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Do shorter delays to care and mental health system renewal translate into better occupational outcome after mental disorder diagnosis in a cohort of Canadian military personnel who returned from an Afghanistan deployment?

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Keywords: military, mental health, attrition, delay to care

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ABSTRACT

Objective: Mental disorders in military personnel result in high rates of attrition. Military organizations have strengthened their mental health systems and attempted to overcome barriers to care in order to see better outcomes. This study investigated the roles of mental health services renewal and delay to care in Canadian Armed Forces (CAF) personnel diagnosed with mental disorders.

Design: Administrative data were used to identify a retrospective cohort of 30,513 CAF personnel who deployed in support of the mission in Afghanistan. Study subjects included 508 individuals with a mental disorder diagnosis identified from CAF medical records of a weighted, stratified random sample of 2014 individuals selected from the study cohort. Weighted Cox proportional hazards regression assessed the association of diagnosis era and delay to care with the outcome, after controlling for a broad range of potential confounders (e.g., disorder severity, comorbidity). Taylor series linearization methods and sample design weights were applied in generating descriptive and regression analysis statistics.

Primary Outcome: The outcome was release from military service for medical reasons, assessed using administrative data for the 508 individuals with a mental disorder diagnosis.

Results: 17.5% [95% CI: 16.0-19.0] of the cohort had a mental disorder diagnosis after an Afghanistan-related deployment, of which 21.3% [95% CI: 17.2-25.5] had a medical release over a median follow-up of 3.5 years. Medical release risk was elevated for individuals diagnosed before 30-Apr-2008 relative to those with more recent diagnoses (aHR, 1.77 [95% CI, 1.01-3.11]) and for individuals with a long delay to care (> 21 months after return) relative to those with intermediate delays (8 to 21 months, aHR, 2.47 [95% CI, 1.28-4.76]).

Conclusions: Mental health services renewal in the CAF was associated with a better occupational outcome for those diagnosed with mental disorders. Longer delays to care were associated with a less favorable outcome.

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Strengths and limitations of this study

- This study demonstrates that two modifiable factors, mental health system change and delay to care, have associations with medically-related attrition rates among personnel with a mental disorder in a previously deployed Canadian military cohort. After controlling for potential confounding variables, the accumulation of change in the Canadian military's mental health system was determined to be associated with lower rates of medically-related attrition. Long delays to care were associated with higher rates medically-related attrition.

- Disorder severity, diagnosis mix (specifically, PTSD co-morbid with a depressive disorder), being a non-commissioned service member, and being in certain occupational categories were also determined to be independently associated with medically-related attrition rates.

- Diagnosis era was a proxy for changes in the CAF mental health system. It was not possible to identify precise implementation time-points for the many concurrent mental health system changes, precluding identification of the drivers of the more favorable outcomes seen over time.

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INTRODUCTION

Since 2001, millions of military personnel have deployed to the conflicts in Southwest Asia; many have returned with mental health problems.[1, 2] In Canada, 13.5% of personnel who deployed in support of the mission in Afghanistan were diagnosed with a service-related mental disorder within four years after their return.[2] For those in high-threat locations, rates approached 30% after seven years.[2]

Mental health problems have a pronounced impact on military occupational fitness,[3-17] which in turn can lead to attrition when personnel fail to meet stringent military occupational fitness requirements. Attrition is the largest single mental health-related cost for employers[18] and it has particular salience for military organizations, given their extensive and specialized training requirements.

Many factors influence adverse military occupational outcomes such as attrition.[5-8, 10, 17, 19-24] In addition to mental health problems,[3-17] factors include age,[5-8, 10, 19-21, 24] gender,[5-7, 10, 17, 19-22] race/ethnicity,[6, 8, 19] rank,[5, 10, 17, 19, 20, 23, 24] component (Regular or Reserve Force),[19] years of service,[10, 17, 23, 24] marital status,[10, 22, 24] element (Army, Navy or Air Force),[5, 21] and education.[10]

Research on factors influencing outcome among those with mental disorders is sparse. Associations have been seen with diagnosis,[17, 23] illness severity,[23, 24] years of service,[17, 23, 24] combat occupation,[17, 24] rank,[17, 23, 24] gender,[17, 24] age,[24] marital status,[24] presence of comorbid conditions,[17] and treatment,[17] factors that are mostly non-modifiable.

