AFRL-RH-WP-TR-2013-0055

Risk of Incident Mental Health Conditions Among Critical Care Air Transport Team Members

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June 2013
Technical Report

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
06/27/2013	Technical Report	05/12 – 06/13

4. TITLE AND SUBTITLE
Risk of Incident Mental Health Conditions Among Critical Care Air Transport (CCATT) Team Members

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Anthony P. Tvaryanas
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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
711 Human Performance Wing
2510 5th Street
Wright-Patterson AFB OH 45433-7951

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
AFRL-RH-WP-TR-2013-0055

12. DISTRIBUTION/AVAILABILITY STATEMENT
Distribution A: Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
88ABW-2013-2830, cleared 13 June 2013

14. ABSTRACT
This study investigated whether CCATT members were at increased risk for incident post-deployment mental health conditions. A retrospective cohort study of 604 CCATT members without preexisting mental health conditions who had at least one deployment as a CCATT member during 2003-2012 as compared to a control group of 604 non-CCATT medical personnel, frequency matched based on job role. The incidence of post-deployment mental health conditions was 2.1 per 1,000 months for the CCATT group versus 2.2 per 1,000 months for the control group. Females were at marginally increased risk and nurses and technicians were at twice the risk of physicians.

15. SUBJECT TERMS
Aeromedical evacuation, deployment, mental health, military, medical personnel

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Anthony P. Tvaryanas
U	U	U	UU	29	19b. TELEPHONE NUMBER *(Include area code)* 937-938-3253

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ACKNOWLEDGEMENTS

The views and opinions are those of the authors, and do not necessarily represent the views of the U.S. Air Force, the Department of Defense, or any other government agency.

1. ABSTRACT

Background: This study investigated whether Critical Care Air Transport Team (CCATT) members are at increased risk for incident post-deployment mental health conditions.

Methods: We conducted a retrospective cohort study of 604 U.S. Air Force medical personnel without preexisting mental health conditions who had at least one deployment as a CCATT member during 2003-2012 as compared to a control group of 604 medical personnel, frequency matched based on job role, with at least one deployment during the same period, but without CCATT experience. Electronic health record data were used to ascertain the diagnosis of a mental health condition.

Results: The incidence of post-deployment mental health conditions was 2.1 per 1,000 months for the CCATT group versus 2.2 per 1,000 months for the control group. The six most frequent diagnoses were the same in both groups: adjustment reaction not including post-traumatic stress disorder (PTSD), anxiety, major depressive disorder, specific disorders of sleep of nonorganic origin, PTSD, and depressive disorder not elsewhere classified. Females were at marginally increased risk and nurses and technicians were at twice the risk of physicians. The distribution of the time interval from end of the most recent deployment to diagnosis of incident mental health condition was positively skewed with a median greater than 6 months.

Conclusions: CCATT members were at no increased risk for incident post-deployment mental health conditions as compared to non-CCATT medical service members. Nearly two-thirds of incident post-deployment mental health conditions were diagnosed outside the standard 6-month medical surveillance period, a finding warranting further study.

2. INTRODUCTION

Clinical Scenario

A Critical Care Air Transport Team (CCATT) member in her early thirties presents to your flight medicine clinic for a periodic health assessment. She returned from a second deployment as a CCATT member approximately 10 months prior. Since then, she experienced symptoms of nightmares; avoidance and withdrawal; and irritability, hypervigilance, and insomnia. Additionally, she is having difficulty performing her present healthcare duties because of distressing recollections and intense physiological and psychological reactions triggered by exposures to trauma patients. She was seen by a mental health provider, was diagnosed with post-traumatic stress disorder (PTSD), and is being treated with cognitive therapy and a selective serotonin reuptake inhibitor. She believes that her post-deployment experience is shared by many other CCATT personnel and she inquires whether CCATT duties are associated with an increased risk for PTSD. What then is the incidence and relative risk for post-deployment mental health conditions in CCATT personnel?

Background

The concept of CCATT is to manage stabilizing casualties—that is, patients who have undergone initial resuscitation but who remain critically ill. The CCATT program utilizes a three-person team composed of a physician specializing in critical care, pulmonology, anesthesiology, or emergency medicine; a critical care nurse; and a respiratory therapist with supplies and equipment necessary to provide a critical care environment that moves with the patient during evacuation. The team is designed to manage a maximum of three high-acuity ventilator patients or six lower acuity stabilizing patients. The team dynamics on a CCATT differ from the normal routine in an intensive care unit (ICU); the CCATT depends on a high degree of cross-training and cross-functionality to enable the single nurse to cover three to six patients versus one to two patients in the ICU. The team assumes care of patients being stabilized at a ground-based facility, observes them over a period of several hours to determine their stability, and then manages the patients through ground and air transportation until care is transferred to a hospital of greater capability. While deployed, CCATT members live in close quarters and experience the stress of basing and operating in austere environments, sometimes with exposure to combat (3).

The wars in Iraq (Operation Iraqi Freedom) and in Afghanistan (Operation Enduring Freedom) have had demonstrable adverse psychological impacts on military personnel to include PTSD, anxiety, depression, and alcohol misuse (9,16,21). While there has been a growing body of literature on the impact of current wars on deployed military personnel, there has been little information that directly addresses the impact on military healthcare professionals. Clearly, military healthcare professionals are not immune to deployment-related operational stresses; however, historically, they have received little attention about how their operational experiences impacted their psychological health. Deployed military healthcare professionals may practice in an arena where deaths frequently occur or patients with disabling injuries survive, all the while concerns for their well-being are subordinated to the demands of the operational circumstances. In addition, current wars have lacked distinctive fronts, and healthcare settings, which have been

relatively safe in the past, are now subjected to random mortar, sniper, or rocket attacks (8). These types of experiences have been associated with psychological and functional impairments in other combat veteran populations (20), and there is no reason to expect that this would not also be the case for veteran military health professionals.

