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Rationale and Methods of the Substance Use and Psychological Injury Combat Study (SUPIC): A Longitudinal Study of Army Service Members Returning from Deployment in FY2008–2011

Mary Jo Larson, PhD, MPA [Senior Scientist],

The Heller School for Social Policy & Management, Institute for Behavioral Health, Brandeis University, Waltham, Massachusetts, USA

Rachel Sayko Adams, PhD, MPH [Senior Research Associate],

The Heller School for Social Policy & Management, Institute for Behavioral Health, Brandeis University, Waltham, Massachusetts, USA

Beth A. Mohr, MS [Biostatistician],

The Heller School for Social Policy & Management, Institute for Behavioral Health, Brandeis University, Waltham, Massachusetts, USA

Alex H. S. Harris, PhD [Health Science Specialist],

Veterans Administration Palo Alto Health Care System, Menlo Park, California, USA

Elizabeth L. Merrick, PhD, MPA [Senior Scientist],

The Heller School for Social Policy & Management, Institute for Behavioral Health, Brandeis University, Waltham, Massachusetts, USA

Wendy Funk, MS [Senior Health Services Researcher],

Kennell and Associates, Inc., Falls Church, Virginia, USA

Keith Hofmann, BS [Analyst],

Kennell and Associates, Inc., Falls Church, Virginia, USA

Nikki R. Wooten, PhD, LCSW-C, LISW-CP [Assistant Professor],

Military Social Work Research and Practice, University of South Carolina College of Social Work, Columbia, South Carolina, USA

Diana D. Jeffery, PhD [Director], and

Center for Healthcare Management Studies, Defense Health Cost Assessment and Program Evaluation, TRICARE Management Activity, Assistant Secretary of Defense - Health Affairs, Department of Defense, Falls Church, Virginia, USA

Thomas V. Williams, PhD [Director]

Methods, Measures, Analyses, Defense Health Cost Assessment and Program Evaluation, TRICARE Management Activity, Department of Defense, Falls Church, Virginia, USA

Abstract

SUPIC will examine whether early detection and intervention for post-deployment problems among Army Active Duty and National Guard/Reservists returning from Iraq or Afghanistan are associated with improved long-term substance use and psychological outcomes. This paper describes the rationale and significance of SUPIC, and presents demographic and deployment characteristics of the study sample ($N=643,205$), and self-reported alcohol use and health

problems from the subsample with matched post-deployment health assessments ($N=487,600$). This longitudinal study aims to provide new insight into the long-term post-deployment outcomes of Army members by combining service member data from the Military Health System and Veterans Health Administration.

Keywords

Military Health System; deployment; observational study design; outcomes; urinalysis; active duty; National Guard/Reservists; veterans; alcohol use disorder; posttraumatic stress disorder; depression

Military service members returning from deployment to Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) are at risk for numerous psychological health problems, including alcohol or drug (AOD) misuse and substance use disorders (SUDs). Deployment duration and frequency, and high lifetime combat exposure, are associated with higher rates of alcohol misuse and alcohol consumption-related problems (Adams, Larson, Corrigan, Horgan, & Williams, 2012; Institute of Medicine, 2012a; Jacobson et al., 2008; Spera, Thomas, Barlas, Szoc, & Cambridge, 2010; Wilk et al., 2010). Further, among the more than two million service members who have deployed to OEF/OIF, an estimated 13–20% have or will be diagnosed with posttraumatic stress disorder (PTSD) (Institute of Medicine, 2012b), and the forces now have unprecedented rates of depression and suicide (Army Suicide Prevention Task Force, 2010; Harrell & Berglass, 2011; Institute of Medicine, 2010). While deployment experiences put service members at risk of SUDs, other risk factors are inherent in the military lifestyle: frequent binge drinking (Bray et al., 2010), a demographic profile that matches risk of onset of SUD (young age, single, frequent relocation) (Department of Defense, 2011; Office of Applied Studies, 2005), and a culture where heavy alcohol consumption is viewed as normative (Ames & Cunradi, 2004; Larson, Wooten, Adams, & Merrick, 2012). Despite the high prevalence of binge drinking, brief interventions are underutilized in the military and treatment is often only sought in response to alcohol-related incidents or positive drug screening tests; early detection of problems is rare. An Institute of Medicine committee recommended that the Department of Defense (DoD) adopt additional public health strategies to address the increasing problems associated with AOD misuse that would both mitigate post-deployment problems and improve the readiness of the armed forces (Institute of Medicine, 2012a). While research on PTSD, depression, and suicide has increased the military's attention to the need for increased mental health services (Chiarelli, 2012; White House Executive Order 13625, Aug 31, 2012), there has been much less attention to SUDs.

In response to perceptions that many service members with serious psychological health needs were not receiving optimal interventions, the DoD developed new surveillance and outreach programs (Engel et al., 2008). In 2003, the post-deployment health surveillance program was extended force-wide to include mandatory post-deployment health assessments (PDHA) which are completed by returning service members immediately post-deployment, and the post-deployment health re-assessments (PDHRA), completed 3–6 months post-deployment (Armed Forces Health Surveillance Center, 2010a; Bliese, Wright, & Hoge, 2011). Information from this surveillance program has provided prevalence estimates of post-deployment problems; however, its effectiveness for reducing problems is unknown (Hoge et al., 2004; Milliken, Auchterlonie, & Hoge, 2007). The DoD also has significant data gathering initiatives to monitor and understand the long-term health of current and former troops, including the Millennium Cohort study, a longitudinal study of over 100,000 service members that will be followed until 2022 (Ryan et al., 2007), and the DoD surveys of health-related behaviors of Active Duty (AD) and National Guard/Reservists (NG/R).

which have been conducted every few years since 1980 (Bray et al., 2010; Hourani et al., 2007). Despite these initiatives, two recent Congressional reports on PTSD and SUD in the armed forces called for additional tracking of service member psychological health and increased evaluation of the adequacy of the DoD programs that address these problems (Institute of Medicine, 2012a, 2012b).

It is unknown how often, under which circumstances, and to what effect, there is an early response by the Military Health System (MHS) to AOD and psychological health problems of service members upon return from deployment. Milliken, Auchterlonie, and Hoge (2007) found that 20.3% of AD and 42.4% of NG/R had at least one clinician-identified mental health problem on the PDHA or PDHRA, yet only 4.4% were referred for mental health treatment on the PDHA and only 11.7% were referred on the PRDRA, representing a missed treatment opportunity. Whether early response to post-deployment problems leads to improved long-term outcomes remains an unaddressed question.