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The Canadian Armed Forces (CAF) has reinforced its mental health system over the past 15 years.[25] The number of mental health providers has more than doubled. Seven multidisciplinary centers now provide standardized assessment and treatment of service-related mental health problems. Lower levels of stigma and other barriers to care have been seen in comparison to other military organizations,[26] perhaps as a result of de-stigmatization efforts.[27] Extensive resilience and mental health training is embedded throughout individuals' careers and across the deployment cycle, which includes in-depth post-deployment mental health screening.[28] The past decade has also seen policy changes that make it easier for personnel who recover from mental disorders to remain in uniform. Other nations have engaged in similar efforts. [29, 30]

Mental disorders have been shown to be associated with attrition,[13, 31] both before and after the current conflicts in Southwest Asia, but there are no formal assessments of changes in prognosis over time. In addition, while it is asserted that early care for PTSD and other mental disorders improves long-term prognosis, there is very little research supporting this assertion.[32]

This study investigates risk factors for medically-related attrition among personnel who deployed in support of the CAF mission in Afghanistan and were diagnosed with a mental disorder. We hypothesized that those who were diagnosed later in the course of the conflict and those who presented for care earlier would show more favourable outcomes.

METHODS

Study Population and Sampling:

The study cohort consists of all CAF personnel (N = 30,513) who initiated a deployment outside of North America and Europe in support of the Afghanistan mission from 01-October-2001 through 31-December-2008. Over the duration of the mission, 158 CAF personnel died on-duty. A weighted, stratified random sample of 2045 individuals was identified and medical records of 2014 were reviewed. The sampling strata were defined by deployment location and apparent mental health services use, strata relevant to the parent study's primary objective.[2]

The current study was limited to individuals whose mental disorder diagnosis was dated after the start date of their first Afghanistan-related deployment (n=508).

Data Collection:

As discussed elsewhere,[2] deployment details came from administrative databases. Mental disorder diagnoses, mental health history, and clinician-identified attributions to service were abstracted from medical records over the period of 22-June-2010 to 30-May-2011. Data on release from service, demographics, and military characteristics came from administrative databases (extract date: 15-December-2012). Data linkages were based on service number, a unique CAF-specific personal identifier.

Outcome Definition:

The primary outcome was release from military service for medical reasons (i.e., medically-related attrition). The broad categories for release, and their representation in

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the cohort, include: misconduct (0%); unsatisfactory service (0%); service completed (3.7%); medical (5.4%); and voluntary (19.9%). Medical releases result when individuals are determined to be unfit to perform the full range of their duties as a consequence of a health problem.[33]

Covariates of Interest:

The primary covariates of interest were: 1) diagnosis era, a proxy for evolutionary enhancements to the CAF mental health system and changes in medical fitness determination practices for individuals with mental disorders, and 2) delay to diagnosis and care, calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date. The most recent Afghanistan-related deployment return date, prior to a diagnosis, was the most relevant reference point for delay calculations; a majority of the cohort had a single deployment (80%) and it's very rare for an individual to deploy with a significant mental health problem. The median date (30-April-2008) categorized diagnosis dates into two eras. Delay to care was categorized into tertiles: ≤ 245 days (≤ 8 months), 246 to 636 days (8 to 21 months), and ≥ 637 days (> 21 months).

Potential Confounders:

Potential confounders identified in other studies[2-17, 19-24] included: sex; age; element (Army, Navy or Air Force); component (Regular or Reserve Force); rank category; military occupation; years of service; marital status; and presence of live-in dependents. Military occupation was categorized into 8 groups:[34] facility support (FS);

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health services (HS); information management (IM); intelligence, surveillance and reconnaissance (ISR); operations support (OPS Support); operations technicians (OPS Tech); specialist; and operations (OPS), which included combat arms occupations.