To date, we are aware of no published research that has specifically examined the incidence of post-deployment mental health conditions in CCATT personnel. Given that the CCATT program was designed to provide care for critically ill or injured patients with multisystem trauma, open/closed head injuries, shock, burns, and other life-threatening complications (3), veteran CCATT personnel would be expected to have had intermittent, intensive exposures to life threats and the experience of suffering, grief, and death that leads to psychological effects (6). Consequently, the following research questions (Q) and hypotheses (H) were adopted for the present study:

Q1: Were CCATT members at increased risk for incident post-deployment mental health conditions?

H1: The relative risk of having a post-deployment mental health diagnosis is higher for U.S. Air Force medical service members with exposure to the CCATT work environment as compared to those with no such exposure.

Q2: Were there other variables that explained variance in risk for incident post-deployment mental health diagnoses?

H2A: Individual differences (age and gender) modulate risk for incident mental health conditions.

H2B: Social differences (marital status and number of dependents) modulate risk for incident mental health conditions.

H2C: Occupational differences (career field, service component, and number of deployments) modulate risk for incident mental health conditions.

Q3: What was the distribution of time from the most recent deployment to the diagnosis of the first incident mental health condition?

Q4: Were there variables that explained variance in the time from the most recent deployment to the diagnosis of the first incident mental health condition?

H4A: Individual differences (age and gender) modulate the time interval from the most recent deployment to the diagnosis of the first incident mental health condition.

H4B: Social differences (marital status and number of dependents) modulate the time interval from the most recent deployment to the diagnosis of the first incident mental health condition.

H4C: Occupational differences (career field, service component, and number of deployments) modulate the time interval from the most recent deployment to the diagnosis of the first incident mental health condition.

Q5: Is the 6-month post-deployment medical surveillance period sufficient to detect most incident mental health conditions?

H5: The odds are greater than 1.00 that an incident mental health condition was diagnosed during the 6-month post-deployment medical surveillance period.

3. METHODS

Research Design

This was a retrospective (historical) cohort study of 604 U.S. Air Force specialized physicians, critical care nurses, and cardiopulmonary technicians with no history of preexisting mental health conditions who had at least one deployment as a CCATT member during the period from 2003-2012. This cohort represented the identifiable population of CCATT members (i.e., *N* = all) with at least one deployment and not just CCATT training. As a control group, 604 medical service members with at least one deployment during the same period, but without CCATT experience, were included. This control group was selected by frequency matching based on job role (specialized physician, critical care nurse, or cardiopulmonary technician).

Measurements

Exposure: Air Force Personnel Center (AFPC) data were used to ascertain the exposure of interest: performance of CCATT duties. The CCATT cohort was identified based on its assigned Unit Type Code and completed training codes. Individual CCATTs are composed of a nurse, respiratory therapist, and physician. Air Force Specialty Codes (AFSCs) for these career fields, specific to CCATT, include 46N3E for ICU nurse, 46N3J for emergency room nurse, and 4H0X1 for respiratory therapist; physicians may be AFSC 44E3A for emergency room physician, 44M3 for internist (who may also be specialized in pulmonology [44M3G] or cardiology [44M3B]), 45A3 for anesthesiologist, 44Y3 for critical care physician, or 45S3 for surgeon. These AFSCs were used to determine the control group of non-CCATT nurses, cardiopulmonary technicians, and physicians. Only those who deployed during the study period were considered for inclusion in the study. Appropriate non-CCATT medical service members were selected as controls to frequency match the CCATT cohort on a 1:1 ratio based on career field. All active duty, Guard, and Reserve members were included, regardless of age or gender. Once the CCATT cohort was identified and the control group selected, the following variables were collected using the AFPC data: Social Security number (SSN) for merging purposes, date of birth (DOB) to calculate age, rank, AFSC, deployment dates, component (i.e., active duty, Guard, or Reserve), gender, marital status, and total number of dependents.

Outcome: Military Health System Mart (M2) data were used to ascertain the outcome of interest: diagnosis of a mental health condition. The M2 includes encounter data for both outpatient and inpatient visits as well as "direct" care (visits on base) and "network" care (visits off base). The M2 uses International Classification of Diseases, Ninth Revision, Clinical Modification codes to record data on diagnoses. Diagnosis codes of interest range from 290 to 319; of particular interest are codes for anxiety and depression, since these conditions increase during times of stress (17). Specific codes for anxiety and depression include 296.2 and 296.3 for major depressive disorder, 300.0 for anxiety, 300.2 for phobias, 300.3 for obsessive compulsive disorder, 300.4 for neurotic depression, 308 for acute reaction to stress, 309.0 for brief depression, 309.1 for prolonged depression, 309.81 for PTSD, and 311 for depressive

disorder. M2 data fields utilized included SSN for merging purposes, DOB to confirm data were for the service member (versus an associated beneficiary), date(s) of care, and diagnosis codes. Dates of care were used to ensure that diagnoses were after the initial deployment; service members with diagnoses of mental disorders before deployment were excluded. M2 data were merged with AFPC data using SSN. Once data were merged and age calculated, SSN and DOB were removed from the dataset. Members needed to have a mental health diagnosis on at least two separate encounters to be classified as having an incident post-deployment mental health condition—that is, an isolated diagnosis was judged insufficient for classification in terms of the outcome of interest.

Institutional Review

This study was conducted under a human-use protocol approved by the 711th Human Performance Wing Institutional Review Board. The protocol did not require informed consent of participants because it was based entirely on the use of existing personnel and medical data that are routinely collected for other purposes.

Statistical Analysis

All the statistical analyses were performed with SAS version 9.2 (SAS Institute, Inc., Cary, NC). The Kaplan-Meier method was used to calculate the actuarial rate of incident mental health conditions. Univariate analyses were performed using χ^2. Multivariate analyses were performed with stepwise method for multiple linear regression, logistic regression, and time-dependent proportional hazard Cox's models. A *p*-value of less than 0.05 was considered statistically significant. The multiple linear regression model was performed with caution to the validation procedures: the normal distribution of the response variable was checked for each value of the every explanatory variable, all potential explanatory variables were explored for collinearity, and outliers were sought.

