environmental site characterization identified low radioactivity uranium which could be potentially harmful only if inhaled. The 2002 site survey and risk assessment found very small amounts of "processed" uranium, which was later identified as depleted uranium of non-U.S. origin present at an area outside of the perimeter of Camp Stronghold Freedom. No DU or any other radioactive material was found anywhere else at the site. The contaminated area was covered with clean fill in November 2001, fenced and marked off-limits. It was determined that the uranium posed minimal health risk. The radiation hazard from this material is low.

5.2.1 Short-term health risks:

Low. Air sampling did not find radiation present at levels above background.

5.2.2 Long-term health risks:

None identified based on available data. Confidence in risk estimate is medium.

5.3 Ionizing Radiation:

The 2002 site survey and risk assessment found no identifiable ionizing radiological hazards for any areas within the K2 perimeter.

Short and Long-term health risk: None identified based on available data. Confidence in risk estimate is medium.

5.4 Non-Ionizing Radiation:

No specific hazard sources were documented in DOD OEHS Portal.

Short and Long-term health risk: None identified based on available data. Confidence in risk estimate is medium.

6 Endemic Disease[1]

This document lists the endemic diseases reported in the region, its specific health risks and severity and general health information about the diseases. In addition, site-specific information from the MESL database was used. The modification 11 to the CENTCOM deployment health surveillance and force health protection regulation (Reference 15) lists deployment requirements, to include immunization and chemoprophylaxis, in effect during the period covered by this POEMS.

6.1 Foodborne and Waterborne Diseases

Food borne and waterborne diseases in the area are transmitted through the consumption of local food and water. Local unapproved food and water sources (including ice) are heavily contaminated with pathogenic bacteria, parasites, and viruses to which most U.S. Service Members have little or no natural immunity. Effective host nation disease surveillance does not exist within the country. Only a small fraction of diseases are identified or reported in host nation personnel. Diarrheal diseases are expected to temporarily incapacitate a very high percentage of U.S. personnel within days if local food, water, or ice is consumed. Hepatitis A and typhoid fever infections typically cause prolonged illness in a smaller percentage of unvaccinated personnel. Vaccinations are required for DOD personnel and contractors. In addition, although not specifically assessed in this document, significant outbreaks of viral gastroenteritis (e.g., norovirus) and food poisoning (e.g., *Bacillus cereus*, *Clostridium perfringens*, *Staphylococcus*) may occur.

6.1.1 Diarrheal diseases (bacteriological)

High, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was high year round. Mitigation strategies in place include consumption of approved food, water, and ice; handwashing; and applied food/water safety mechanisms. Diarrheal diseases (bacteriological) could be expected to temporarily incapacitate a very high percentage of personnel (potentially over 50 percent per month) within days if local food, water, or ice was consumed. Field conditions (including lack of hand washing and primitive sanitation) may facilitate person-to-person spread and epidemics. Typically, these result in mild disease treated in outpatient setting; recovery and return to duty in less than 72 hours with appropriate therapy. A small proportion of infections may require greater than 72 hours limited duty, or hospitalization.

6.1.2 Hepatitis A

High, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was high year round. Mitigation strategies in place include immunization, consumption of approved food, water, and ice; handwashing; and applied food/water safety mechanisms. U.S. Personnel did not drink untreated water, and vaccination for Hepatitis A is required for deployment into the CENTCOM Area of Responsibility (AOR). Hepatitis A typically occurs after consumption of fecally contaminated food or water or through direct fecal-oral transmission under conditions of poor hygiene and sanitation. Field conditions (including primitive sanitation, lack of hand washing) may facilitate outbreaks driven by

[1] NOTE: "Risk" level refers to both severity of disease (without controls, for example vaccinations) and probability of disease based on local rates/endemic status. Diseases described are those presenting greater risk when compared with U.S. conditions. Most identified disease risks can and are being mitigated with military preventive medicine measures/policies.

person-to-person spread. A typical case involves 1 to 3 weeks of debilitating symptoms, sometimes initially requiring inpatient care; recovery and return to duty may require a month or more.

6.1.3 Typhoid/paratyphoid Fever

High, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was high year round. Mitigation strategies in place include immunization, consumption of approved food, water, and ice; handwashing; and applied food/water safety mechanisms. U.S. Personnel did not drink untreated water, and vaccination with typhoid fever vaccination is required for deployment into the CENTCOM AOR. Risk was typically highest following spring floods. Typhoid and paratyphoid fever are acquired through the consumption of fecally contaminated food or water. The two diseases are clinically similar, and in areas where they are endemic, typhoid typically accounts for 90 percent of cases. Asymptomatic carriers are common with typhoid and contribute to sustained transmission. In countries with a mixture of primitive and modern sanitation and hygiene, outbreaks of typhoid fever can occur and may involve all age groups. A small number of cases (less than 1% per month attack rate) could occur among unvaccinated personnel consuming local food, water, or ice. With appropriate treatment, typhoid and paratyphoid fever are debilitating febrile illnesses typically requiring 1 to 7 days of supportive care, followed by return to duty.

6.1.4 Diarrhea – protozoal

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate year round. Risk was typically highest following spring floods. Mitigation strategies in place include consumption of approved food, water, and ice; handwashing; and applied food/water safety mechanisms. In general, *Cryptosporidium* spp., *Entamoeba histolytica*, and *Giardia lamblia* were the most common protozoal causes of diarrhea wherever sanitary conditions were significantly below U.S. standards. A small number of cases (less than 1% per month attack rate) could occur among personnel consuming local food, water, or ice. Outbreaks affecting a higher percentage of personnel were possible with *Cryptosporidium*. Symptomatic cases may vary in severity; typically mild disease demonstrating recovery and return to duty in less than 72 hours with appropriate therapy; severe cases may require 1 to 7 days of supportive care, followed by return to duty.