Diagnosis-related covariates included indication of previous mental disorder diagnoses and each DSM-IV-TR (DSM) axis, excluding Axis IV. Axis I diagnosis codes were categorized into 7 groups based on conceptual considerations and disorder patterns: 4 single diagnosis categories of PTSD, Depressive Disorder (i.e., Major Depression or Dysthymic Disorder), Adjustment Disorder or single 'Other' disorder, and 3 comorbid categories of both PTSD and Depressive Disorder only, all other comorbid combinations with PTSD and any other non-PTSD comorbid combination. Axis II information was dichotomized for presence of a personality disorder or trait, while Axis III information was categorized for presence of a relevant musculoskeletal condition, other condition or none. Functional status (reflected by Axis V, the Global Assessment of Functioning) was categorized into 4 groups: 0-50 (severe symptoms); 51-60 (moderate symptoms); 61-70 (mild symptoms); and 71-100 (transient symptoms).

Data Analysis:

The data were analyzed using SAS for Windows, version 9.3, and sampling weights accounted for the design effect. Taylor Series Linearization methods[35] were used to determine 95% confidence intervals (CI's) for descriptive statistics. Missing values were identified for marital status, the presence of live-in dependents, and DSM Axis V. The fully conditional specification multiple imputation method[36] was implemented when analyzing these covariates.

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Weighted Kaplan-Meier methods[37] generated event probabilities. Zero-time was defined as the diagnosis date. Event-time was the medical release date. Individuals were censored at the earlier of non-medical release date or database extraction date. 95% CI's for Kaplan-Meier estimates were generated using bootstrap methods.[38]

Weighted Cox regression assessed the association of medical release with covariates; results were expressed as hazard ratios (HR's) and their 95% CI's, generated using Taylor Series Linearization methods.[35] The 2 primary covariates of interest (i.e., diagnosis era and delay to care) were forced into a regression model that included potential confounders selected using a two-stage approach. Initially, weighted Cox regressions assessed the unadjusted relationship between each potential confounder and medical release; covariates with a Wald test p-value less than 0.15 were included in a multivariate model. In the second stage, backwards elimination removed potential confounders using a Wald test p-value threshold of 0.05. Delay to care was handled as an interaction term (delay by whether the diagnosis was Afghanistan deployment-related). This approach optimized the use of available data; Afghanistan deployment-related diagnoses use Afghanistan-related deployment return date as a relevant proxy for symptom-onset timing in delay calculations while other diagnoses use Afghanistan-related deployment return date as an imprecise proxy of this timing. Delay to care hazard ratios were only assessed among those with Afghanistan deployment-related diagnoses. Regression diagnostic plots were reviewed with respect to the proportional hazards assumption.[37]

Ethics: The research protocol was approved by Veritas Research Ethics Board (Dorval, QC).

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RESULTS

Study Cohort Characteristics:

Medical records were reviewed for 2014 individuals and inaccessible for an additional 31. Of the 2014 individuals, 508 who had a mental disorder diagnosis after the start of their first Afghanistan-related deployment comprised the study sample, representing 5337 individuals in the cohort (17.5%, 95% CI: 16.0-19.0).

The study subset consisted largely of men in the Regular Forces of the Army (Table 1). At the time of their diagnosis, a majority of individuals were younger than 40, married, had no live-in dependents, and had less than 20 years of military service. Although 46.0% of the study subset were in the "Operations" occupation category, 79.6% of these were combat arms occupations. Table 1 summarizes the distribution and bivariate associations of these characteristics with medically-related attrition.

Table 1: Demographic and Military Characteristics of the Study Subset (weighted N = 5,337; sample n = 508) and their Unadjusted Association with Medically-related Attrition.