4. RESULTS

The characteristics of the 604 members of the CCATT cohort and the 604 matched controls are summarized in Table 1. They were followed-up during 79 ± 31 (standard deviation) months (range, 2 to 121 months).

Table 1. Demographic characteristics of CCATT cohort and control group.

Characteristic	CCATT (*n*=604)	Control (*n*=604)	*p*-value*
Career Field			
Physician	233 (38.58)	227 (37.58)	
Nurse	225 (37.25)	228 (37.75)	0.938
Technician	146 (24.17)	149 (24.67)	
Service Component			
Active Duty	421 (69.70)	460 (76.16)	
Air National Guard	79 (13.08)	87 (14.40)	<0.001
Air Force Reserve	104 (17.22)	57 (9.44)	
Gender			
Male	420 (69.54)	350 (57.95)	<0.001
Female	184 (30.46)	254 (42.05)	
Age (yr)			
18-29	229 (37.91)	229 (37.91)	
30-39	282 (46.69)	250 (41.39)	0.037
40-60	93 (15.40)	125 (20.70)	
Marital Status†			
Married	347 (57.64)	345 (57.60)	
Single	217 (36.05)	221 (36.89)	0.824
Divorced	38 (6.31)	33 (5.51)	
Total Dependents			
0	262 (43.48)	273 (45.20)	
1	117 (19.37)	104 (17.22)	
2	102 (16.89)	84 (13.91)	0.247
3	72 (11.92)	93 (15.40)	
4 or more	51 (8.44)	50 (8.28)	
Total Deployments			
1	417 (69.04)	359 (59.44)	<0.001
2 or more	187 (30.96)	245 (40.56)	

*Pearson χ^2 test.
†Missing n=7.

In the CCATT group, there were 91 new cases of a mental health condition over 43,736 total person-months of observation for an incidence of 2.1 per 1,000 months. In contrast, in the control group, there were 95 new cases over 42,301 person-months observation for an incidence of 2.2 per 1,000 months. Table 2 summarizes the observed mental health diagnoses and their frequency for the CCATT and control groups. For any individual, more than one mental health diagnosis may have been assigned during the period of observation covered by this study. Accordingly, an individual may have contributed multiple diagnoses, but not multiple counts for the same diagnosis. Figure 1 provides a graphical comparison of the relative and cumulative frequency distributions of mental health diagnoses by group. In terms of the individual diagnoses that accounted for 80% of the total observed diagnoses within each group, the six most

frequent diagnoses were the same: adjustment reaction not including PTSD, anxiety, major depressive disorder, specific disorders of sleep of nonorganic origin, PTSD, and depressive disorder not elsewhere classified. Thereafter, the diagnosis of "other neurotic, personality, or nonpsychotic mental disorders" was relatively more prevalent in the CCATT group versus the diagnoses of dysthymic disorder, nondependent abuse of drugs, and organic psychotic conditions in the control group.

Table 2. Frequency of observed mental health diagnoses by group.

Mental Health Diagnosis	CCATT		Control	
	Freq	%	Freq	%
Acute reaction to stress	5	2.19	10	3
Adjustment reaction (not including PTSD)	44	19.3	57	17.12
Alcohol dependence syndrome	2	0.88	10	3
Anxiety	34	14.91	34	10.21
Depressive disorder, not elsewhere classified	17	7.46	34	10.21
Drug dependence	1	0.44	2	0.6
Dysthymic disorder	6	2.63	15	4.5
Major depressive disorder	33	14.47	57	17.12
Nondependent abuse of drugs	5	2.19	11	3.3
Organic psychotic conditions	5	2.19	11	3.3
Other anxiety, dissociative and somatoform disorders	6	2.63	5	1.5
Other neurotic, personality, or nonpsychotic mental disorders	7	3.07	7	2.1
Other psychoses	1	0.44	4	1.2
Other special symptoms or syndromes, not elsewhere classified	2	0.88	9	2.7
Personality disorder	1	0.44	4	1.2
Postconcussion syndrome	3	1.32	4	1.2
PTSD	18	7.89	19	5.71
Psychosexual dysfunction	7	3.07	6	1.8
Specific disorders of sleep of nonorganic origin	31	13.6	34	10.21

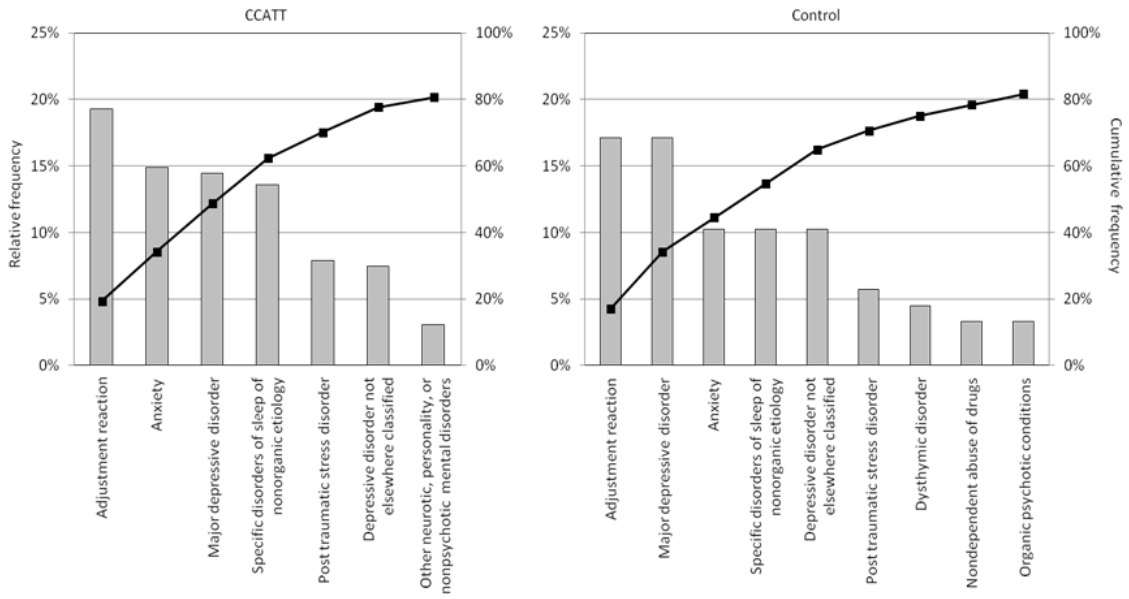

Figure 1. Comparison of the relative (left axis) and cumulative (right axis) frequency distributions of mental health diagnoses for CCATT (left graph) versus control (right graph) groups.