6.1.5 Brucellosis

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate year round. Mitigation strategies in place include consumption of approved food, water and ice; handwashing; universal blood/fluid-borne pathogen protection when working with animals; and applied food/water safety mechanisms. Brucellosis is a common disease in cattle, sheep, goats, swine, and some wildlife species in most developing countries. Humans contract brucellosis through consumption of contaminated dairy products (or foods made with such products) or by occupational exposures to infected animals. The health risk from direct animal contact was likely to be highest in rural areas where livestock were present. The health risk from contaminated dairy products exists countrywide, including urban areas. Rare cases (less than 0.1% per month attack rate) could occur among personnel consuming local dairy products or having direct contact with livestock. With appropriate treatment, brucellosis is a febrile illness of variable severity, potentially requiring inpatient care; convalescence is usually over 7 days even with appropriate treatment.

6.1.6 Hepatitis E

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was low year round. Mitigation strategies in place include consumption of approved food, water, and ice; hand washing; and applied food/water safety mechanisms. Risk was typically highest following spring floods. Hepatitis E occurs in four major genotypes. Genotypes 1 and 2, found primarily in Africa and Asia, cause large numbers of sporadic cases, as well as large outbreaks. Fecal contamination of drinking water is the most common source of exposure for these genotypes. Large outbreaks are usually associated with particularly severe breakdowns in baseline sanitation, as often occurs during heavy rainfall which increases mixing of sewage and drinking water sources. Secondary household cases from person-to-person transmission are uncommon. Unlike hepatitis A, where local populations living in poor sanitary conditions were usually highly immune from childhood exposures, immunity levels for hepatitis E were often much lower, even in areas of extremely poor sanitation. Typically, outbreaks of hepatitis E occur primarily among adults. Although data are insufficient to assess potential disease rates, we cannot rule out rates approaching 1 percent per month among personnel consuming local food, water, or ice. Rates may exceed 1 percent per month for personnel heavily exposed during outbreaks in the local population. Typical case involves 1 to 3 weeks of debilitating symptoms, sometimes initially requiring inpatient care; recovery and return to duty may require a month or more.

6.1.7 Tularemia

Low: Unmitigated health risk to U.S. personnel was low year round. Mitigation strategies in place include consumption of approved food, water, and ice; handwashing; and applied food/water safety mechanisms. The disease can be transmitted in multiple ways, including by eating infected meat, drinking water contaminated by infected animals, direct animal contact, animal bites, inhalation of contaminated dust, and arthropod vectors (including ticks, deer flies, and mosquitoes). Disease symptoms reflect the mode of transmission, with ulceroglandular forms associated with direct animal contact or vectors, pharyngeal and gastrointestinal forms associated with food- or waterborne outbreaks, and pneumonic or typhoidal forms associated with inhalation of contaminated dust. Rare cases (less than 0.1% per month) cannot be ruled out among personnel consuming local food, water, or ice. Potentially severe disease may require hospitalization and convalescence for over 7 days.

6.1.8 Diarrhea – cholera

Low: Unmitigated health risk to U.S. personnel was low year round. Mitigation strategies in place include consumption of approved food, water, and ice; handwashing; and applied food/water safety mechanisms. Development of symptomatic cholera requires exposure to large inoculums and typically is associated with ingestion of heavily contaminated food or water. Person-to-person spread of cholera occurs very infrequently, if at all. The majority of infections (75 percent or more, depending on biotype) among healthy adults are very mild or asymptomatic. Only a small percentage of infections are severe. Because cholera frequently causes serious public health impact, cholera cases are more likely to be reported under the International Health Regulations than other types of diarrhea. Rare cases (less than 0.1% per month attack rate) could occur among personnel consuming local food, water, or ice. Most symptomatic cases are mild, with recovery and return to duty in less than 72 hours on appropriate outpatient treatment; severe cases may require 1-7 days of supportive or inpatient care, followed by return to duty.

6.1.9 Short-term health risks:

High to Low, unmitigated; Low to None, mitigated: The overall short-term unmitigated health risk associated with other foodborne and waterborne diseases at K2 was considered high (for bacterial

diarrhea, hepatitis A, typhoid fever), moderate (for diarrhea-protozoal, brucellosis, hepatitis E), and low (tularemia, diarrhea-cholera) if local food or water was consumed. Preventive Medicine measures such as vaccinations, consumption of approved food, water, and ice; and handwashing reduced the health risk to low to none. Confidence in the risk estimate was medium.

6.1.10 Long-term health risks:

None identified based on available data. Confidence in the risk estimate was medium.

6.2 Arthropod Vector-Borne Diseases

During warmer months (typically from April through November), ecological conditions support populations of arthropod vectors, including mosquitoes, ticks, and sandflies, with variable rates of disease transmission. A variety of vector-borne diseases occur at low or unknown levels; as a group, these diseases may constitute a significant risk in the absence of mitigation measures. Personnel exposed to mosquitoes, ticks, sandflies, or other biting vectors were at risk during day or night.