Characteristic	Un-weighted Sample No.	Weighted %	Medical Release %	Medical Release 95% CI	Unadjusted HR	95% CI
Occupation Categorization[e]						
FS	12	2.7	54.8	24.4, 85.3	5.36[a]	2.21, 12.98
HS	28	4.8	12.6	0.9, 24.3	0.76	0.26, 2.26
IM	31	4.8	18.2	5.0, 31.5	0.79	0.32, 2.00
ISR	22	3.5	21.3	4.2, 38.5	1.29	0.57, 2.92
OPS Support	96	15.4	29.9	19.0, 40.8	1.75[c]	0.98, 3.12
OPS Tech	58	16.0	21.2	9.3, 33.1	0.81	0.36, 1.80
Specialist	34	6.8	15.7	2.7, 28.6	0.86	0.34, 2.18
OPS	227	46.0	18.6	12.7, 24.5	reference	reference
Occupation Categorization (Aggregated)[e]						
FS	12	2.7	54.8	24.4, 85.3	5.75[a]	2.46, 13.46
OPS Support	96	15.4	29.9	19.0, 40.8	1.88[b]	1.11, 3.20
Other	400	81.9	18.6	14.2, 23.0	reference	reference
Component						
Reserve Forces	23	6.7	12.7	0, 28.7	0.68	0.16, 2.81
Regular Forces	485	93.3	21.9	17.6, 26.2	reference	reference
Element[e]						
Air Force	66	12.9	26.9	13.9, 39.9	2.21[c]	0.94, 5.22
Navy	65	21.0	17.4	7.3, 27.5	reference	reference
Army	377	66.1	21.5	16.8, 26.2	1.84[c]	0.95, 3.57
Rank[e]						
Officer	48	10.4	4.9	0, 9.8	reference	reference
SNCM	130	24.8	25.4	16.3, 34.5	6.10[a]	1.92, 19.33
JNCM	330	64.7	22.4	17.2, 27.6	4.63[a]	1.51, 14.17
Sex						
Female	62	9.8	25.2	14.5, 36.0	1.25	0.74, 2.11
Male	446	90.2	20.9	16.4, 25.4	reference	reference
Age[e]						
≤ 29	140	27.9	11.2	5.5, 16.8	reference	reference
30 – 39	234	44.5	24.7	18.3, 31.1	1.85[c]	0.98, 3.47
≥ 40	134	27.6	26.1	17.4, 34.8	2.38[b]	1.20, 4.72
Years of Service[e]						
≤ 9	214	43.1	16.3	10.7, 22.0	reference	reference
10 – 19	194	35.5	24.6	17.5, 31.6	1.42	0.86, 2.35
≥ 20	100	21.4	26.0	16.0, 35.9	1.84[b]	1.01, 3.37
Marital Status (MI)[f]						
Married	350	68.7	23.1	17.8, 28.3	reference	reference
Single – never married	100	20.0	14.5	7.5, 21.4	0.58[c]	0.32, 1.06
Divorced/ Widowed/ Separated	49	9.7	17.5	5.9, 29.1	0.70	0.33, 1.49
Unspecified	9	1.6	55.3	18.7, 92.0		
Live-in Dependents (MI)[e,f]						
Yes	232	42.8	27.3	20.4, 34.2	1.61[b]	1.03, 2.53
No	246	50.8	16.5	11.4, 21.6	reference	reference
Unspecified	30	6.4	19.5	3.5, 35.5		

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Abbreviations: FS, Facility Support; HS, Health Services; IM, Information Management; ISR, Intelligence, Surveillance and Reconnaissance; OPS Support, Operations Support; OPS Tech, Operations Technicians; OPS, Specialist; and Operations; MI, Multiple imputation used; JNCM, Junior Non-commissioned Member; SNCM, Senior Non-commissioned Member.
[a] p-value ≤ 0.01
[b] p-value ≤ 0.05
[c] p-value ≤ 0.1
[d] p-value ≤ 0.15
Otherwise, p-value >0.15
[e] The Wald test p-value was less than 0.15 for variables: Occupation Categorization, Element, Rank, Age, Years of Service and Live-in Dependents (MI).
[f] Multiple imputation was used to compute the unadjusted HR for variables: Marital Status (MI) and Live-in Dependents (MI).