Risk for Incident Mental Health Condition

Figure 2 displays the Kaplan-Meier estimate of the survival function from return from first deployment to first diagnosis of a mental health condition, accounting for censoring of individual observations. The groups appear to have similar survival, and the logrank test was not significant (χ_1^2 = 3.344, p = 0.067). A Cox regression analysis was carried out on the data to compare the CCATT and control groups in terms of survival time from return from first deployment to first diagnosis of a mental health condition while accounting for potential covariates. An exposure indicator variable (i.e., exposure group: CCATT vs. control) and variables corresponding to the demographic characteristics shown in Table 1 were included in the model, which was then fitted using forward stepwise regression. For those characteristics in which the exposure groups differed (component, gender, age, and total deployments), the corresponding variable and the exposure indicator variable were forced into the final fitted model. The results are displayed in Table 3. There was a marginal, but not significant, difference between the CCATT and control groups in risk for incident mental health conditions; thus, Hypothesis 1 was rejected. The regression coefficient for age was not significant, but females were at marginally increased risk for incident mental health conditions. These results partially supported Hypothesis 2A. Neither of the variables corresponding to marital status or number of dependents was retained in the final model, meaning that Hypothesis 2B was rejected. Both nurses and technicians were at approximately twice the risk of physicians for incident mental health conditions. However, the regression coefficients for service component and number of deployments were not significant. Overall, there was only partial support for Hypothesis 2C.

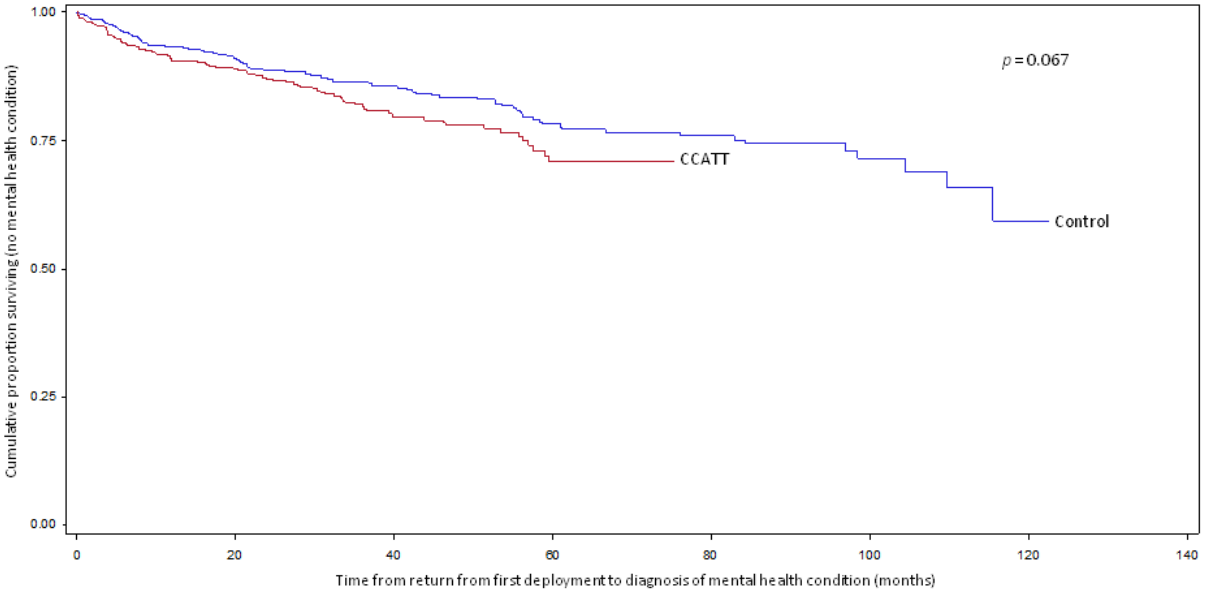

Figure 2. Kaplan-Meier estimate of the survival function.

Table 3. Cox regression model for the hazard of incident mental health condition.

Variable	Regression Coefficient (b)	Standard Error SE(b)	exp^b Hazard Ratio†	95% CI for Hazard Ratio		*p*-value*
				Lower	Upper	
Exposure Group (0 = control, 1 = CCATT)	0.294	0.153	1.342	0.994	1.813	0.055
Career Field						
Career (Nurse) (0 = Physician, 1= Nurse)	0.625	0.204	1.869	1.252	2.791	0.002
Career (Technician) (0 = Physician, 1= Technician)	0.734	0.222	2.083	1.348	3.219	<0.001
Service Component						
Component (G) (0 = Active duty, 1= Guard)	-0.280	0.267	0.756	0.448	1.275	0.294
Component (R) (0 = Active duty, 1= Reserves)	-0.208	0.268	0.812	0.48	1.374	0.439
Gender (0 = Male, 1= Female)	0.340	0.157	1.404	1.032	1.911	0.031
Age	-0.001	0.011	0.999	0.704	1.268	0.926
Deployments (0 = One, 1= Two or more)	-0.057	0.150	0.944	0.978	1.021	0.704

†Risk of incident mental health condition.
*Pearson χ^2 test.
G: Guard; R: Reserves.

Given concerns for a potential detection bias between active duty versus Guard and Reserve members (the latter tending to have less extensive medical data available), the analysis was repeated using only active duty personnel. The resulting model was very similar to that shown in Table 3.