6.2.1 Crimean-Congo hemorrhagic fever

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate year round with peak transmission from April-October. Crimean-Congo hemorrhagic fever (CCHF) infections can occur as sporadic cases or clusters of cases, and are associated with tick bites or occupational contact with blood or secretions from infected animals. Outbreaks of CCHF occur infrequently. It is a very severe illness typically requiring intensive care with fatality rates from 5% to 50%. Mitigation strategies in place include Individual Protective Measures (IPM) practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.2 *Plague*

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate year round. The risk was greatest during the summer (June through August) and autumn (September through November). It is reservoired by rats and transmitted by their flea populations. Rare cases (less than 0.1% per month attack rate) could occur among personnel exposed to rodents and flea bites. Epidemic transmission is unlikely, but may occur under conditions of crowding, with heave flea exposure and respiratory transmission. Potentially severe illnesses may require more than 7 days of hospitalization and convalescence. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.3 Leishmaniasis-cutaneous

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate with seasonal transmission (April-October). Leishmaniasis-cutaneous (acute form) is transmitted by sandflies. A small number of cases (less than 1% per month attack rate) could occur among personnel exposed to sandfly bites in areas with infected people, rodents, dogs, or other reservoir animals. In groups of personnel exposed to heavily infected sandflies in focal areas, attack rates can be very high (over 50%). Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls. Cutaneous infection is

unlikely to be debilitating, though lesions can be disfiguring.

6.2.4 Malaria

Low: Unmitigated health risk to U.S. personnel was low with seasonal transmission (April-October). Malaria incidents are often determined based on the presence of agriculture activity, including irrigation systems, which provide breeding habitats for vectors. In the Uzbekistan region, a small number of cases (less than 0.1 percent per month attack rate) could occur among personnel exposed to mosquito bites, primarily at night. Malaria incidents can cause debilitating febrile illness typically requiring 1 to 7 days of inpatient care, followed by return to duty. Severe cases may require intensive care or prolonged convalescence, and fatalities can occur. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.5 Lyme disease

Low: Unmitigated health risk to U.S. personnel was low with seasonal transmission (April-October). Lyme disease, transmitted by tick bites, is present in the region. Rare cases are possible. Incidents can result in debilitating febrile illness typically requiring 1-7 days of inpatient care followed by return to duty. Severe cases may require prolonged convalescence. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.6 Sandfly fever

Low: Unmitigated health risk to U.S. personnel was low with seasonal transmission (April-October). The disease is transmitted by sandflies, which typically bite at night and breed in dark places rich in organic matter, particularly in rodent or other animal burrows. Rare cases are possible. Abandoned dwellings, sometimes used by troops as temporary quarters, also can harbor significant numbers of sandflies. Although data are insufficient to assess potential disease rates, 1 to 10 percent of personnel could be affected per month under worst-case conditions with no mitigation measures in place. In small groups exposed to heavily infected sandfly populations in focal areas, attack rates can be very high (over 50 percent). Incidents can result in debilitating febrile illness typically requiring 1 to 7 days of supportive care followed by return to duty. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.7 California group viruses

Low: Unmitigated health risk to U.S. personnel was low with seasonal transmission (April-October). California group viruses are maintained in an enzootic cycle involving mosquitoes and a variety of vertebrate reservoirs. The great majority of infections in adults are asymptomatic. Most symptomatic and severe cases occur in children. Rare cases (less than 0.1% per month) cannot be ruled out among personnel exposed to mosquito bites. Incidents can result in a mild to moderate febrile illness typically requiring 1 to 7 days of inpatient care followed by return to duty. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.8 Tick-borne encephalitis (TBE)

Low: Unmitigated health risk to U.S. personnel was low with seasonal transmission (April-October). TBE infections occur as sporadic cases or outbreaks and are associated with tick bites. Rare cases (less than 0.1% per month) of TBE disease are possible among personnel exposed to tick bites. TBE is a potentially very severe disease sometimes requiring intensive care. Fatalities may occur in 1-5% of Central European encephalitis cases. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.9 Rickettsioses, tickborne

Low: Unmitigated health risk to U.S. personnel was low with seasonal transmission (April-October). Rare cases (less than 0.1% per month) of rickettsioses disease are possible among personnel exposed to tick bites. Rickettsioses are transmitted by multiple species of hard ticks, including *Rhipicephalus* spp., which are associated with dogs. Other species of ticks, including *Ixodes* are also capable of transmitting rickettsial pathogens in this group. In addition to dogs, various rodents and other animals also may serve as reservoirs. Ticks are most prevalent from April through November. Incidents can result in debilitating febrile illness, which may require 1 to 7 days of supportive care followed by return to duty. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.10 Sindbis

Low: Unmitigated health risk to U.S. personnel was low with seasonal transmission (April-October). Sindbis and sindbis-like viruses are maintained in a bird-mosquito cycle in rural areas and occasionally caused limited outbreaks among humans. The viruses are transmitted by a variety of *Culex* mosquito species found primarily in rural areas. A variety of bird species may serve as reservoir or amplifying hosts. Extremely rare cases (less than 0.01% per month attack rate) could have occurred seasonally (April - November). Debilitating febrile illness often accompanied by rash, typically requires 1 to 7 days of supportive care; significant arthralgias may persist for several weeks or more in some cases. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.11 Typhus-murine (fleaborne)

Low: Unmitigated health risk to U.S. personnel was with seasonal transmission (April-October). Typhus-murine is assessed as present, but at unknown levels. Rare cases are possible among personnel exposed to rodents (particularly rats) and fleabites. Incidents may result in debilitating febrile illness typically requiring 1 to 7 days of supportive care followed by return to duty. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.12 West Nile fever