Purpose

The Substance Use and Psychological Injury Combat Study (SUPIC) is an observational, longitudinal study funded by the National Institute on Drug Abuse (NIDA), and sponsored by TRICARE Management Activity (TMA) at the DoD. This study is designed to examine AOD misuse, SUDs, and psychological injury among US Army service members after deployment to OEF/OIF. SUPIC explores whether early detection and intervention of problems associated with deployment are related to outcomes tracked up to three years post-deployment using linked data from the MHS and Veterans Health Administration (VHA). We seek to advance thinking about how the military's administrative data systems can be used for additional studies to inform better policy choices and programmatic strategies in the treatment of AOD and psychological injury. Additionally, we discuss solutions to complex analytic challenges to provide insight to other researchers designing future studies.

The paper has 3 parts. Part I of the paper describes the rationale of the study. It introduces SUPIC's longitudinal study design and methods, including its conceptual model, data sources, and measures for long-term outcomes. Part II presents methods and selected results for the first study aim about the prevalence of self-reported AOD and psychological problems immediately post deployment. Finally, in Part III we conclude the paper with a discussion of the complex challenges researchers can anticipate, and possible analytic approaches to address the potential for missing data when conducting longitudinal analysis.

Aims and Significance

SUPIC's four specific study aims are to: (1) describe the prevalence of AOD and psychological problems immediately post-deployment and 3 to 6 months later, and the concordance between self-reported and provider-identified problems; (2) describe the frequency of clinical responses to detected problems (e.g., referral for follow-up assessment, conducted follow-up assessment, assigned a diagnosis or not), and the frequency with which cohort members initiate and engage in behavioral health treatment; (3) identify the individual characteristics, deployment experiences, and the programs and practices of service members' military treatment facilities (MTF) associated with identifying, referring, and diagnosing post-deployment problems, and other process of care measures in MHS and VHA data; and (4) describe service members' AOD and psychological outcomes, and attrition from military service, between 12 to 36 months post-deployment, and investigate the association of early MHS intervention to outcomes.

The significance of this study is, in part, its analysis of both MHS and other data in a quasi-experimental design to permit better understanding of the outcomes associated with the

DoD's surveillance programs. SUPIC is innovative because it tracks cohort members into the VHA to analyze outcomes combining MHS and VHA data, something that has been done infrequently despite the inherent relationship of service members and veterans being served in both health care delivery systems. Thus, the study can observe whether and how selection bias may affect findings of VHA-only studies, particularly, estimates of AOD problems and SUD prevalence. SUPIC is also significant because of its comprehensiveness. The study includes both AD and NG/R, accrues military lifetime MHS data, tracks post-deployment outcomes for up to 36 months, and combine MHS claims data with self-report assessments and drug screening urine test results.

Part I

In this section we describe the rationale and design of SUPIC.

Conceptual Framework

Several concepts form the study's conceptual model (Figure 1), which suggests that there are service member attributes, MTF facility attributes, and attributes of deployment itself that may be associated with long-term outcomes such as AOD, PTSD, and attrition from the Army.

Framing health care utilization in the military context—The classic health services framework describes the demand for behavioral health services as influenced by how potential patients perceive their mental health and AOD needs, barriers to services they confront, as well as facilitators to receiving care, and their own predisposition to use health services (Andersen, 1995). Within this framework, there are unique features for patients of the MHS; an organized delivery system that promotes access to and high demand for preventive health services (mandatory medical examinations, free visits, co-location of services with work location) (Larson et al., 2012). While members of SUPIC's cohort are eligible for MHS care during their active duty mission or career, most become eligible for VHA care after the combat deployment, either when they demobilize from active duty (NG/Rs) or when they discharge from active duty (Department of Veterans Affairs, 2012). The MHS and VHA have different missions and medical protocols, thus we anticipate diversity among MTFs in the MHS and Veterans Health Centers in the VHA.

Deployment experiences and combat exposure—While it is not feasible to establish a causal link, the aims of the study are specific to how the military responds to service members' stresses, psychological injuries, and AOD problems associated with deployments. Combat exposure includes injury resulting from enemy actions, friendly fire, and non-battle accidents, and there is concern that some service members are forever changed by experiences they had while deployed (Hoge, Auchterlonie, & Milliken, 2006; Litz, 2007). Service members with combat exposure exhibit a variety of adaptive and maladaptive coping responses (McNulty, 2005; Smith et al., 2008). Combat veterans and their families are advised to expect a period of adjustment (Castro & Adler, 2011; Hoge, 2011), and to prepare to establish a 'new normal' that incorporates the changes that emerged during the deployment (physical injuries, psychological adjustments, new family roles). Excessive AOD use is a potential maladaptive coping response (Castro & Adler, 2011; Castro, Bienvenu, Hufmann, & Adler, 2000).

SUPIC Study Methods and Research Design

A partnership between SUPIC study investigators and staff of DoD/TRICARE's Defense Health Cost Assessment Program Evaluation (DHCAPE) make this study feasible. DHCAPE staff have broad responsibility for program studies, contribute to SUPIC's

science, and serve as Government Project Managers (GPMs), a requirement of all studies using DoD data. The knowledge of the GPMs and others at TRICARE/DoD permitted us to identify necessary administrative data held by many DoD entities.

Data sources—For this study, we had to build research files, appending to a comprehensive existing MHS Data Repository (MDR) relatively raw administrative data from many other DoD entities. Thus, file building required identifying the entities and persons with authority to release data, and required several different data request applications and approvals. Figure 2 shows the specific data entities and data sources used in this study.

TRICARE's MHS Data Repository: Core data elements on all study cohort members come from the MDR, the data warehouse for the MHS. The MDR is a comprehensive system containing administrative, demographic, and clinical data about TRICARE eligible military beneficiaries and the healthcare provided to them through military or civilian providers under the TRICARE program. The core MDR data include TRICARE enrollment data from the Defense Enrollment Eligibility Reporting System, including referrals, diagnosis and procedure codes, prescription drugs, and payments/costs of inpatient and ambulatory clinical events. The MDR is longitudinal, with more than 20 years of history for some types of data. Starting in FY2000, person identification was standardized to allow linkage of data across disparate sources that feed into the MDR.