Time to Diagnosis of Mental Health Condition

This analysis was a nested cross-sectional study of those medical service members who were diagnosed with an incident mental health condition. The characteristics of the 91 members of the CCATT cohort and the 95 controls with incident mental health conditions are summarized in Table 4. The CCATT and control groups were comparable in terms of baseline characteristics.

Table 4. Demographic characteristics of subgroup of CCATT cohort and control group with incident mental health condition.

Characteristic	CCATT (*n*=91)	Control (*n*=95)	*p*-value*
Career Field			
Physician	23 (25.27)	16 (16.84)	
Nurse	40 (43.96)	45 (47.37)	0.360
Technician	28 (30.77)	34 (35.79)	
Service Component			
Active Duty	71 (78.02)	82 (86.32)	
Air National Guard	7 (7.69)	9 (9.47)	0.057
Air Force Reserve	13 (14.29)	4 (4.21)	
Gender			
Male	51 (56.04)	49 (51.58)	0.542
Female	40 (43.96)	46 (48.42)	
Age (years)			
18-29	31 (34.07)	41 (43.16)	
30-39	45 (49.45)	38 (40.00)	0.382
40-60	15 (16.48)	16 (16.84)	
Marital Status			
Married	55 (60.44)	52 (54.74)	
Single	28 (30.77)	35 (36.84)	0.678
Divorced	8 (8.79)	8 (8.42)	
Total Dependents			
0	38 (41.76)	46 (48.42)	
1	16 (17.58)	17 (17.89)	
2	15 (16.48)	11 (11.58)	0.846
3	14 (15.38)	14 (14.74)	
4 or more	8 (8.79)	7 (7.37)	
Total Deployments			
1	57 (62.64)	48 (50.53)	0.096
2 or more	34 (37.36)	47 (49.47)	

*Pearson χ^2 test.

Figure 3 displays the boxplots of the time interval from the end of the most recent deployment preceding the diagnosis of an incident mental health condition to the assignment of the diagnosis. A linear regression analysis was carried out on the data, examining potential predictors of time to incident mental health diagnosis. An exposure indicator variable (i.e., exposure group: CCATT vs. control) and variables corresponding to the demographic characteristics shown in Table 4 were included in the model, which was then fitted using forward stepwise regression. The final fitted regression model was significant ($F_{2,183} = 6.43$, $p = 0.002$), although it only explained 7% of the variance in the response variable. As shown in Table 5, just two explanatory variables were retained in the final model: exposure group and number of deployments. Accordingly, we rejected Hypotheses 4A and 4B; Hypothesis 4C, that

occupational differences modulate the response variable, was supported with the exception that there was no effect of service component. Being a deployed CCATT member or being deployed two or more times was each individually associated with an 8-month (95% confidence interval [CI] 2-15) decrease in the time interval to first diagnosis of an incident mental health condition.

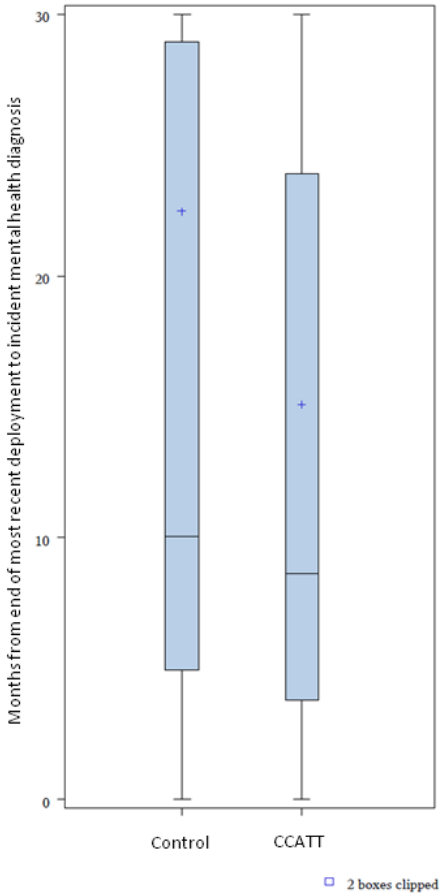

Figure 3. Boxplots of time interval from end of most recent deployment to first diagnosis of incident mental health condition. The length of the box represents the interquartile range (the distance between the 25th and 75th percentiles). The symbol in the box interior represents the group mean. The horizontal line in the box interior represents the group median. The vertical lines (called whiskers) issuing from the box extend to the group minimum and maximum values.

Table 5. Linear regression model for time interval from end of most recent deployment to first diagnosis of incident mental health condition.

Variable	Regression Coefficient (b)	Standard Error SE(b)	*t*-value	95% CI for b		*p*-value
				Lower	Upper	
Intercept	35.119	5.187	6.77	24.885	45.354	<0.001
Exposure Group (0 = control, 1 = CCATT)	-8.409	3.126	-2.69	-14.577	-2.240	0.008
Deployments (0 = One, 1= Two or more)	-8.458	3.152	-2.68	-14.678	-2.239	0.008

Likelihood of Diagnosis in the Post-Deployment Medical Surveillance Period

This analysis was another nested cross-sectional study of those medical service members who were diagnosed with an incident mental health condition. A logistic regression analysis was carried out on the data, examining potential predictors of whether the initial mental health diagnosis occurred during the 6-month post-deployment medical surveillance period. For each individual, a binary response variable was created to indicate whether the time interval from the end of the most recent deployment to the first diagnosis of an incident mental health condition was 6 months or less. As before, an exposure indicator variable (i.e., exposure group: CCATT vs. control) and variables corresponding to the demographic characteristics shown in Table IV were included in the model, which was then fitted using forward stepwise regression. No variables were included in the final fitted regression model, indicating that none of the potential explanatory variables were associated with the response variable. Accordingly, we rejected Hypothesis 5 and concluded that there was no increased likelihood for an incident mental health condition to be diagnosed during the 6-month post-deployment medical surveillance period. Overall, 54 (36%) of medical service members who were diagnosed with an incident mental health condition had that diagnosis occur during the standard post-deployment medical surveillance period.