Low: Unmitigated health risk to U.S. personnel was low with seasonal transmission (April-October). West Nile fever was present and maintained by the bird population and mosquitoes that help to

transfer the diseases from birds to humans. The majority of infections in young, healthy adults are asymptomatic although it can result in fever, headache, tiredness, and body aches, occasionally with a skin rash (on the trunk of the body) and swollen lymph glands. West Nile fever is a febrile illness typically requiring 1-7 days of inpatient care followed by return to duty; convalescence may be prolonged. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.13 Leishmaniasis – visceral

Low: Unmitigated health risk to U.S. personnel was moderate with seasonal transmission (April-October). Leishmaniasis-visceral is transmitted by sandflies. Rare cases are possible among personnel exposed to sandfly bites in areas with infected humans, dogs, or other reservoir animals. Asymptomatic chronic infections may occur and may become symptomatic years later. When symptomatic, visceral leishmaniasis causes a severe febrile illness, which typically requires hospitalization with convalescence over 7 days. Mitigation strategies in place include IPM practices, proper wear of permethrin treated uniforms, application of repellent to exposed skin, use of bed nets (when applicable), reduction of pest/breeding habitats, and engineering controls.

6.2.14 Short-term health risks:

Moderate to Low, unmitigated; Low to None, mitigated: The overall short-term unmitigated health risk associated with arthropod vector-borne diseases at K2 was considered Moderate (for Crimean-Congo hemorrhagic fever, plague, and leishmaniasis-cutaneous) and Low (for malaria, tick-borne encephalitis (TBE), leishmaniasis-visceral, California group viruses, lyme disease, rickettsioses, sandfly fever, typhus-murine (fleaborne), West Nile fever, and sindbis). Preventive measures such as IPM practices, proper wear of treated uniforms and application of repellent to exposed skin reduced the health risk to low to none for arthropod vector-vector borne diseases. Confidence in the risk estimate was medium.

6.2.15 Long-term health risks:

Low: The unmitigated risk is moderate for leishmaniasis-visceral (chronic). Risk was reduced to low by proper wear of the uniform and application of repellent to exposed skin. Confidence in the risk estimate is high.

6.3 Water Contact Diseases

Tactical operations or recreational activities that involve extensive contact with surface water such as lakes, streams, rivers, or flooded fields may result in significant exposure to leptospirosis. Arid portions of Iraq without permanent or persistent bodies of surface water do not support transmission of leptospirosis. Risk was restricted primarily to areas along rivers and lakes. These diseases can debilitate personnel for up to a week or more. Leptospirosis risk typically increases during flooding. In addition, although not specifically assessed in this document, bodies of surface water are likely to be contaminated with human and animal waste. Activities such as wading or swimming may result in exposure to enteric diseases including diarrhea and hepatitis via incidental ingestion of water. Prolonged water contact also may lead to the development of a variety of potentially debilitating skin conditions including bacterial or fungal dermatitis.

6.3.1 Leptospirosis

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate with seasonal transmission (April--October). Leptospirosis is present in Uzbekistan but at unknown levels. Human infection occurs through exposure to water or soil contaminated by infected animals and has been associated with wading, and swimming in contaminated, untreated open water. The occurrence of flooding after heavy rainfall facilitates the spread of the organism because, as water saturates the environment, Leptospirosis present in the soil pass directly into surface waters. Leptospirosis can enter the body through cut or abraded skin, mucous membranes, and conjunctivae. Ingestion of contaminated water can also lead to infection. The acute generalized illness associated with infection can mimic other tropical diseases (for example, dengue fever, malaria, and typhus), and common symptoms include fever, chills, myalgia, nausea, diarrhea, cough, and conjunctival suffusion. Manifestations of severe disease can include jaundice, renal failure, hemorrhage, pneumonitis, and hemodynamic collapse. Recreational activities involving extensive water contact may result in personnel being temporarily debilitated with leptospirosis.

6.3.2 Short-term health risks:

Moderate, unmitigated; Low to None, mitigated: The overall short-term unmitigated health risk associated with water contact disease at K2 was considered moderate (for leptospirosis). Preventive measures such as avoiding water contact and recreational water activities; and protective coverings for cuts/abraded skin reduced the health risk to low to none. Confidence in the risk estimate was medium.

6.3.3 Long-term health risks:

None identified based on available data. Confidence in the risk estimate was medium.

6.4 Respiratory Diseases

Although not specifically assessed in this document, deployed U.S. forces may be exposed to a wide variety of common respiratory infections in the local population. These include influenza, pertussis, viral upper respiratory infections, viral and bacterial pneumonia, and others. The U.S. military populations living in close-quarter conditions are at risk for substantial person-to-person spread of respiratory pathogens. Influenza is of particular concern because of its ability to debilitate large numbers of unvaccinated personnel for several days.

6.4.1 Tuberculosis (TB)

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate year round. Tuberculosis (TB) is usually transmitted through close and prolonged exposure to an active case of pulmonary or laryngeal TB, but can also occur with incidental contact. The risk of TB in U.S. forces varies with individual exposure. TB was evaluated as part of the Post Deployment Health Assessment (PDHA). Mitigation strategies include routine medical screenings; enforcing minimum space allocation in housing units; implementing head-to-toe sleeping in crowded housing units; implementation of proper personal protective equipment (PPE), when necessary (treating active case, detainee operations); and active case isolation in negative pressure rooms, where available.