Other DoD Sources: We received permission from other DoD entities to append data to the MHS data for cohort members. The *Defense Manpower Data Center (DMDC)* of the Under Secretary of Defense (Personnel and Readiness) maintains the contingency tracking system (CTS), which contains each deployment order for operations since 9/11/2001. Also, within DMDC, the *Data, Analysis and Programs Division* provided each drug screening urinalysis test result in the study period. This file contains each drug test conducted, result (positive or negative), test date, medical review disposition if the drug tested was available by prescription, and test premise (e.g., for cause, part of treatment plan, random selection). The *Armed Forces Health Surveillance Center* holds the post-deployment health assessments and reassessments: PDHA (Form DD2796) and PDHRA (Form DD2900). The Army's Office of the Surgeon General (OTSG) gave permission to release these data.

The Veterans Health Administration (VHA) databases: For SUPIC's study Aims 3 and 4, three VHA databases provided additional data. The VHA maintains a comprehensive National Patient Care Data Base (NPCD) with medical record data including diagnoses and procedures for all clinical activity and medical encounters in outpatient, inpatient, and residential settings. Pharmacy and lab data were obtained from the VHA Decision Support System and AUDIT-C alcohol screening data, an abbreviated 3-item instrument of the larger Alcohol Use Disorders Identification Test, was obtained from the VHA Corporate Data Warehouse (Babor, de la Fuente, Saunders, & Grant, 1989).

Protection of human subjects and data security—To ensure protection of human subjects, Brandeis University's Committee for Protection of Human Subjects and the Human Research Protection Program at the Office of the Assistant Secretary of Defense for Health Affairs/TRICARE Management Activity (OASD/TMA) at the DoD granted approval. The TMA Privacy and Civil Liberties Office executed an annual Data Sharing Agreement for our use of protected health information to ensure compliance with DoD privacy and security regulations and the Health Insurance Portability and Accountability Act (HIPAA). Supplemental agreements also were signed with the other data sharing entities.

The VHA portion of the study received IRB review and approval from Stanford University and the VA Palo Alto Health Care System.

Primary Outcome Measures—This study has three primary outcomes, all measured at 12 months, 24 months, and 36 months after the service member's deployment end date.

AOD misuse: The first primary outcome, AOD misuse post-deployment is assessed in several ways. For all sample members using MHS or VHA services, we have data on the primary and secondary diagnoses associated with each visit or hospitalization. Recorded diagnoses underestimate the true level of AOD problems, which are likely to be under-recognized and under-recorded for reasons including stigma; however, diagnoses are useful in examining treated prevalence.

For study members who remain in military service we anticipate an annual or more frequent drug test result because the DoD conducts random drug tests of all service members at least annually, as well as targeted drug tests for other reasons such as a commander's request for a unit-wide assessment, for cause, or for periodic medical exams. This will be an objective measure for tested substances (primarily cocaine, heroin, and marijuana). The VHA records include drug test results, although it does not conduct random urine screening. For cohort members who use the VHA system, we will have the AUDIT-C, typically conducted annually for VHA patients. The MHS also administers the AUDIT-C for post-deployment screening, which will only be available on service members with future deployment returns within the follow-up window.

Proxy indicators for AOD problems can help to compensate for anticipated under-reporting of this stigmatized behavior, particularly in the MHS. "Early non-voluntary discharge from military service" is suggestive of possible AOD concerns, and although there are several reasons for early discharge, AOD misuse is a frequent primary reason. Furthermore, AOD misuse contributes to poor performance and other conduct problems that may be the direct reason for discharge (Institute of Medicine, 2012a). Early discharge, in its own right, represents a loss of a trained, experienced service member in whom the DoD invested valuable training.

VHA linkage: The second primary outcome is enrollment in and linkage to services in the VHA, with focus on linkage to behavioral health services. By virtue of their service on an OEF/OIF combat mission, most cohort members are eligible for VHA services for up to 5 years once discharged or demobilized from service, independent of injury and income qualifications (with the exception of those with a dishonorable discharge) (U.S. Department of Veterans Affairs, 2012).

Psychological injury: A third primary outcome is post-deployment 'psychological injury.' Similar to AOD misuse, this outcome is comprised of several measures. We know that psychiatric co-morbidity is common and that primary care providers are trained to identify and address depression, acute stress reaction, behavioral risk, and PTSD in many MTFs. If we are unable to adjust for psychological disorders that are treated within the MHS but are pre-existing conditions not related to combat stress, our analyses may overstate the impact of combat on psychological health, yet this overestimation may be balanced by the under-recording of diagnoses due to stigma and other unexplained factors.

Core Independent variables

MHS response to post-deployment problems: MHS early response to post-deployment AOD problems is the primary intervention being studied. We define early response by 1) the

providers' report of actions taken during the face-to-face interview on the PDHA and PDHRA, 2) MDR referrals, and 3) the procedures and diagnoses in the MDR within 150 days post-deployment. Specific early response measures include the following responses to a positive screen for alcohol problems on the PDHA: PDHA provider-reported AOD problem, evidence of a further assessment, referral to primary care, referral to the Army Substance Abuse Program (ASAP), diagnosis of an AOD recorded, and treatment for AOD or other behavioral health condition with AOD as a secondary diagnosis. The comparison group consists of cohort members with a post-deployment positive screen for alcohol misuse without evidence of any 'early military response.' We define "early" to be within 5 months of the service member's return as it simulates the time frame of the post-deployment screening program.

Post-deployment problems and symptoms: Using self-report data on the PDHA and the DoD's specific screening guidelines (Department of Defense, 2010), we characterize several post-deployment problems and symptoms. Risky drinking is defined by summing the three consumption items from the AUDIT-C; a score (range 0–12) of four or more for men, or three or more for women is considered positive. This cutoff score balances sensitivity and specificity (Bradley et al., 2007). The Patient Health Questionnaire (PHQ-2) is used to screen for depression, a positive score is three or greater from a possible score of 0–6 (Kroenke, Spitzer, & Williams, 2003; Spitzer, Kroenke, & Williams, 1999). The Primary Care PTSD Screen (PC-PTSD) identifies those with a positive PTSD screen using a cutoff score of three or more from a possible score of 0–4; a cutoff score endorsed for use with service members post-deployment (Bliese et al., 2008; Calhoun et al., 2010; Prins & Ouimette, 2004). Service members are identified to be at behavioral risk if when questioned by the interviewer they endorsed either thoughts of harming others or thoughts of harming themselves or being better off dead.

