The Career History Archival Medical and Personnel System (CHAMPS): An Epidemiological Data Resource for Force Health Protection

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LONGITUDINAL EPIDEMIOLOGIC STUDIES OF DOD PERSONNEL USING THE CAREER HISTORY ARCHIVAL MEDICAL AND PERSONNEL SYSTEM (CHAMPS)

The Career History Archival Medical and Personnel System (CHAMPS) is a comprehensive database that provides an individually based longitudinal record of career events and hospitalizations from the date that an individual's military service began until the date of separation or retirement. Most routinely collected administrative or medical data are a collection of discrete events that are compiled and updated in monthly files. CHAMPS organizes these routinely collected cross-sectional files into an individually based narrative history that is organized by the event date and type of event. CHAMPS chronologically tracks career events that include deployments, duty station or ship assignments, job designations, foreign port visits, changes in the number of dependents and many other types of personnel and military career events. Outcomes include medical events such as hospitalization discharge diagnoses, coded using an International Classification of Diseases Code (ICD), HIV testing results, service separation (including type of discharge), or death with ICD or external cause code. CHAMPS' flexible architecture also allows addition and analysis of data from dependents of service members. CHAMPS provides a rapid, cost-effective method for defining cohorts of military personnel and following them longitudinally for subsequent medical or personnel events. CHAMPS enhances the DoD's ability to conduct epidemiologic research and provide force health protection for active-duty forces and has been used to study a wide variety of potential exposures and health outcomes of military importance.

1.0   INTRODUCTION

The concept of force health protection depends on the ability to readily ascertain environmental factors that may be related to deployments or occupational exposures and examine subsequent medical and personnel outcomes, including hospitalizations (1).   The Career History Archival Medical and Personnel System (CHAMPS) is a comprehensive database that provides an archival career and medical history for active-duty military personnel organized at the level of the individual in a chronological narrative format. Key career and military events are coded and recorded in order by event date. In this way, a military service member can be tracked from accession to service separation. Because of this unique design, the CHAMPS system is ideally suited for use in conducting longitudinal observational studies using a variety of career-related variables to define exposure. CHAMPS has been used to study factors associated with the incidence of HIV seroconversion (2-7), including risk of HIV seroconversion following visits to foreign ports by Navy personnel (8). CHAMPS has been used to study the incidence of first hospitalization for a variety of chronic and infectious diseases and injuries in active-duty personnel potentially associated with military occupation or duty-station assignment (9-21). Studies of chronic disease include incidence of outcomes such as diabetes (9), Hodgkin's disease (10) and non-Hodgkin's lymphoma (11) and testicular cancer (12) and melanoma (13). CHAMPS was used to conduct studies of leukemia in both active-duty personnel (14) and their children (15). Injury studies include studies of the incidence of heat stress (17), eye injury (18), carpal tunnel syndrome (19) and others (20). Data sets from CHAMPS have also been used as a basis for epidemiologic modeling and have been used to define populations at risk in the military according to demographic or service characteristics. CHAMPS data sets have been used to compare incidence of malignant neoplasms in military personnel with that experienced in the civilian population (9-14), and have also been developed to determine the expected occurrence of adverse pregnancy outcomes aboard U. S. Navy ships (21).

2.0   METHODS

CHAMPS is created and updated from a wide variety of military data sources. Detailed personnel data are currently obtained from the Defense Manpower Data Center (DMDC) in Monterey, CA, USA.   This information includes key demographic and career events including name, SSN, date of birth, race, gender, home of record, service and date of accession, military training schools attended, qualifications and testing results, changes in pay grade, rank and duty station, and dependent changes. A variety of potentially adverse events such as positive drug testing results, AWOLs, desertions, demotions and discharges are also obtained.

The design of CHAMPS is analogous to that of a relational database that organizes medical and personnel data into an individual narrative format composed of a chronologically arranged history of events in the individual's military career. Like commercial relational databases, CHAMPS' architecture allows any number of records to be incorporated for a particular individual.   CHAMPS' unique event-driven architecture combines data from numerous sources in the DoD into a single coherent chronologically organized record.   It uses advanced commercial software that allows rapid quality assurance and editing, integration of new data, and manipulation of the approximately five million career histories that it contains. CHAMPS is updated on a quarterly basis to reflect the latest career changes and medical events during an individual's military career.