6.4.2 Meningococcal meningitis

Low: Unmitigated health risk to U.S. personnel was low year round. Meningococcal meningitis is transmitted from person to person through droplets of respiratory or throat secretions. Risk is comparable to the U.S. among unvaccinated personnel who have close contact with the local population. Close and prolonged contact facilitates the spread of this disease. Meningococcal meningitis is a potentially very severe disease typically requiring intensive care; fatalities may occur in 5-15% of cases. Mitigation strategies include routine medical screenings; enforcing minimum space allocation in housing units; implementing head-to-toe sleeping in crowded housing units; implementation of proper PPE, when necessary (treating active case, detainee operations); and active case isolation in negative pressure rooms, where available. Additional measures include vaccination and frequent sanitation of common use items (phones, door handles) and areas.

6.4.3 Short-term health risks:

Moderate to Low, unmitigated; **Low to None, mitigated**: The overall short-term unmitigated health risk associated with respiratory diseases at K2 was considered moderate (for tuberculosis) to low (for meningococcal meningitis). Preventive measures such as vaccination; routine medical screenings; and active case isolation in negative pressure rooms reduced the health risk to low to none. Confidence in the risk estimate was medium.

6.4.4 Long-term health risks:

None identified based on available data. TB was evaluated as part of the Post Deployment Health Assessment (PDHA). A TB skin test was required post-deployment if potentially exposed and was based upon individual service policies.

6.5 Animal-Contact Diseases

6.5.1 Rabies

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate year round. Occurrence is well above U.S. levels due to the lack of organized control programs. Dogs are the primary sources of human exposure to rabies in Uzbekistan, and canine rabies is the most common rabies strain. Rabies is transmitted by exposure to the virus-laden saliva of an infected animal, typically through bites, but could occur from scratches contaminated with the saliva. The vast majority (>99%) of persons who develop rabies disease will do so within a year after a risk exposure, there have been rare reports of individuals presenting with rabies disease up to six years or more after their last known risk exposure. Mitigation strategies included command emphasis of CENTCOM GO 1B, reduction of animal habitats, active pest management programs, and timely treatment of feral animal scratches/bites.

6.5.2 Q-Fever

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate year round. Rare cases were possible among personnel exposed to aerosols from infected animals, with clusters of cases possible in some situations. Significant outbreaks (affecting 1-50 percent) could occur in personnel with heavy exposure to barnyards or other areas where animals are kept. Unpasteurized milk may also transmit infection. The primary route of exposure is respiratory, with an

infectious dose as low as a single organism. Q-Fever is a debilitating febrile illness, sometimes presenting as pneumonia, typically requiring 1 to 7 days of inpatient care followed by return to duty. Mitigation strategies include consuming approved food sources, avoidance of animals and farms, dust abatement when working in these areas (wet mop, water sprayed on high volume traffic areas, etc.), and proper PPE for personnel working with animals, and immunization.

6.5.3 Anthrax

Moderate, unmitigated; Low, mitigated: Unmitigated health risk to U.S. personnel was moderate year round. Cutaneous and gastrointestinal anthrax are the most common forms of naturally occurring infection; cutaneous anthrax is transmitted by direct contact with infected animals or carcasses, including hides. Eating undercooked infected meat can result in contracting gastrointestinal anthrax. Pulmonary anthrax is contracted through inhalation of spores and is extremely rare. Cutaneous anthrax typically requires 1 to 7 days of supportive care with subsequent return to duty; gastrointestinal anthrax typically requires hospitalization, and has a high fatality rate if untreated. Mitigation strategies include consuming approved food sources, avoidance of animals and farms, dust abatement when working in these areas (wet mop, water sprayed on high volume traffic areas, etc.), and proper PPE for personnel working with animals, and immunization.

6.5.4 H5N1 avian influenza

Low: Unmitigated health risk to U.S. personnel was low year round. Extremely rare cases could occur in U.S. personnel who have close contact with birds or poultry infected with H5N1. H5N1 is a very severe illness. The fatality rate is higher than 50 percent in symptomatic cases. Mitigation strategies include avoidance with birds/poultry and proper cooking temperatures for poultry products.

6.5.5 Short-term health risks:

Moderate to Low, unmitigated; Low to None, mitigated: The overall short-term unmitigated health risk associated with animal contact diseases at K2 was considered moderate (for rabies, Q-fever, and anthrax) to Low (for H5N1 avian influenza). Preventive measures such as consuming approved food sources; immunization; and avoidance of animals and farms reduced the health risk to low to none. Confidence in risk estimate was medium.

6.5.6 Long-term health risks:

Low: The long-term risk for rabies is low because the incubation period for rabies can be several years in rare cases.

7 Venomous Animal/Insect

The DOD Occupational and Environmental Health Surveillance (OEHS) Data Portal did not have a base camp assessment for any venomous animal/insects. Routine pest control measures are conducted at K2.

8 Heat/Cold Stress

Uzbekistan has long, hot summers and short, mild winters. Extreme maximum and low temperatures are 104 degrees Fahrenheit (ºF) and 28.4 ºF.

8.1 Heat

8.1.1 Short-term health risk:

High, unmitigated; Low, mitigated: The short-term health risk of heat injury was high in unacclimated personnel. Preventive measures such as work-rest cycles; and proper hydration reduced the health risk to low.