Combat exposure/deployment experiences for deployment: Deployments are characterized by total months deployed, number of deployments, and dwell time between deployments. Combat exposure is characterized by self-report exposures and events reported on the post-deployment surveillance forms, self-report of sick days/quarters associated with injuries, and objective measures from the Theater Medical Data Store of medical events in theater, MDR events indicating inpatient stays during the index deployment period, or assignment to a Warrior Transition Unit (WTU) after the deployment. WTUs are special garrison units for service members with polytrauma developed to prepare them for medical discharge or return to duty in which there is suggestion of overprescribing of opiates, antidepressants and antianxiety medications (Army Suicide Prevention Task Force, 2010; U.S. Department of the Army, 2009).

Other process of care measures: Specific to AOD treatment, the study is calculating AOD identification, treatment initiation, and treatment engagement measures for MTFs and annual cohorts which come from the National Committee for Quality Assurance's widely used HEDIS performance measurement set (Garnick et al., 2007; Garnick, Lee, Horgan, & Acevedo, 2009). While originally designed for health plan performance measurement, the MHS and the VHA now also calculate selected HEDIS measures for some conditions (Harris & Bowe, 2008; Harris, Humphreys, Bowe, Tiet, & Finney, 2008), and we will generate performance measures developed within the VHA system as AOD and PTSD treatment metrics (e.g., receipt of intensive SUD treatment, receipt of an evidence-based duration of psychotherapy) and will apply them across the MHS and VHA systems for individual cohort measures. These measures may point to areas where the systems are performing well and areas of missed treatment opportunity.

Sample Development

SUPIC uses a broad sample definition to generate representative findings and to permit study of select subgroups (e.g., women, NG/R). The main sample includes all Army service members (AD and NG/R) who had a deployment end date between October 1, 2007 and September 30, 2011 (FY2008–2011). A core subsample includes those who completed a PDHA associated with a study deployment (post-deployment screening subsample).

Main sample: Figure 3 outlines the multistage selection process, which begins on the deployment level. We collapsed CTS deployment records where the time between records was less than 90 days since we believed these to be segments of a multi-order deployment rather than separate deployments. We selected deployments typical of the Army by excluding outliers, those lasting less than 30 days and those 5 years or longer. The deployments that remained were used to identify unique service members in the main sample.

Matching PDHAs to deployments: Construction of the study sample also involved identifying one deployment and matched PDHA for each service member. During FY2008–2011 service members may have been deployed multiple times, and they may have completed a PDHA each time they changed location, and also multiple times around the end date of the deployment. Furthermore, there is no identification number to associate PDHA(s) with deployments, and anecdotal evidence suggests that the deployment end date on the CTS record may not be the actual date the service member left theater, but may include post-deployment “leave” days or days in hospital. Consequently, we developed an algorithm to match each PDHA to a specific deployment, and then we selected a single deployment-PDHA match for analysis of study aims.

In brief, we first identified all PDHAs completed in FY2008–FY2011 for a specific service member using social security numbers. Next, we compared date fields in common on the deployment record and PDHA, as well as the difference between the PDHA completion date and the deployment end date from the CTS record before deciding on the final algorithm. After several iterations, we defined matched-PDHAs as those with a completion date within ± 60 days of the return date on the deployment record. This definition ensured that the matched-PDHAs were completed close to the end of deployment, and also allows us to associate PDHA data more reliably with deployment characteristics and events occurring post deployment.

Selection of index deployment: The next step was to identify an index deployment to begin the longitudinal window for each sample member. About one third of the main sample had more than one deployment ending in FY2008–2011. In performing this task we addressed an additional problem of two different PDHA versions used during this time window, the “old” PDHA (2003-01) was phased out in 2008 and replaced by the “new” PDHA (2008-01). The old version did not contain alcohol consumption items and other important items. For members with multiple deployments, we selected the first deployment which could be matched to a new PDHA, if available, as the index deployment; otherwise we used the first deployment matched to an old PDHA. For members with no matching PDHA, we selected the first deployment ending in FY2008–2011 as the index deployment. This selection process permitted us to identify a post-deployment screening subsample (those with an index deployment matched to a new PDHA; Figure 3) with the most complete analytic variables important to the majority of study aims.

We excluded service members whose deployments did not include stays in OEF/OIF countries (Iraq, Afghanistan, Qatar, Kuwait). Since country(ies) of deployment were

contained on the PDHA form only, not the CTS data, this exclusion does not apply to the main sample lacking a matched PDHA. Based on preliminary analysis of country information on matched-PDHA's, CTS deployment records for US and other non-OEF/OIF missions are not common.

Selection of index PDHA for analysis: The last step was the selection of a single matched-PDHA for the index deployment when multiple, matched-PDHAs were completed. Based on a preference to analyze self-report health status items after return from deployment (rather than while in country), we selected as the index the last matched-PDHA.

The main sample consists of N=643,205 service members of whom 75.8% are in the post-deployment screening subsample.

Part II

Part II of this paper presents demographic and deployment characteristics of the study sample and selected descriptive and bivariate findings for the first SUPIC study aim related to the prevalence of self-report of alcohol and psychological health problems immediately post-deployment. We close this section with comparison of our findings to those in the literature.

Statistical Analysis

We present descriptive statistics (means, standard deviations (SD) and proportions) and statistical tests for differences between service members included and excluded from the post-deployment screening subsample (Table 1) and differences by component (AD versus NG/R; Table 2). Chi-square tests of independence were used for categorical variables and t-tests for continuous variables. Due to the large sample size, most p-values were less than 0.05; thus, we emphasize the magnitude of the differences.

Results

Sample Description—The main sample consists of 643,205 Army members returning from a deployment ending in FY2008–FY2011. Table 1 compares demographic and deployment characteristics of the sample by service component. Of the main sample, 67.6% are Active Duty, and 32.4% are National Guard/Reserve. Although important differences exist between the two components, they are similar in many ways. Both are predominantly young and male (full sample: mean age (SD) of 28.6 (8.1) years, 89.5% are male). Slightly over half of the sample is married, and nearly half has children who are TRICARE dependents. The study sample is deployed from a fairly even distribution of regions across the US; residence generally indicates the location of the duty station for AD, rather than residence. The NG/R component tends to be slightly older than their AD counterparts, have fewer junior enlisted personnel, and is more likely to be white.