5. DISCUSSION

This study is the first analysis of incident mental health conditions in veteran CCATT personnel returning from operations in Iraq and Afghanistan. Unlike the vast majority of studies that have addressed this issue in combat veteran populations using self-administered questionnaires, this study used actual diagnoses as derived from electronic health record systems. The latter methodology allowed the study to include all CCATT members who could be identified from the existing record systems (i.e., *N* = all).

It was predicted that CCATT members would have a higher incidence of post-deployment incident mental health conditions as compared to matched non-CCATT veteran military health professionals. Data analysis indicated a marginal, but not significant, difference between the CCATT and control groups in risk for incident mental health conditions. The

incidence of post-deployment mental health conditions was 2.1 per 1,000 months for the CCATT group versus 2.2 per 1,000 months for the control group. In terms of the individual diagnoses, the six most frequent diagnoses were the same in both groups: adjustment reaction not including PTSD, anxiety, major depressive disorder, specific disorders of sleep of nonorganic origin, PTSD, and depressive disorder not elsewhere classified. In aggregate, these results suggested that there was no additional relative risk for psychological effects that could be attributed to the CCATT work environment per se versus exposure to the deployed healthcare environment. The inference, then, is that deployed non-CCATT military health professionals have a similar exposure to trauma as do CCATT members.

Importantly, this study does not allow a determination of the relative risk of both cohorts, comprising occupations associated with the emergency room and critical care environments, versus military health professionals in general. However, Kerasiotis and Motta (11), who investigated the psychological health of nurses across levels of nursing care (i.e., emergency room, ICU, and general floor) within a Level 1 trauma center, found that all nurses experienced a significant level of anxiety, suggesting that there is not a significant effect of level of care. Overall, the pooled prevalence of post-deployment mental health conditions was 15% for the study sample. Hoge and colleagues (10) estimated that between 12% and 20% of recent combat veterans have probable PTSD and between 7% and 15% have probable depression. In a much smaller sample of healthcare professionals within one military hospital, Kolkow and colleagues (12) estimated the prevalence of PTSD at 9% and depression at 5% among those who had previously deployed to a combat setting. Thus, it can be concluded that the members of the study sample do not appear to have an excessive burden of mental health conditions relative to the larger population of military personnel serving in combat-specific occupations, but they may have a higher burden relative to other populations of military healthcare professionals.

It was expected that individual (age and gender), social (marital status and number of dependents), and occupational (career field, service component, and number of deployments) differences would modulate the risk for incident mental health conditions. The survival analysis indicated significant effects for gender and career field. There were no significant effects for age, marital status, number of dependents, service component, or number of deployments. Specifically, females were at marginally increased risk for incident mental health conditions, and both nurses and technicians were at approximately twice the risk of physicians for incident mental health conditions. While the present study cannot provide further insight into the etiology of these observed differences, a future nested case control study utilizing cohort members' post-deployment health assessment (PDHA) questionnaire data archived in the Defense Medical Surveillance System would allow exploration of differences in the risk of having a risk factor for an incident mental health condition.

There are several studies of healthcare professionals with combat-related exposures in both civilian and military settings, primarily in terms of PTSD, that provide some comparative context for interpreting the above findings. Ben-Ezra, Palgi, and Essar (1) conducted a cross-sectional study of war stress and post-traumatic symptoms among 80 nurses and physicians in a general hospital targeted by missiles during the war between Lebanon and Israel in 2006. They found that almost one-quarter (23.4%) of the hospital staff sampled had symptoms of post-traumatic stress rising to the level of clinical concern. There was an observed effect of

profession, with nurses having five times greater risk as compared to physicians for clinically significant symptoms of post-traumatic stress. No other demographic variables (age, gender, or marital status) were associated with an increased risk for high levels of PTSD symptoms.

Kolkow and colleagues (12) conducted a cross-sectional survey of medical staff at a single U.S. Navy hospital to identify risk factors for PTSD, depression, and mental health care utilization among medical personnel who had deployed to a combat zone. They observed that the prevalence of both PTSD and depression was lower among their cohort of medical personnel as compared to returning combat soldiers. Of the demographic factors examined (i.e., age, race, gender, and education level), only non-Caucasian race was associated with an increased risk of PTSD and depression. Combat traumatic experiences (i.e., reported direct personal threat or perceived sense of personal danger), but not medical traumatic experiences (i.e., exposure to seriously wounded or dead soldiers and civilians), were associated with an increased risk for PTSD.

Ben-Ezra and colleagues (2) conducted a repeated measures cross-sectional study that included a survey of two random samples of hospital personnel (physicians and nurses), one collected during the 2009 Gaza War and the other 6 months later; each sample included hospital personnel who were exposed to war-related stress and others who were not exposed. They observed that post-traumatic and depressive symptoms were significantly higher for exposed hospital personnel versus unexposed personnel both during the Gaza War and 6 months later. There were also observed effects for age and gender, with older hospital personnel reporting lower subjective health and well-being and women reporting a higher level of post-traumatic symptoms as compared to men.

Gibbons and colleagues (7) conducted a secondary analysis of data from the 2005 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel to explore the impact of operational stress on active duty healthcare providers who served at least one tour of duty in the armed conflicts in Iraq or Afghanistan. They compared male versus female and officer versus enlisted healthcare personnel in terms of measures of self-reported psychological distress (i.e., post-traumatic stress, depression, anxiety, alcohol misuse, and serious psychological distress) and social relations problems (i.e., before and after deployment, divorce, and separation). Female enlisted healthcare personnel reported significantly more psychological distress than their male colleagues, although female officers also manifested significant stress reactions. Overall, there was a suggestion of post-deployment difficulties in women, as a significant number endorsed possible depression, anxiety, and harmful drinking to a greater extent than did males in the study sample.