8.1.2 Long-term health risks:

Low: The long-term health risk may be greater to certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions. Long-term health implications from heat injuries were rare but could occur–especially from more serious heat injuries such as heat stroke. It was possible that high heat in conjunction with various chemical exposures could increase long-term health risks, though specific scientific evidence was not conclusive. Confidence in these risk estimates was medium.

8.2 Cold

Short-term and Long-term health risks: The risk of cold injury was low. Confidence in this risk estimate was medium.

9 Noise

9.1 Continuous:

Noise evaluation from the Environmental Site Survey and Operational Health Risk Assessment (2002) and SF600 (September 2002-May 2003) indicated combined noise sources at the site generate noise levels that are equivalent to a large city or industrial facility. Major noise sources were the prime power generation station, Subsistence/Storage refrigeration trailer area, the refrigeration trailers located next to the base camp's dining facility and flight operations. Noise levels are not appreciably lower during the overnight hours. The noise levels indicated that personnel could be exposed to hazardous levels of noise that may lead to hearing loss. Hearing protection is required by personnel working in sources of major noise.

Short-term and Long-term risks: **High, unmitigated; Low, mitigated**. The unmitigated health risk was high for individuals working near major noise sources without proper hearing protection. Risk was reduced to low through use of proper hearing protection. Confidence in risk estimate was medium.

9.2 Impulse:

No impulse noise evaluations conducted, not evaluated.
Short-term and Long-term risks: Not evaluated because there is no available impulse noise evaluation/data. No identified health risks.

10 Other Unique Occupational Hazards

10.1 Potential environmental contamination sources

DoD personnel are exposed to various chemical, physical, ergonomic, and biological hazards in the course of performing their mission. These types of hazards depend on the mission of the unit and the operations and tasks which the personnel are required to perform to complete their mission. The health risk associated with these hazards depends on a number of elements including what materials are used, how long the exposures last, what is done to the material, the environment where the task or operation is performed, and what controls are used. The hazards can include exposures to heavy metal particulates (e.g. lead, cadmium, manganese, chromium, and iron oxide), solvents, fuels, oils, and gases (e.g. carbon monoxide, carbon dioxide, oxides of nitrogen, and oxides of sulfur). Most of these exposures occur when performing maintenance task such as painting, grinding, welding, engine repair, or movement through contaminated areas. Exposures to these occupational hazards can occur through inhalation (air), skin contact, or ingestion; however exposures through air are generally associated with the highest health risk.

10.2 Fuel/Petroleum Products/Industrial Chemical Spills

The Environmental Site Characterization and Operational Health Risk Assessment conducted in November 2001 by PHRC-Europe (formally USACHPPM-Europe) found widespread jet fuel plumes, usually 1-3 meters underground, most likely from a leaking Soviet-era underground fuel distribution system. The fuel vapors from the plumes were the cause of the bad smell and pooling of "black goo" while digging.

Short-term and Long-term risks: **Low**. In November 2001, the trench was filled with clean soil to create a cap to hold the vapors underground. In addition, areas of known fuel contamination were delineated as "no dig" areas. These measures reduced Personnel exposure to chemicals. Confidence in this risk estimate is medium.

10.3 Waste Sites/Waste Disposal

During the closure of K2, a 20-foot long shipping container accumulating regulated medical waste was discovered. A local contractor was found that could properly handle and incinerate the container's contents.

Short-term and Long-term health risks: None identified based on available data. Confidence in this risk estimate is medium.

10.4 Pesticides/Pest Control

The Baseline Infectious Disease Risk Assessment for Uzbekistan identifies mosquitoes, ticks, and sandflies as present in the country. The DOD OEHS Data Portal database was searched for any information on this topic along with the 2002 and 2004 site assessments. The databases and reports did not contain data on pesticides/pest control.

Short-term and Long-term risks: **Low**. Confidence in this risk estimate is low to medium.

10.5 Lead- based Paint

The base camp's One-Stop In-processing Center was the only structure with lead based paint. Information pertaining to the condition of the lead based paint is not available. The Center was relocated (relocation date not available) into Corimec-type containers and the old facility was not occupied by US personnel. No paint chip sampling was required.

Short-term and Long-term risks: None identified based on available data. Confidence in this risk estimate is medium.

10.6 Asbestos

The Environmental Site Characterization and Operational Health Risk Assessment conducted in November 2001, found asbestos was present in localized areas of surface dirt. Several years prior to the U.S. occupying K2, Soviet missiles were destroyed there. This event contaminated some areas of surface dirt with asbestos. Also, the 2004 Final Deployment Occupational and Environmental Health Site Assessment stated previous operational health risk assessments identified several structures (i.e., 416th AEG Vehicle maintenance Facility, CI/FP/JAG Building and its gazebo, and Military Police Headquarters Building) with friable asbestos containing material (ACM) tiled roofs. However, the 2004 site assessment identified only one structure with ACM tiled roofs, the CI/FP/JAG Building's gazebo. The site assessment concluded airborne friable asbestos does not pose a health threat.

Short-term and Long-term risks: **Low**. Air samples did not detect the presence of any airborne asbestos fibers. Facility personnel were not exposed to inhalable asbestos fibers. Confidence in this risk estimate is medium.

11 References[2]

1. Army Medical Department Journal, Preventive Medicine Support in Afghanistan during Operation Enduring Freedom, April-June 2007.

2. CJCS (MCM) 0028-07, *Procedures for Deployment Health Surveillance,* 2007.

3. Central Intelligence Agency (CIA), The World Factbook, Uzbekistan at https://www.cia.gov/library/publications/the-world-factbook/geos/uz.html. The website was accessed on 9 December 2010.