Generally, AD members had longer index deployments compared to NG/R (mean (SD): 11.8 (5.3) months versus 9.6 (4.7), and a larger proportion of the AD had a dwell time of less than 12 months, defined as the time between the end of the prior deployment and the beginning of the index deployment (11.9% versus 7.4%). A low proportion of returning members were assigned to a WTU, with a higher proportion from the NG/R (4.8% versus 2.5%).

The differences between those included (n=487,600; 75.8%) and excluded (155,605, 24.2%) from the post-deployment screening subsample are not large in magnitude. The main difference is the end date of the index deployment, which was in FY09–11 for 94.3% of service members in the subsample compared to 37.8% of those excluded (not shown),

reflecting the subsample requirement of a new PDHA (introduced in FY08). Other differences may be related to the timing of the index deployment. Compared to those in the subsample, those excluded were more likely to be older (16.4% vs. 10.7% aged 40+), of higher rank (15.9% vs. 11.0% officer), have an index deployment longer than 12 months (38.1% vs. 21.3%), be assigned to a WTU post-deployment (5.9% vs. 2.4%) and be in an inpatient facility during or after the index deployment (3.2% vs. 0.6%).

Table 2 displays self-reported findings from the post-deployment screening subsample. Overall, around one-fifth reported being wounded, injured, assaulted, or hurt during their previous deployment with a similar proportion experiencing a blast or explosion. More than 50% reported being in excellent or very good health, yet 28% had some to extreme difficulty with a physical problem in the last month. Slightly over one-fourth of service members reported having emotional problems that interfered with their day-to-day lives within the past month; 5.7% met the criterion for a positive screen for PTSD, and 7.5% met the criterion for a positive screen for depression. Binge drinking at least monthly was reported by 15.7%, and 27.6% of service members were AUDIT-C positive.

A higher proportion of those in the NG/Rs (27.0%) reported being wounded, injured, assaulted, or hurt during their previous deployment, compared to AD (16.9%). Yet, a greater proportion of AD (20.3%) reported being exposed to a blast or explosion, compared to those in the NG/Rs (17.3%). Consistent with the overall injury prevalence, more AD report never being seen by a healthcare provider during the index deployment compared to the NG/R.

When asked about past month, general health status, those in AD had a greater proportion report overall health as excellent or very good compared to those in the NG/Rs, consistent with a smaller proportion with physical difficulties in the past month. A slightly higher proportion of those in AD reported binge drinking at least monthly (prior to deploying or during the recent deployment) compared to those in the NG/Rs (16.5%) vs. 13.8%), with less than 1% overall reporting daily binge drinking. Further, a slightly higher proportion of AD had a positive AUDIT-C screen (women 3+ and men 4+), or an 8+ on the AUDIT-C increasing the risk of possible alcohol dependence. Despite the high levels of alcohol consumption, only 3.6% overall reported being concerned about their own drinking such as felt that they 'wanted or needed to cut down' on their drinking. A little over one percent reported thoughts of harming others or themselves, or of being better off dead, within the past month.

Discussion of Results

In this section we set our findings in context to other literature. Almost 16% of SUPIC's post-deployment screening subsample reporting binge drinking (6+ drinks on one occasion) prior to deploying or during the recent deployment, with slightly higher estimates from AD compared to NG/R, and only 0.8% overall reported daily binge drinking. By comparison, when assessing past month binge drinking on the anonymous 2008 HRB survey, 25.6% of AD service members returning from a combat deployment in the past year reported binge drinking at least weekly in the past month (Adams et al., 2012). Binge drinking was assessed at a slightly lower cutoff score on the HRB survey, consistent with National Institute on Alcohol Abuse guidelines (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2005); however, this alone likely does not explain the significantly higher proportion reporting past-month binge drinking. The HRB survey is anonymous whereas the PDHA responses form the basis of a provider interview and are included in service members' medical records. The prevalence of screening positive for alcohol problems using the 2-item TICS, was reported as 11.8% of AD and 15.0% of NG/Rs on the PDHRA administered 3 to 6 months after deployment (PDHRA old version) (Milliken et al., 2007), much higher than the very low rate reported immediately post-deployment of this study. A study using the

Millennium Cohort data found that among those who had deployed and reported combat exposure, 56% reported binge drinking and 9.2% reported heavy weekly drinking during the time of the follow-up interview, which occurred up to five years post-deployment, using slightly different definitions of binge and heavy drinking (Jacobson et al., 2008).

Over one quarter (26.0%) of SUPIC's subsample that completed a PDHA reported difficulty with emotional problems in the past month, with 5.7% positive for possible PTSD using a score of 3+ with the PC-PTSD. This is consistent with a study that assessed 88,235 Army service members in 2005–06 (PDHA old version) which found that 6.2% of AD and 6.7% of NG/R service members screened positive for PTSD (Milliken et al., 2007), and both are lower than the 2009–10 estimates of the AFHSC which found that 8.8% of AD and 9.0% of NG/R service members reported a lower threshold of 2+ PTSD symptoms (Armed Forces Health Surveillance Center, 2010b). Further, the overall prevalence of PTSD among all AD Army service members in 2010, including those who have never deployed, was 3.4% (Armed Forces Health Surveillance Center, 2010a). Using a diagnostic assessment instrument and an expanded timeframe, and based on anonymous and voluntary reporting, analysis of the 2008 HRB survey of AD found that 13.4% of service members from all branches who returned home from a combat deployment in the past 12 months screened positive for PTSD in the past month (Adams et al., 2012), using the PTSD Checklist-Civilian (PCL-C) standard diagnostic cutoff score of 50 or greater (Bliese et al., 2008). Further, among all respondents of the 2008 HRB survey, including those who had never deployed, 10.7% screened positive for past month positive PTSD with the PCL-C (Bray et al., 2010). Thus, the PTSD screening rate we report here, while not as specific as a diagnostic instrument, appears low.

Part III

Future Analytic Challenges and Solutions

The analytic goals of SUPIC are quite ambitious. The study uses an observational design which could introduce selection bias and, if not addressed, jeopardize the validity of our findings. We intend to follow a highly mobile population longitudinally, and for many service members, we may not be able to observe their outcomes directly because they may drop out of the sample due to being demobilized, discharged, etc. Furthermore, we plan to study highly stigmatized problems (e.g. AOD, psychological injury) using, in part, administrative data and a non-anonymous survey. This section describes our proposed statistical approaches to addressing these problems.