The largest current source of health outcome data used by CHAMPS comes from the Department of Defense Tricare Management Activity (TMA) Standard Inpatient Data Record (SIDR) which includes admissions to military hospitals. The SIDR electronic record identifies hospital discharge diagnoses in the International Classification of Diseases (ICD) format. CHAMPS captures up to eight discharge diagnoses for each individual inpatient hospital admission to a DoD medical treatment facility.   A second source of

hospitalization data that has been used with CHAMPS to ascertain health outcomes among dependents is the Health Care Service Record (HCSR), available from TMA. This is used to ascertain DoD-reimbursed hospitalizations of beneficiaries outside military medical treatment facilities. The search procedure used is extensive, but is limited to hospitalizations in military or civilian hospitals receiving payment for medical care from DoD. It does not include hospitalizations not reimbursed by DoD, or any not yet reported in the SIDR and HCSR databases. CHAMPS currently contains no information on outpatient medical treatments or events, but these data will soon be added using on the Standard Ambulatory Data Record (SADR) database of outpatient visits to DoD medical treatment facilities available from TMA which contains outpatient records going back to 1996. Some additional data elements contained in CHAMPS include results of HIV testing for all military personnel and dates and locations of foreign port visits by Navy personnel assigned aboard ship. Foreign port visit events are derived by combining duty station assignment codes for specific ships obtained from DMDC with ship movement data provided by the Chief of Naval Operations (CNO).

CHAMPS can be used to support a variety of epidemiological study designs. It can be used to define cohorts by age, race, gender, time-period and occupation or duty-station assignment. The population at risk in these cohorts can be expressed as the number of individuals in a group over a particular time-period or as the number of person-years in a specific group. This information can then be used to determine an expected number of events in a particular military population, such as the number of expected cancer diagnoses in a particular occupational group (11-14) or the number of adverse pregnancy outcomes expected aboard a particular group of ships (21). CHAMPS is also well suited for use in long-term longitudinal studies to determine person-days of exposure in various occupations or duty stations and has been used to create extracts for use in proportional hazards regression studies. An example of some particular source files used for CHAMPS and how they enter an individual CHAMPS narrative structure is illustrated in figure 1. Examples of types of extract files and methods for analysis are also shown.

3.0   RESULTS

Results from several studies that were conducted using the CHAMPS system are presented below. These studies illustrate the advantages of CHAMPS' individually based chronological file structure.

3.1   FOREIGN PORTS OF CALL AND RISK OF HIV ACQUISITION

The US Navy visits ports on all continents and many islands of the world, many of which have been reported to have a high prevalence of human immunodeficiency virus (HIV). CHAMPS was used to carry-out a nested case-control study to examine the relationship between visits to the 100 foreign ports most frequently visited by the navy and risk of HIV seroconversion (8). Prior to this study, there had been no link between personnel assigned aboard ship and ship movement information. DMDC had information on individuals assigned to ships, but no ship movement data. CNO had ship movement data, but no information concerning the identities of personnel assigned aboard ship. CHAMPS was used to create this link at an individual level by linking ship assignment data to ship movement data, resulting in creation of a foreign port visit event code. A total of 813 HIV seroconverters were matched to 6993 seronegative active-duty controls by age, race, sex, occupational group, homeport, and year of test. The unique longitudinal structure of CHAMPS was used to identify cases who had an initial negative HIV test and foreign port deployment, followed by a positive HIV test. Odds ratios of seroconversion associated with visits to foreign ports showed no statistically significant excess risk of HIV infection for navy personnel after visits to any of these foreign ports. Despite the mobility of the US Navy and the large variation in HIV seroprevalence rates throughout the world, navy personnel generally did not appear to be acquiring HIV infections abroad.