Mental Disorder Diagnoses:

Table 2 summarizes the distribution of clinical characteristics and their unadjusted association with medically-related attrition. A majority of diagnoses (82.0%; 95% CI: 78.3-85.7) were service-related; 77.0% were attributed to Afghanistan-related deployments and 5.0% were attributed to other deployments. PTSD was the most diagnosed condition (49.1%; 95% CI: 44.2-53.9), followed by Depressive Disorder (i.e., Major Depression or Dysthymic Disorder) (44.7%; 95% CI: 39.5-49.8). PTSD was often a comorbid diagnosis: It occurred alone in 15.7% (95% CI: 12.1-19.4); with Depressive Disorder only in 14.3% (95% CI: 10.9-17.7); and with any other disorder(s) in 19.1% (95% CI: 15.6-22.5).

The median diagnosis date was 30-April-2008 (range: 19-November-2001 to 24-January-2011). The mean delay to care among individuals with an Afghanistan-related mental disorder diagnosis was 551 days (95% CI: 500-602 days; median: 400 days).

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Table 2: Clinical Characteristics among Individuals of the Study Subset (weighted N = 5,337; sample n = 508) and their Unadjusted Association with Medically-related Attrition.

Clinical Characteristic	Un-weighted Sample No.	Weighted %	Medical Release %	Medical Release 95% CI	Unadjusted HR	(95% CI)
Diagnosis Timing[f] (Median Split)						
Apr 30, 2008 or Later	273	50.2	12.1	7.6, 16.6	reference	reference
Before Apr 30, 2008	235	49.8	30.6	23.9, 37.4	1.45[e]	0.87, 2.42
Delay to Care[a,f] (Tertile Split)						
Short: ≤ 245 days	138	33.0	27.3	19.4, 35.2	1.69[d]	0.93, 3.08
Medium: 246 to 636 days	144	33.9	14.7	8.4, 20.9	reference	reference
Long: ≥ 637 days	133	33.1	23.1	14.1, 32.1	2.24[c]	1.17, 4.30
Mental Disorder Diagnosis History						
Yes	142	28.4	23.0	15.1, 30.8	0.84	0.52, 1.37
None Indicated	366	71.6	20.7	15.8, 25.6	reference	reference
Mental Disorder Diagnoses						
Any PTSD	272	49.1	28.9	22.8, 35.0	2.22[b]	1.36, 3.63
No PTSD	236	50.9	14.0	8.6, 19.4	reference	reference
Any Non-PTSD Anxiety	128	26.8	14.7	7.9, 21.6	0.54[c]	0.31, 0.95
No Non-PTSD Anxiety	380	73.2	23.7	18.7, 28.8	reference	reference
Any Adjustment Disorder	128	23.6	17.3	9.4, 25.3	0.73	0.41, 1.31
No Adjustment Disorder	380	76.4	22.5	17.7, 27.4	reference	reference
Any Depressive Disorder	228	44.7	25.6	19.0, 32.2	1.58[c]	1.00, 2.48
No Depressive Disorder	280	55.3	17.9	12.5, 23.2	reference	reference
Any Bipolar Disorder	6	1.7	35.7	0, 79.0	1.34	0.51, 3.54
No Bipolar Disorder	502	98.3	21.1	16.9, 25.2	reference	reference
Any Other Mood Disorder	7	1.7	9.8	0, 28.7	0.25	0.03, 2.30
No Other Mood Disorder	501	98.3	21.5	17.3, 25.7	reference	reference
Any Somatoform Disorder	6	1.5	79.9	44.5, 100	4.52[c]	1.16, 17.64
No Somatoform Disorder	502	98.5	20.4	16.3, 24.6	reference	reference
Any Substance Abuse Disorder	83	16.1	19.3	9.7, 28.9	0.93	0.52, 1.66
No Substance Abuse Disorder	425	83.9	21.7	17.1, 26.3	reference	reference
Mental Disorder Diagnosis Case-mix[f]						
PTSD Only	79	15.7	25.5	13.8, 37.2	1.50	0.58, 3.88
Depressive Disorder Only	58	13.4	20.4	7.1, 33.7	1.46	0.51, 4.20
Other Single Diagnosis Only	47	10.8	4.0	0.0, 8.4	0.21[c]	0.05, 0.87
Adjustment Disorder Only	59	10.7	18.2	5.6, 30.7	reference	reference
PTSD and Depressive Disorder	80	14.3	33.8	22.5, 45.2	2.38[d]	0.97, 5.82
PTSD and Other	113	19.1	28.0	18.7, 37.3	1.82	0.75, 4.41
Any Other Combination (excl. PTSD)	72	15.9	12.7	3.7, 21.7	0.74	0.25, 2.22
DSM IV – AXIS II Personality Disorder/Trait						
Yes	70	14.3	20.7	9.1, 32.3	0.97	0.50, 1.89