4. Chronological Record of Medical Care Standard Form 600, OEF Environmental/Occupational Health Exposure Data Karshi-Khanabad (K2) Airfield, Uzbekistan, September 2002-April 2003.

5. Defense Occupational and Environmental Health Readiness System (referred to as the DOEHRS-EH database) at https://doehrs-ih.csd.disa.mil/Doehrs/.

6. Department of Army (DA) Technical Bulletin, Medical 577, *Sanitary Control and Surveillance of Field Water Supplies*, 2010.

7. DoDI 6055.05, Occupational and Environmental Health, 2008.

8. DoDI 6490.03, *Deployment Health*, 2006.

9. DOD OEHS Data Portal: https://doehsportal.apgea.army.mil/doehrs-oehs/. Some of the data and reports used may be sensitive or otherwise have some restricted distribution.

10. Final Report, Deployment Occupational and Environmental Health Site Assessment, Karshi-Khanabad, Karshi, Uzbekistan, 31 August-11 September 2004.

11. Global Security: Karshi-Khanabad (K2) Air Base, Camp Stronghold Freedom, Khanabad, Uzbekistan at http://www.globalsecurity.org/military/world/centralasia/khanabad.htm. The website was accessed on 19 October 2010.

12. Klaassen, Curtis D. *Casarett and Doull's Toxicology*: the Basic Science of Poisons, Chapter 2-Principles of Toxicology; Fifth Edition, McGraw-Hill, New York.

---

[2] NOTE. The data are currently assessed using the TG230 Final. The general method involves an initial review of the data which eliminates all chemical substances not detected above 1-yr negligible MEG. Those substances screened out are not considered acute or chronic health hazards so are not assessed further. For remaining substances, acute and chronic health effects are evaluated separately for air and water (soil is only evaluated for long-term risk). This is performed by deriving separate short-term and long-term population exposure level estimates (referred to as population exposure point concentrations (PEPC) that are compared to MEGs derived for similar exposure durations. If less than or equal to negligible MEG the risk is Low. If levels are higher than negligible then there is a chemical-specific toxicity and exposure evaluation by appropriate SMEs, which includes comparison to any available marginal, critical or catastrophic MEGs. For drinking water, 15 L/day MEGs are used for the screening while site specific 5-15 L/day are used for more detailed assessment. For non-drinking water (such as that used for personal hygiene or cooking), the 'consumption rate' is limited to 2 L/day (similar to the EPA) which is derived by multiplying the 5 L/day MEG by a factor of 2.5 to conservatively assess non-drinking uses of water.

13. USACHPPM, Field Final Report, Environmental Site Survey and Operational Health Risk Assessment Stronghold Freedom, Karshi-Khanabad Airfield, Uzbekistan, 31 May-14 June 2002.

14. USACHPPM, Particulate Matter Factsheet No. 64-009-0708, 2008.

15. U.S. Central Command (CENTCOM) Regulation 220-1, Deployment Health Surveillance and Force Health Protection, 2010.

16. USAPHC TG230, June 2010 Revision, Final Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel TG230.

17. World Health Organization (WHO) Fact Sheet No. 141, *Meningococcal meningitis*, 2010.

12 Where Do I Get More Information?

If a provider feels that the Service member's or Veteran's current medical condition may be attributed to specific OEH exposures at this deployment location, he/she can contact the Service-specific organization below. Organizations external to DOD should contact DOD Force Health Protection and Readiness (FHP & R).
U.S. Army Public Health Command (USAPHC) [(formerly the US Army Center for Health Promotion and Preventive Medicine (USACHPPM)] Phone: (800) 222-9698. http://phc.amedd.army.mil
Navy and Marine Corps Public Health Center (NMCPHC) (formerly NEHC) Phone: (757) 953-0700. www.nmcphc.med.navy.mil
U.S. Air Force School of Aerospace Medicine (USAFSAM) (formerly AFIOH) Phone: (888) 232-3764. http://www.wpafb.af.mil/afrl/711hpw/usafsam.asp
DOD Force Health Protection and Readiness (FHP & R) Phone: (800) 497-6261. http://fhp.osd.mil

ENCLOSURE 7

MEMORANDUM OF RECORD (MOR)
DEPLOYMENT HEALTH SUPPORT STAFF MEETING
THURSDAY, MAY 16, 2002

Opening Remarks

- Dr. Kilpatrick met this morning with Ms. Embrey, who is now double-hatted as the Deputy Assistant Secretary of Defense (DASD) for Force Health Protection and Readiness (FHP&R) and the Director of Deployment Health Support.
  - Dr. Kilpatrick will also be double-hatted. He is currently the Deputy Director for Deployment Health Support. Three Chiefs (COL Diniega, Dr. Cirone, and COL Denise Baken) are under his direction.
    - The Chiefs are to be moved into Sky 4, Suite 901.
    - It is extremely beneficial to work closely with the policy makers and analysts.
  - Ms. Embrey said that Dr. Winkenwerder wishes to develop a task force plan for the implementation of preparation for a possible smallpox or influenza incident.
    - The forces are to work together on this.
    - COL Diniega and COL Grabenstein from AVIP are to chair the task force.
    - DHSD will provide space and administrative support to six officers who have not yet been appointed to the task force.
- Ms. Embrey is closely looking at DHSD's scope.
  - DHSD deals with issues such as today's deployments, medical intelligence, individual unit locations, IM IT functions that support today's deployments (where does IM IT support fit in to that?), etc.
  - A good example of current issues is the group of eighteen ill British soldiers at Bagram AFB.
  - DHSD is operational.
    - Policy flows to the operational side. For example, COL Diniega is working on policy for West Nile virus vaccine. Urgency has been generated by the fact that birds are dying earlier this year from the disease, and DHSD will most likely take on the issue after the policy aspect is resolved.
    - Operational function is to provide the ability to communicate, to be the "communication link."
    - COL Thompson will be leading for medical readiness issues.
    - Overlap and interplay are extremely important.
    - Must differentiate deployments. OCONUS deployments are separate, but positive challenges.
- On 22 May 02, Dr. Kilpatrick will accompany Ms. Embrey to the MHS Strategic Planning Offsite, and she will speak on DHSD's plans for the next year.
  - Mr. Sipos inquired on whether DHSD will be maintaining a database for K-2 data. The response to his question is no, we will not have a K-2 database.
  - We will be working closely with the services.
- Dr. Winkenwerder is very enthusiastic about *Deployment Quarterly*.