3.2   A Model for Adverse Pregnancy Outcomes Aboard Navy Ships

The goal of this study was to model the incidence of ectopic pregnancy and spontaneous abortion if pregnant women were allowed to remain aboard ship during the first 20 weeks of gestation while at sea during deployments. Ectopic pregnancies and other pregnancy complications at sea can be life-threatening events. Data sources included information from shipboard medical departments, an enlisted personnel survey, and the NHRC CHAMPS system.   The overall pregnancy rate was 19 per 100 woman-years (95% confidence interval, 18-20), based on the complement of women assigned to participating ships.   The population of women assigned to all Navy ships and specific ship-types was determined using CHAMPS.   If pregnant women routinely were to remain aboard ships at sea during deployments through their first 20 weeks of pregnancy, it was estimated that approximately 9 ectopic pregnancies and 40 spontaneous abortions would occur aboard ships at sea annually.

3.3   A 27-Year Historical Prospective Study of Sarcoidosis and Other Pulmonary Disease

This study used the CHAMPS system to examine long-term trends in incidence rates of pulmonary sarcoidosis and other lung diseases in a large cohort of Navy personnel and to evaluate the relationship between sarcoidosis and other lung disease to Navy occupation (22).   CHAMPS was used to determine person-years at risk in particular Navy enlisted occupational groups and the average annual populations at risk over the entire study period. Incidence rates of first hospitalizations were calculated for black and white male Navy enlisted personnel on active-duty between 1975 and 2001. Specific occupational groups may have had greater exposure potential. First hospitalizations included cases of sarcoidosis (n = 674), asthma (n = 3,536), emphysema and chronic bronchitis (n = 1,103), respiratory conditions due to fumes and vapors (n = 61), and pneumoconiosis (n = 51) observed in approximately 10 million person-years of active-duty service. Overall hospitalized sarcoidosis incidence rates per 100,000 were 24.9 for black males and 3.5 for white males (black/white ratio= 7.1). Annual incidence rates in blacks declined markedly during the study period (figure 2). This decline could not be explained by an increase in incidence rates of the other major lung disease categories examined. Occupational associations were present in blacks and whites. Black ships servicemen (23 cases) and aviation structural mechanics specializing in structures (12 cases) had more than twice the expected incidence rate compared to all blacks, and white Mess Management Specialists (15 cases) had twice the overall white incidence rate. Occupational associations suggest the possibility that sarcoidosis may have a previously unrecognized occupational component.

3.4   Investigation of a Potential Leukemia Cluster in a Town Near a Naval Air Station

The Nevada State Health Department identified an apparent cluster of 16 cases of acute lymphocytic leukemia (ALL) that were diagnosed in children and teenagers in Fallon, Nevada, USA. Fallon is in Churchill County, which is the location of the Fallon Naval Air Station (NAS). For this reason, the Nevada State Epidemiologist asked the Navy for help in locating other possible leukemia cases in children of naval personnel who may have left the state. Data resources of the DoD Deployment Health Research Center at NHRC were used to identify potential cases of leukemia among Navy families. CHAMPS was used to determine whether family members were ever stationed at NAS Fallon (15). More than 400 incident cases of acute lymphocytic leukemia were identified among active-duty Navy and Marine Corps personnel or their dependents from 1 January 1997 to 15 March 2001 using SIDR and HCSR hospitalization data. Duty station assignments to NAS Fallon were identified from the CHAMPS career history using a sequential search of over 12 million records. No active-duty person who developed leukemia during the study period had a history of assignment to NAS

Fallon. Two leukemia cases were identified in children of active-duty personnel who had been assigned to NAS Fallon. These two cases had been known to the Nevada State Health Department and were already part of the previously recognized cluster.

3.5   Basic Epidemiological Modeling and Research

CHAMPS was used to perform a methodological study that compared results of three epidemiological study-designs carried out to examine the association between military occupation and incidence of a particular cancer during the same time interval. The study compared results of a nested case-control study using conditional logistic regression (7,600 individuals) with results of a baseline cohort study (right censored only, with 1.9 million individuals and 10 million person-years of follow-up), and results of a full cohort study (ongoing recruitment and right censored observations, with 4 million individuals and 18 million person-years of follow-up). The study provides an analysis of results of the nested case-control design using conditional logistic regression compared with two types of cohort studies using proportional hazards regression and will provide a basis for understanding the relative power and sensitivity of these three approaches to detection of epidemiological associations and the evaluation of the strength of the associations.