Selection Bias—Selection bias is an associated challenge of observational study designs (Shadish, Cook, & Campbell, 2002) since investigators cannot randomize subjects to treatment and comparison groups. We would like to determine whether early MHS response to problems is associated with improved outcomes; however, we have no control over which service members receive a referral (“treatment” group) and those who do not (comparison group). Service members with the most needs may also be more likely to receive “early” services. Because the groups may differ on observed and unobserved covariates (such as severity of psychological problems) which affect study outcomes, we could find an association between early treatment and poorer outcomes but this association could be a reflection of preexisting differences between the groups, and not the result of the MHS response. Thus, selection bias can lead to invalid conclusions. Traditional techniques for controlling for imbalances between groups, such as covariate adjustment, may not adequately eliminate this bias (D’Agostino, 1998).

To reduce such bias we will consider using propensity score modeling, which can help balance groups on observed covariates (D’Agostino, 1998). The propensity score for an

individual is the predicted probability of being in the treatment group and is calculated from a model predicting group membership given the individual's covariates. Propensity scores are used as regression weights in multivariate models to adjust for the propensity to be in the treatment group (Hogan & Lancaster, 2004).

Clustered Data—In this study, service members are clustered within MTFs. Those assigned to a particular MTF may be more similar to each other on factors affecting outcomes (e.g. occupation, deployment experiences) than they are to personnel assigned to a different MTF. Also, the MTFs may differ on the PDHA administration, the number of mental health providers, availability of special programs, behavioral health protocols, and leadership style; all of which could impact whether service members receive referral and subsequent care. The result is that outcomes of service members within a MTF may be correlated. If the correlation is not accounted for analytically, the standard regression model assumption of independence of observations is violated and could result in invalid inferences.

To account for clustering, we will consider using hierarchical linear models (HLM) for multivariate analysis, with MTF or another appropriate variable as the cluster. HLMs are appropriate when the goal of the analysis is to measure associations between independent variables and a dependent variable, but the data have a clustered structure. HLMs are especially useful when the goal of an analysis is to study variables operating simultaneously at different levels. For example, person-level characteristics (level 1) such as mental health history and system or organizational characteristics (level 2) such MTF attributes may impact whether the service member receives a referral. Typically, the dependent variable for an HLM is measured at level 1, and the independent variables can be measured at level 1 or level 2 (Singer & Willett, 2003).

Longitudinal Data—Outcomes for this study will be measured at multiple points during 12–36 months post deployment, resulting in multiple observations over time for the each service member. Longitudinal data are a special case of clustering, i.e. clustering of repeated measures within a person. For example, in SUPIC time points are clustered within service members, who are clustered within MTF's. Thus, another benefit to using HLM's for multivariate analysis is that they can be used to analyze longitudinal data (Fitzmaurice, Laird, & Ware, 2004).

Censoring of Outcome Data—We anticipate that we will not be able to observe all service members for the full 12–36 months because some will be deployed again, discharged, or medically boarded. NG/Rs may lose benefits after 6 months so their healthcare utilization will not be accessible unless they access the VHA. Censoring could introduce selection bias in that service members with fewer problems may be more likely to be redeployed, while those with more problems may be more likely to be discharged. We will consider several methods to address this problem including: using a broad definition of outcomes, studying attrition/early separation as an outcome, analyzing historical data about substance use in military lifetime prior to index deployment, incorporating VHA data to study service members after military separation, stratifying by component since censoring mechanisms differ by component, and employing analytic techniques such as survival analysis which takes into account the amount of time the individual was observed. In addition, we intend to compare service members with censored data to members with non-censored data in terms of substance use history, severity of AOD problems, combat experiences, and demographics, in order to assess degree of selection bias resulting from censoring.

Measuring AOD Misuse—We anticipate that measuring AOD misuse accurately in this population will be difficult. Since a substance abuse diagnosis could jeopardize service members' retention in military service, providers may be reluctant to assign a diagnosis and service members may underreport problems. We will compensate by measuring medical diagnoses highly associated with SUD, such as cirrhosis or poisoning, to identify SUD indicators; we will incorporate objective drug use test data, e.g. urinalysis, and analyze alcohol consumption screening results post deployment when available (medical exams & VA assessments). We plan to use latent variable modeling including factor analysis, a technique for combining many indicators to measure outcomes that cannot be observed directly (Muthen, 2002).

Identifying the Full Sample in the VHA Data Systems—The basic task of finding the utilization of VHA services among post-deployment service members and classifying it by reason for eligibility requires algorithms to reconcile the two systems. While only discharged or demobilized service members become eligible for VHA enrollment, AD members and NG/R members when activated may receive VHA care based on a referral from, and reimbursed through, TRICARE. In general, AD personnel who served a minimum duty requirement, and who were discharged under any condition other than dishonorable, may qualify for VHA benefits. Combat veterans, including activated members of the NG/Rs, are defined for VHA enrollment purposes as those who served on active duty in an area of combat operations after 1998, and have been discharged under other than dishonorable conditions. Combat veterans are eligible for 5 years of at least Priority Group 6 status, which entitles them to free health care services for conditions potentially related to service in a war zone once enrolled (Department of Veterans Affairs, 2012). Given we are conducting among the first studies using joint MHS and VHA data, we will examine several candidate measures before identifying accurate measures of eligibility; accurate measures are necessary in order to construct the most meaningful rates for study outcomes. We will identify cohort members in VHA enrollment and utilization files based on a social security number and name algorithm.

Conclusion

This paper describes how SUPIC, a longitudinal, observational study funded by NIDA and conducted with the support of TMA/DOD, intends to advance what is known about post-deployment AOD misuse, SUDs, and psychological problems, and the early response of military personnel to such problems. This type of comprehensive research is needed to inform better policy choices and programmatic strategies. A unique collaboration of University AOD investigators, investigators within DHCAPE of TMA/DoD, and investigators affiliated with the VHA, has made this comprehensive study possible. This model of team collaboration facilitates the translation of scientific research findings into actionable information for clinical practice and health policy.