In summation, this study's finding that female healthcare professionals were at increased risk for mental health conditions was consistent with the results of Ben-Ezra and colleagues (2) and Gibbons and colleagues (7). However, this finding was in contrast to the report of no gender effect as shown by Ben-Ezra and colleagues (1) and Kolkow and colleagues (12). For further comparison, a meta-analysis of risk factors for PTSD in trauma-exposed adults found that women were more at risk for developing PTSD, although the effect size was small (5), which was consistent with the findings of the present study. In addition, this study's finding that nurses were at increased risk for mental health conditions was consistent with the results of Ben-Ezra

and colleagues (2), although their observed relative risk was approximately twice that of the present study. Similarly, the increased risk for mental health conditions in enlisted technicians was consistent with that observed by Gibbons and colleagues (7). Lastly, the lack of an observed effect of service component and number of deployments was consistent with findings from a cohort study in the United Kingdom armed forces (14,19), with the study by Jones and colleagues (14) specifically examining medical services personnel.

This study also explored the time interval from end of most recent deployment to first diagnosis of incident mental health condition, which is valuable data for individuals structuring post-deployment medical surveillance programs. It is noteworthy that the optimal timing for when PDHAs should be conducted has not been specifically studied. Within the U.S. military services, the PDHA is completed either in the deployed location immediately before reintegration or within the first 2 weeks of reintegration (4). In addition, a second screening, called the post-deployment health reassessment, is completed 3-6 months after return from deployment (16). Data analysis from the present study revealed that the distribution of the time interval from end of the most recent deployment to first diagnosis of incident mental health condition was positively skewed, with the median greater than 6 months. This observation—that there is a potentially lengthy delay from the end of the last deployment until initiation of outpatient mental health care—is consistent with the study by Maguen and colleagues (15), which found a median lag of 2.1 years in a cohort of veterans enrolled in Veterans Affairs health care.

In our study sample, only one-third of medical service members who were diagnosed with an incident mental health condition had that diagnosis occur during the standard post-deployment medical surveillance period. The data analysis also revealed that CCATT members and study participants with two or more deployments who developed an incident mental health condition tended to present earlier. However, no predictor variables were found that could help identify individuals who were diagnosed outside the standard post-deployment medical surveillance period. Overall, these results suggest the need to significantly increase the duration of the post-deployment medical surveillance period, which affirms the recent U.S. Department of Defense policy instituting a mental health assessment as part of the annual periodic health assessment at 1 and 2 years post-deployment (18).

Study Limitations

Both a strength and weakness of this study was the ascertainment of the clinical end point of psychological effect using diagnosis data extracted from electronic health records (EHRs). The data in the EHRs yielded validated psychiatric diagnoses that were not constrained to those diagnoses for which ready survey instruments exist. Additionally, EHR data provided the opportunity to detect cases outside the standard post-deployment medical surveillance period and allowed assessment of time from exposure to diagnosis as a continuous variable, thereby yielding distributional data. However, it is well known that validated diagnoses represent only visible cases—that is, the iceberg phenomenon, where the number of people with diagnosed disease is a smaller subset of the total number of people with the disease (13). Accordingly, incidence estimates in this study likely underestimate the true incidence of post-deployment mental health conditions. Nonetheless, the estimates of relative risk should serve as a fairly unbiased indicator

of difference in mental health disease burden between the groups unless there were significant intergroup variations in care seeking behavior.

Suggestions for Future Research

Little is known about the incidence of post-deployment mental health conditions for other medical services specialties outside those included in the present study. Future research should expand the scope of career specialties considered and ascertain the relative contribution of specialty-unique exposures versus exposure to the deployed healthcare environment in general. In addition, future studies should more directly ascertain the nature of wartime exposures (patient contact versus personal threat of injury or death) to assess the relative contribution of different exposures to the development of post-deployment mental health conditions. To that end, Kolkow and colleagues (12) and Jones and colleagues (14) provide contradictory findings on this question, although they studied distinctly different populations (i.e., U.S. versus United Kingdom military medical personnel, respectively). Lastly, PDHA and post-deployment health reassessment data should be correlated with EHR data to explore the utility of current assessment instruments in predicting objective outcomes over a longer period of interest—that is, 0-30 months post-deployment.

Summary

The present study has demonstrated that CCATT members are at no increased relative risk for incident post-deployment mental health conditions as compared to non-CCATT medical service members in the same career specialties. Females were at marginally increased risk for incident mental health conditions, and nurses and technicians were at twice the risk of physicians for incident mental health conditions. Nearly two-thirds of incident post-deployment mental health conditions were diagnosed outside the standard post-deployment medical surveillance period, a finding of concern that warrants further study.

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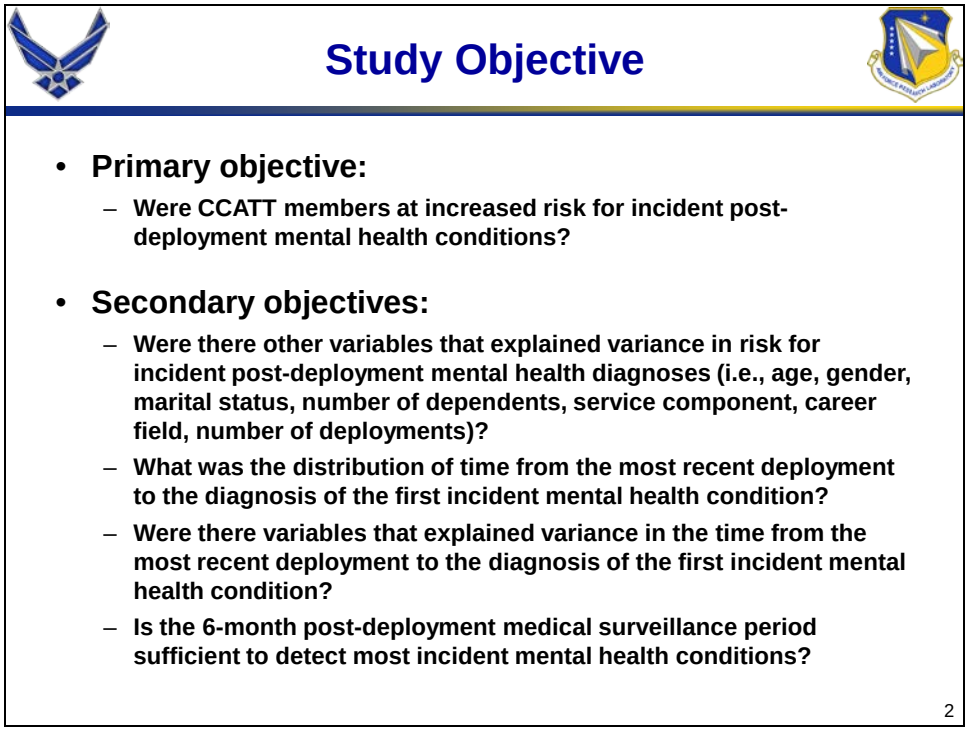
APPENDIX 1: CCATT Mental Health Cohort Study