4.0   CONCLUSIONS

CHAMPS is a unique data system that is well suited to longitudinal epidemiological investigations in the DoD. Its individually-based flexible architecture allows it to be readily adapted to support a wide variety of specific investigations of high military relevance. CHAMPS enhances the DoD's ability to conduct epidemiological research in support of force health protection.
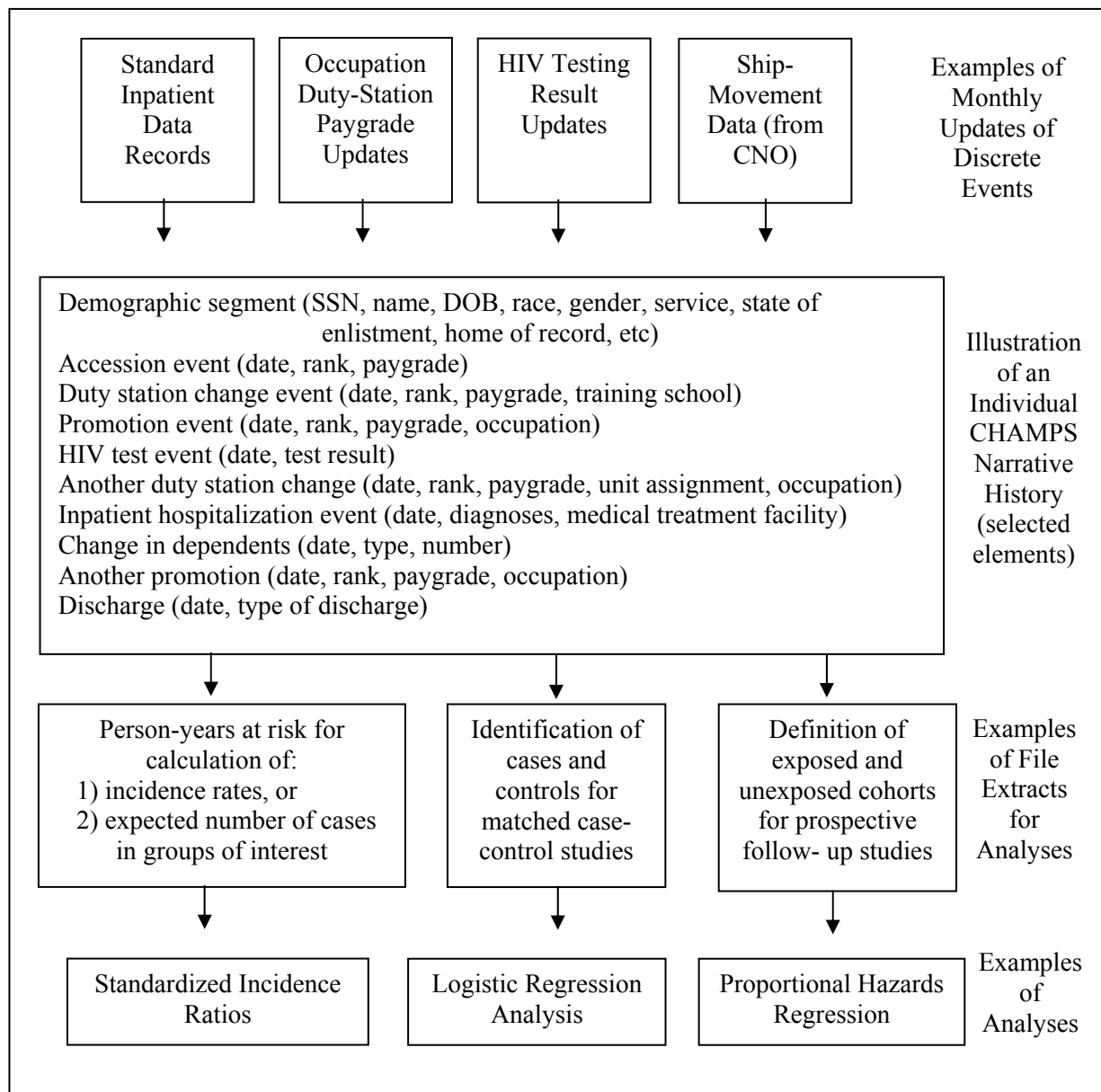
Standard Inpatient Data Records	Occupation Duty-Station Paygrade Updates	HIV Testing Result Updates	Ship-Movement Data (from CNO)	Examples of Monthly Updates of Discrete Events