While there is consensus that progress regarding the identification and treatment of post-deployment psychological health problems is being made, much remains to be done and AOD misuse is especially under-addressed. In particular, public health or population health strategies may be under-utilized in the military even though unhealthy, high-risk alcohol use is considered normative. The risk of AOD misuse is exacerbated in periods of high occupational, personal or family stress, and there is a clear association of misuse with other post-deployment problems such as PTSD, depression, and suicidality (Army Suicide Prevention Task Force, 2010). Many deploying service members return with polytrauma, or co-morbid conditions of PTSD, traumatic brain injury, and chronic pain; and AOD misuse may be one coping strategy among these wounded warriors (Institute of Medicine, 2012a). Despite these interconnections, AOD misuse is viewed as misconduct rather than the less

stigmatized interpretation as a symptom of post-deployment problems. Therefore, we hypothesize that there are missed intervention opportunities that, when fully addressed following public health principles, have the potential to improve the long term psychological and AOD outcomes of military members post-deployment.

While the VHA has a tradition of published research that characterizes the problems among returning veterans and describes the behavioral health services utilized, this tradition is lacking in the MHS outside of surveillance of deployment injuries and illnesses. VHA services are an entitlement for OIF/OEF veterans; however, for those who remain active duty, services are not available without command referral. For many NG/R service members, VHA services may be perceived as being inaccessible or not attractive. Thus, an early MHS response to post-deployment problems is needed, making critical this study of long-term outcomes despite the complexity involved in conducting such research. This study will evaluate our hypothesis that the optimal system would involve identification of and intervention for nascent problems while still engaged with the MHS, with triage and follow-up care within the VHA as needed for service members after discharge.

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Glossary

Combat veterans	for VHA enrollment purposes, veterans, including activated members of the National Guard and Reserve, are defined as those who served on active duty in an area of combat operations after 1998, and have been discharged under other than dishonorable conditions. For general study purposes, all members who have returned from deployment are combat veterans
Early post-deployment response	the course of action taken in the first five months by military providers in response to a positive screen of a post-deployment problem
In theater	events occurring on the battleground or within the arena of combat
Military health system (MHS) or TRICARE	the health care organized and paid for by the Department of Defense for uniformed service members, their dependents, and other beneficiaries entitled to DOD health care
Psychological injury	a term used by veterans' advocates to describe mental health symptoms and problems which they believe may be associated with deployment, repeated deployments, or combat exposure

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Figure 1.
Conceptual Model – Relationship of Post-Deployment Military Health System Early Recognition & Referral of Behavioral Health (BH) Problems to Study Outcomes

Figure 2. Longitudinal File Building with DoD and VHA Data Sources

Acronyms: AFHSC: Armed Forces Health Surveillance Center; AUDIT-C: Alcohol Use Disorders Identification Test –3 consumption items; CDW: Corporate Data Warehouse; CTS: Contingency Tracking System; DAP: Data, Analysis and Programs; DEERS: Defense Enrollment Eligibility Reporting System; DMDC: Defense Manpower Data Centers; DSS: Decision Support System; MDR: MHS Data Repository; MEPRS: The Medical Expense & Performance Reporting System; NPCD: National Patient Care Data Base; PDHA: Post-Deployment Health Assessment Form DD2976; PDHRA: Post-Deployment Health Re-Assessment Form DD2900; PDTS: Pharmacy Data Transaction Service; TMDS – Theater Medical Data Store

Figure 3. Construction of Main Sample and Post-deployment Screening Subsample

*PDHA Match = SSN on PDHA and deployment record match and PDHA completed within 60 days of deployment end date

Table 1

Demographic and Deployment Characteristics of Army Service Members Returning from Index Deployment in FY2008–2011, (N = 643,205)

Characteristics ^{a,b}	Main Sample			Post-deployment Screening Subsample Total ^d
	Active Duty	National Guard and Reserve Component	Total	
Total, <i>n</i> (% of total sample)	434,986 (67.6)	208,219 (32.4)	643,205 (100)	487,600 (75.8)
Demographic				
Age (yr), <i>mean</i> (<i>sd</i>)	27.4 (7.1)	31.2 (9.5)	28.6 (8.1)	28.2 (7.9)
Age (yr), <i>n</i> (%)				
17–24	193,623 (44.5)	66,997 (32.2)	260,620 (40.5)	205,198 (42.1)
25–29	103,943 (23.9)	43,452 (20.9)	147,395 (22.9)	114,459 (23.5)
30–39	105,339 (24.2)	52,372 (25.2)	157,711 (24.5)	116,022 (23.8)
40+	32,081 (7.4)	45,398 (21.8)	77,479 (12.1)	51,921 (10.7)
Gender				
Male, <i>n</i> (%)	389,501 (89.5)	186,082 (89.4)	575,583 (89.5)	436,983 (89.6)
Race, <i>n</i> (%)				
White	267,716 (61.6)	167,379 (80.4)	435,095 (67.6)	325,567 (66.8)
Black	80,359 (18.5)	27,545 (13.2)	107,904 (16.8)	81,489 (16.7)
Asian/Pacific Islander	63,133 (14.5)	6,763 (3.3)	69,896 (10.9)	58,439 (12.0)
Other	23,778 (5.5)	6,532 (3.1)	30,310 (4.7)	22,105 (4.5)
Marital Status, <i>n</i> (%)				
Never Married	159,603 (36.7)	82,146 (39.5)	241,749 (37.6)	187,915 (38.5)
Married	252,608 (58.1)	109,750 (52.7)	362,358 (56.3)	270,769 (55.5)
Divorced	21,357 (4.9)	15,725 (7.6)	37,082 (5.8)	27,444 (5.6)
Other	1,418 (0.3)	598 (0.3)	2,016 (0.3)	1,472 (0.3)
Any child dependent receiving TRICARE benefits, <i>n</i> (%)	198,838 (45.7)	101,094 (48.6)	299,932 (46.6)	222,117 (45.6)
Rank, pay grade, <i>n</i> (%)				
Junior Enlisted (E1–E4)	231,212 (53.2)	97,556 (46.9)	328,768 (51.1)	259,314 (53.2)
Senior Enlisted (E5–E9)	139,176 (32.0)	81,492 (39.1)	220,668 (34.3)	163,130 (33.5)
Warrant Officer	11,205 (2.6)	4,024 (1.9)	15,229 (2.4)	11,337 (2.3)
Officer	53,386 (12.3)	25,143 (12.1)	78,529 (12.2)	53,814 (11.0)
Region of residence, <i>n</i> (%)				
North	127,023 (29.2)	82,129 (39.4)	209,152 (32.5)	157,629 (32.3)
South	131,955 (30.3)	63,572 (30.5)	195,527 (30.4)	150,226 (30.8)
West (including Alaska)	129,691 (29.8)	54,620 (26.2)	184,311 (28.7)	139,501 (28.6)
Outside US	44,124 (10.1)	7,548 (3.6)	51,672 (8.0)	38,444 (7.9)