ENCLOSURE 8

ISSUE PAPER
ON
POTENTIAL EXPOSURES AT K2 (STRONGHOLD FREEDOM)
(as of 19 Apr 02)

BACKGROUND

- US Army Center for Health Promotion & Preventive Medicine (USACHPPM) Deployment Health Risk Management Directorate (LTC Lynn Henselman, Mr. John Resta, Mr. Jeff Kirkpatrick, and COL Robert DeFraites) presented a classified (SECRET) briefing to Representative Gene Taylor (MS) and Representative Jim McDermott (WA) on 21 Mar 02. The brief requested was "Deployment Occupational & Environmental Surveillance". During the brief, the questions turned to exposures at K2 (Uzbekistan) airbase and Congressman Taylor's desire to visit K2.
- Rep. Gene Taylor, 5th MS (D), House Armed Services, Transportation & Infrastructure Subcommittee.
- Rep. Jim McDermott, 7th WA (D), House Budget Committee and Ways & Means Committee, received one complaint regarding this issue.

DISCUSSION

- USACHPPM Europe initially deployed on 27 October 2001 in response to reports of adverse health effects (2 persons) resulting from potential petroleum odor exposures resulting from tent city construction efforts.
- While USACHPPM on the site, commander planned to move tent city to adjoining area.
- USACHPPM conducted site assessment COL Commons, Team Leader and USACHPPM Europe Commander) for new tent city location and encountered radioactive material.
- Tent City was not moved to new location. Soil samples were taken and mitigation strategies were immediately employed (personnel were not permitted near the site of radiation contamination).
- LTC William Rice, Division Surgeon, Headquarters, 1st Armored Division Unit #24309 provided Risk Communication Measures at Stronghold Freedom to provide feedback to soldiers concerning the potential hazards: jet fuel, asbestos, and semi-enriched uranium.
  - *The Rampart*, the Stronghold's local free publication, published an article communicating risks, medical points of contact, and protective measures necessary for soldiers in and around Stronghold Freedom.
- Operational Risk Managment assessment of health risks (total site) was characterized as low, assuming one year on site.
- Mitigation includes not permitting anyone into the area of contamination: area is roped off and well marked, and personnel are trained about the area.
- No illnesses have been reported relating to environmental exposures at K2. Approximately 40 health concerns were identified on the post-deployment health assessment. CENTCOM Surgeon General (SG) and Medical Treatment Facilities will follow up. Health outcomes do not suggest overexposures to servicemen or women.
- Preventive Medicine support is on-going by 172nd Medical Detachment.
- CENTCOM SG continues to provide coordinated medical support for K2.
- CENTCOM SG would like to address any health concerns elevated.

RECOMMENDATIONS

- The Congressmen are concerned about conditions at this site, and may seek more information concerning DoD's intentions regarding length of stay, exposures, and health outcomes. Investigate Congressional intent concerning K2 base relocation.
- USACHPPM is willing to provide the classified (SECRET) briefing to ODUSD(I&E) at any time.
- ADUSD(Safety and Occupational Health) should continue to work with Health Affairs, J-4, USACHPPM, CENTCOM, Armed Forces Medical Intelligence Center (AFMIC), Air Force Institute for Environment, Safety, and Occupational Risk Assessment (AFIERA), National Imaging and Mapping Agency (NIMA), Naval Environmental Health Center (NEHC), and Defense Intelligence Agency (DIA) in reviewing testimony of DoD members on this topic or related topics to prepare a coordinated DoD response.
- Task CENTCOM SG (MAJ Kevin Michaels) to develop official response to the Congressman's question for the record.

References: CENTCOM SG – Maj Kevin Michaels, DSN 968-6397;
USACHPPM – Mr. John Resta, (410) 436-6096;
TMA, Deployment Health Support, COL Daniel Sulka, (703) 575-2661;
J-4 MRD, MAJ Brian Balough & Maj Jeff Gillen, (703) 693-5105.

ACRONYM LIST

AFMIC = Armed Forces Medical Intelligence Center
AFIERA = Air Force Institute for Environment, Safety, and Occupational Risk Assessment
NIMA = National Imaging and Mapping Agency
NEHC = Naval Environmental Health Center
DIA = Defense Intelligence Agency
OASD(HA)/TMA = Office of the Assistant Secretary of Defense (Health Affairs)/Tri-Care Management Activity
SG = Surgeon General
USACHPPM = US Army Center for Health Promotion and Preventive Medicine