None Indicated	438	85.7	21.4	17.0, 25.9	reference	reference
DSM IV – AXIS III General Medical Conditions Present[f]						
Musculoskeletal	126	24.6	31.2	21.7, 40.6	1.92[c]	1.15, 3.21
Other	117	22.5	22.8	13.5, 32.0	1.42	0.80, 2.53
None Indicated	265	52.9	16.1	11.1, 21.1	reference	reference
DSM IV – AXIS V Global Assessment of Functioning (MI)[f,g]						
0-50: Severe Symptoms	46	7.5	42.5	27.6, 57.4	9.32[b]	2.89, 30.09
51-60: Moderate Symptoms	152	27.8	19.7	13.1, 26.4	2.98[d]	0.89, 9.95
61-70: Mild Symptoms	163	33.7	25.3	17.0, 33.6	3.76[c]	1.23, 11.49
71-100: Transient Symptoms	55	11.7	7.1	1.8, 12.3	reference	reference
Unspecified	92	19.3	17.0	7.6, 26.5		

Abbreviations: MI, Multiple Imputation used;
[a] Delay to care is calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date, for diagnoses attributed to an Afghanistan deployment (n=415).
[b] p-value ≤ 0.01
[c] p-value ≤ 0.05
[d] p-value ≤ 0.1
[e] p-value ≤ 0.15
Otherwise, p-value >0.15
[f] The Wald test p-value was less than 0.15 for variables: Diagnosis Timing, Delay to Care, Mental Disorder Diagnosis Case-mix (including any PTSD, any non-PTSD Anxiety Disorder, any Depressive Disorder and any Somatoform Disorder), DSM IV - AXIS III General Medical Conditions Present and DSM IV - AXIS V Global Assessment of Functioning (MI).
[g] Multiple imputation was used to compute the unadjusted HR for variable: DSM IV – AXIS V Global Assessment of Functioning (MI).

Medically-Related Attrition:

As of 15-December-2012, 35.5% (95% CI: 30.8-40.3) had released from service, 21.3% (95% CI: 17.2-25.5) were medical releases and 14.2% (95% CI: 10.7-17.8) were for other reasons (i.e., 12.7% voluntary releases; 1.5% service completion releases). Mean follow-up time from diagnosis to the earlier of release or censor date was 1456 days (95% CI: 1373-1538 days); the median was 1267 days (3.5 years). Individuals who medically released had a mean of 15.5 years of service (95% CI: 13.7-17.3) at the time of release while those without a medical release had 13.0 years (95% CI: 12.2-13.8) at censor date.

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At 5 years of follow-up, an estimated 25.8% (95% CI: 20.2-31.4) medically released compared with 13.7% (95% CI: 10.1-17.3) releasing for other reasons. There was separation in the Kaplan-Meier curves for medical release by diagnosis era (Figure 1). Follow-up time was limited for more recent diagnoses; the maximum was 4.6 years. At 4.5 years of follow-up, an estimated 26.8% (95% CI: 20.2-33.3) of those diagnosed before 30-April-2008 (median) had medically released compared with 19.7% (95% CI: 12.1-27.2) thereafter. However, the unadjusted hazard ratio comparing diagnosis eras was not statistically significant (HR, 1.45 [95% CI, 0.87-2.42]) (Table 2).