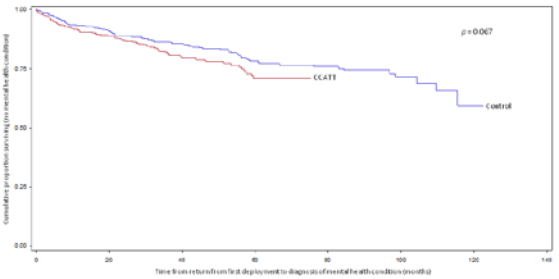
Methods

- **Study design**
  - Retrospective cohort (2003-2012)
  - Exposure = Performance of deployed CCATT duties
  - Outcome = Diagnosis of mental health condition in EHR
- **Study groups**
  - CCATT: AF medical personnel without preexisting mental health conditions with ≥ 1 deployments as a CCATT member (*n* = 604)
  - Control: AF medical personnel, frequency matched based on job role, with ≥ 1 deployments during the same period, but without CCATT experience (*n* = 604)
- **Statistical analysis**
  - Time-dependent proportional hazard Cox's models
  - Linear & logistic regression models

3

Risk for Incident Mental Health Condition

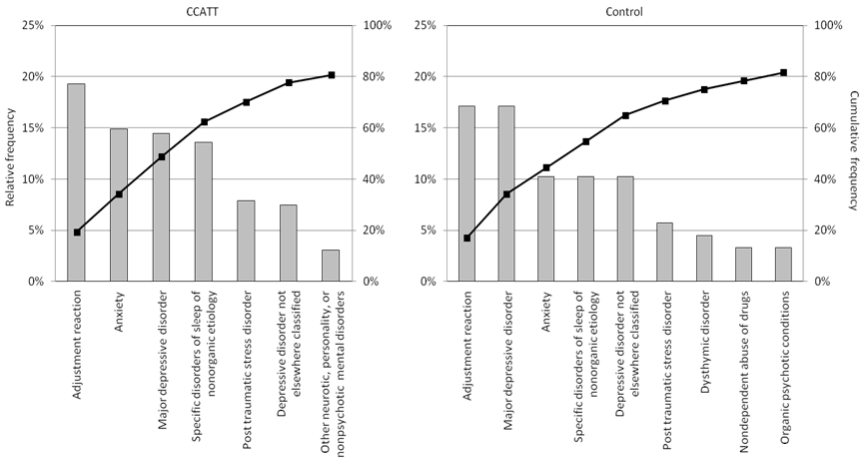
- **Actuarial rate of mental health conditions:**
  - CCATT: *n* = 91, 2.1 per 1,000 months
  - Control: *n* = 95, 2.2 per 1,000 months



- **Survival analysis:**
  - Marginal, but not significant, difference between the CCATT and control groups (*p* = 0.06)
  - Females at increased risk (HR = 1.40, 95% CI = 1.03 to 1.91, *p* = 0.03)
  - Nurses & technicians at increased risk relative to physicians (Nurse: HR = 1.87, 95% CI = 1.25 to 2.79, *p* < 0.01) (Technician: HR = 2.08, 95% CI = 1.35 to 3.22, *p* < 0.01)

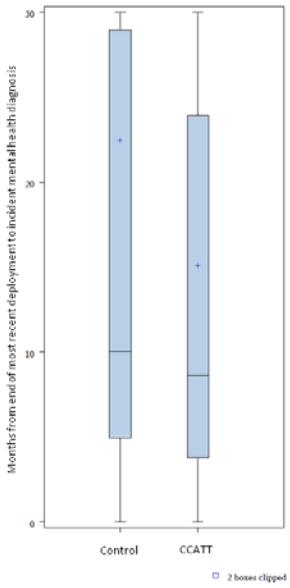
4

Frequency Distribution of Mental Health Diagnoses



5

Timing of Diagnosis of Mental Health Condition



- **Predictors of time to diagnosis (linear regression model):**
  - **CCATT with lower latency (t = -8 months, 95% CI = -15 to -2, p < 0.01)**
  - **Deployed ≥ 2 times with lower latency (t = -8 months, 95% CI = -15 to -2, *p* < 0.01)**
- **Likelihood of diagnosis in the 6-month post-deployment medical surveillance period:**
  - **36% diagnosed during surveillance period**
  - **No predictors for diagnosis during surveillance period (logistic regression model)**

6

Discussion

- There was no significant difference between the CCATT and control groups in risk for incident mental health conditions
- There was a differential impact of gender and occupation in risk for incident mental health conditions
- Compared to the literature, the study sample had a similar burden of mental health conditions relative to the larger population of military personnel serving in combat-specific occupations, but they had a higher burden relative to other populations of military healthcare professionals
- Future nested case control study using archived PDHA questionnaires will assess risk for exposures in cases (+ mental health diagnosis) versus controls (ø mental health diagnosis)

7

Questions

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APPENDIX 2: ACRONYMS

AFPC	Air Force Personnel Center
AFSC	Air Force Specialty Code
CCATT	Critical Care Air Transport Team
DOB	Date of birth
EHR	Electronic Health Record
ICU	Intensive care unit
M2	Military Health System Mart
PDHA	Post-deployment health assessment
PTSD	Post-traumatic stress disorder
SSN	Social Security Number