Demographic segment (SSN, name, DOB, race, gender, service, state of
           enlistment, home of record, etc)
Accession event (date, rank, paygrade)
Duty station change event (date, rank, paygrade, training school)
Promotion event (date, rank, paygrade, occupation)
HIV test event (date, test result)
Another duty station change (date, rank, paygrade, unit assignment, occupation)
Inpatient hospitalization event (date, diagnoses, medical treatment facility)
Change in dependents (date, type, number)
Another promotion (date, rank, paygrade, occupation)
Discharge (date, type of discharge)

Illustration of an Individual CHAMPS Narrative History (selected elements)

Person-years at risk for calculation of: 1) incidence rates, or 2) expected number of cases in groups of interest	Identification of cases and controls for matched case-control studies	Definition of exposed and unexposed cohorts for prospective follow- up studies	Examples of File Extracts for Analyses
Standardized Incidence Ratios	Logistic Regression Analysis	Proportional Hazards Regression	Examples of Analyses

Figure 1: Examples of selected source files for CHAMPS, illustration of a CHAMPS
narrative history, and examples of file extracts and types of analyses
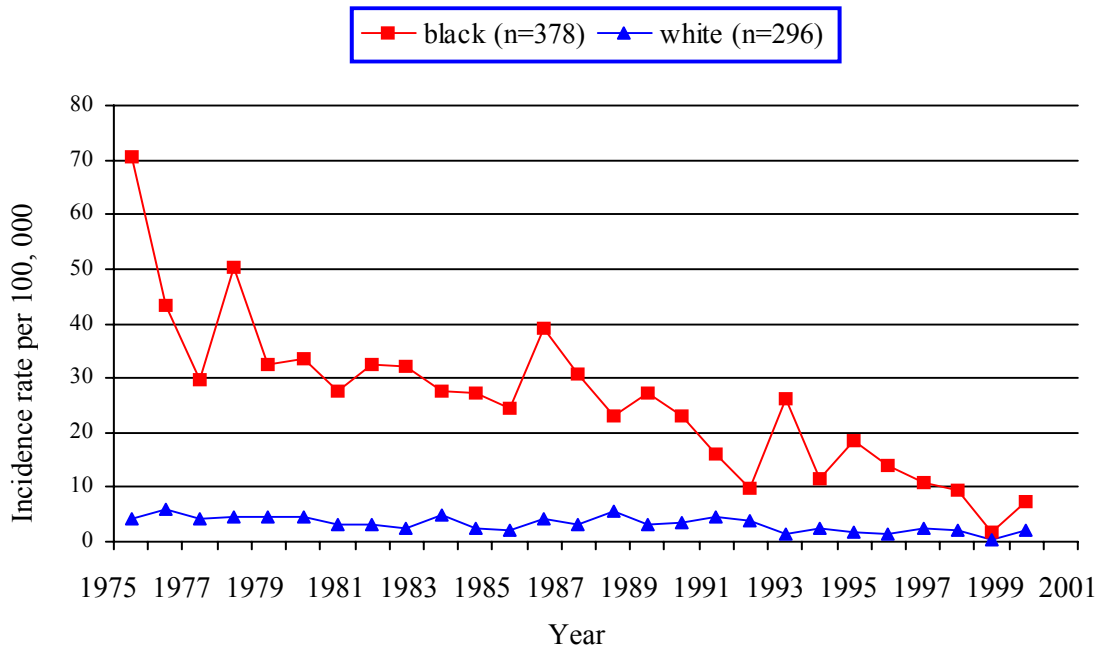
Figure 2: Average annual sarcoidosis incidence rate per 100,000, active duty naval enlisted men by race and year, 1975-2001

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