Characteristics ^{a,b}	Main Sample			Post-deployment Screening Subsample Total ^d
	Active Duty	National Guard and Reserve Component	Total	
Unknown	2,193 (0.5)	350 (0.2)	2,543 (0.4)	1,800 (0.4)
Deployment				
Length of index deployment (months), <i>mean (sd)</i>	11.8 (5.3)	9.6 (4.7)	11.1 (5.2)	11.2 (5.0)
Length of index deployment (months), <i>n (%)</i>				
1–11	162,300 (37.3)	185,668 (89.2)	347,968 (54.1)	268,577 (55.1)
12	120,902 (27.8)	11,178 (5.4)	132,080 (20.5)	115,120 (23.6)
>12	151,784 (34.9)	11,373 (5.5)	163,157 (25.4)	103,903 (21.3)
Prior deployment to index, <i>n (%)</i>	201,064 (46.2)	77,330 (37.1)	278,394 (43.3)	210,293 (43.1)
Number of prior deployments, given any, <i>mean (SD)</i>	1.5 (0.8)	1.2 (0.5)	1.4 (0.7)	1.4 (0.7)
Dwell time ^c under 12 months, <i>n (%)</i>	23,941 (11.9)	5,738 (7.4)	29,679 (10.7)	18,350 (8.7)
Assigned to Warrior Transition Unit since start of index deployment, <i>n (%)</i>	10,748 (2.5)	9,881 (4.8)	20,629 (3.2)	11,440 (2.4)

^a Measured at beginning of Index Deployment unless indicated

^b Percentages may not add to 100% because of rounding

^c Dwell time is the time between the end of the deployment immediately prior to the index deployment and the start of the index deployment

^d P-values comparing demographic and deployment characteristics of those included in the PDHA Screening Subsample to those not included were all statistically significant ($p < 0.001$; Chi-square test of independence for categorical variables; t test for continuous variables) except for number of prior deployments.

Table 2

Self-Reported Deployment Risk Factors, Post-deployment Screening Subsample (N = 487,600)

Post-deployment Screening Item Responses	Post-deployment Screening Subsample ^a		
	Active Duty	National Guard and Reserve Component	Total
	n (%)	n (%)	n (%)
Total, <i>n</i> (% of total subsample)	333,803 (68.5)	153,797 (31.5)	487,600 (100)
Deployment Events (during index deployment)			
Wounded, injured, assaulted or hurt	56,382 (16.9)	41,505 (27.0)	97,887 (20.1)
Experienced a blast	67,758 (20.3)	26,675 (17.3)	94,433 (19.4)
Times seen by healthcare provider			
None/blank	155,695 (46.6)	62,869 (40.9)	218,564 (44.8)
1–3	117,769 (35.3)	60,226 (39.2)	177,995 (36.5)
4 or more	60,339 (18.1)	30,702 (20.0)	91,041 (18.7)
Used medications to stay awake for at least some days	20,712 (6.2)	9,408 (6.1)	30,120 (6.2)
Post-Deployment General Health (past month)			
Overall health			
Excellent/very good	183,265 (55.0)	78,338 (51.0)	261,603 (53.7)
Good	114,810 (34.4)	57,121 (37.2)	171,931 (35.3)
Fair/poor	35,285 (10.6)	18,112 (11.8)	53,397 (11.0)
Difficulty with physical problems (somewhat, very, extremely)	89,725 (26.9)	47,137 (30.7)	136,862 (28.1)
Post-Deployment Mental Health (past month)			
Difficulty with emotional problems (somewhat, very, extremely)	86,307 (25.9)	40,682 (26.5)	126,989 (26.0)
PC-PTSD ^b positive	18,904 (5.7)	9,055 (5.9)	27,959 (5.7)
PHQ-2 ^c positive	25,603 (7.7)	11,033 (7.2)	36,636 (7.5)
Post-Deployment Alcohol Use			
Daily binge drinking	2,670 (0.8)	1,216 (0.8)	3,886 (0.8)
Monthly or more binge drinking	55,153 (16.5)	21,274 (13.8)	76,427 (15.7)
AUDIT-C ^d positive	95,974 (28.8)	38,396 (25.0)	134,370 (27.6)
AUDIT-C score 8+	18,826 (5.6)	6,674 (4.3)	25,500 (5.2)
Own concern (TICS ^e positive)	12,164 (3.6)	5,585 (3.6)	17,749 (3.6)

Post-deployment Screening Item Responses	Post-deployment Screening Subsample ^a		
	Active Duty	National Guard and Reserve Component	Total
	n (%)	n (%)	n (%)
Post-Deployment Behavioral Risk (past month)^f			
Had thoughts of Harming others	4,483 (1.3)	1,831 (1.2)	6,314 (1.3)
Had thoughts of Harming self or of being better off dead	1,238 (0.4)	434 (0.3)	1,672 (0.3)
At least one of above	5,181 (1.6)	2,074 (1.4)	7,255 (1.5)

^a All p-values comparing the distribution of deployment risk factors of Active Duty vs. National Guard/Reserve Component were statistically significant (p<0.01, Chi-square test of independence) except for TICS positive.

^b The Primary Care PTSD Screen (PC-PTSD) is positive if respondent endorses any 3 items out of a 4 item questionnaire about PTSD symptoms.

^c The Patient Health Questionnaire (PHQ-2) is a screening test for depressed mood/anhedonia; scores range from 0–6, with 3 or higher being considered positive.

^d The Alcohol Use Disorders Identification Test Consumption (AUDIT-C) is the sum of 3 consumption items with a total possible score of 12; positive for women 3, for men 4.

^e The Two-item Conjoint Screen (TICS) is positive if respondent indicates drinking more than wanted or reports needing/wanting to cut down on drinking.

^f Administered by provider interview