At 5 years of follow-up, an estimated 29.1% (95% CI: 22.5-35.8) of individuals whose mental disorder diagnosis was Afghanistan deployment-related had medically released. Figure 2 displays the Kaplan-Meier curves for medical release as a function of delay to care among individuals with an Afghanistan deployment-related diagnosis. Separation in the curves was again noted: At 5 years of follow-up, an estimated 28.3% (95% CI: 18.7-37.8) of those with a short delay to care (≤ 245 days) medically released compared to 19.5% (95% CI: 10.6-28.5) with a medium delay (246 to 636 days) and 46.4% (95% CI: 27.4-65.4) with a long delay (≥ 637 days). While medical release risk was elevated for individuals having either short or long delays to care, relative to those with medium delays, the unadjusted hazard ratio was not statistically significant for short delays (HR, 1.69 [95% CI, 0.93-3.08]) but it was for long delays (HR, 2.24 [95% CI, 1.17-4.30]) (Table 2).

Cox Proportional Hazards Regression:

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The mental disorder history, DSM Axis II, component, sex, and marital status potential confounders were discarded during assessment of their unadjusted relationship with medical release; DSM Axis III, element, age category, years of service, and live-in dependents were discarded during the backwards elimination regression. The final model that assessed the primary covariates controlled for diagnosis case-mix, military occupation, DSM Axis V (functional impairment), and rank category.

The adjusted model (Table 3) showed that individuals diagnosed before the median date of 30-Apr-2008 had a higher medical release risk relative to those diagnosed more recently (adjusted HR (aHR), 1.77 [95% CI, 1.01-3.11]). Among individuals with an Afghanistan deployment-related mental disorder, those with a long delay to care had a higher medical release risk relative to those with a medium delay (aHR, 2.47 [95% CI, 1.28-4.76]); there was no statistically significant difference in risk between those with short and intermediate delays to care (aHR, 1.55 [95% CI, 0.85-2.83]).

Medically-related attrition risk varied by diagnosis mix (Table 3). Individuals with both a PTSD and Depression diagnosis had a higher risk relative to those with adjustment disorder alone (aHR, 2.88 [95% CI, 1.05-7.88]). However, while individuals with PTSD alone, Depression alone or PTSD with other mental disorder diagnoses had comparably elevated medical release risks relative to those with adjustment disorder alone, these were not statistically significant. The medically-related attrition risk was also higher for individuals in the Axis V severe symptoms category (aHR, 8.48 [95% CI, 1.86-38.73]) relative to those with transient symptoms and elevated but not statistically

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significant for individuals with moderate or mild symptoms. Additionally, medically-related attrition risk was higher for individuals in both the junior (aHR, 4.12 [95% CI, 1.15-14.73]) and senior (aHR, 4.93 [95% CI, 1.35-18.05]) non-commissioned member rank categories relative to officers.

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Table 3: Cox Proportional Hazard Regression Assessment of the Adjusted Association of Demographic, Military and Clinical Characteristics with Medical Release, following a Backwards Elimination Selection Process[b].

Characteristic	Adjusted HR	95% CI
Diagnosis Timing (Median Split)		
Apr 30, 2008 or Later	reference	reference
Before Apr 30, 2008	1.77 [d]	1.01, 3.11
Delay to Care[a] (Tertile Split)		
Short: ≤ 245 days	1.55	0.85, 2.83
Medium: 246 to 636 days	reference	reference
Long: ≥ 637 days	2.47[c]	1.28, 4.76
Mental Disorder Diagnosis Case-mix		
PTSD Only	2.17	0.77, 6.07
Depressive Disorder Only	2.29	0.68, 7.65
Other Single Diagnosis Only	0.32	0.07, 1.48
Adjustment Disorder Only	reference	reference
PTSD and Depressive Disorder	2.88[d]	1.05, 7.88
PTSD and Other	1.99	0.72, 5.48
Any Other Combination (excl. PTSD)	1.05	0.29, 3.78
DSM IV – AXIS V Global Assessment of Functioning (MI)		
0-50: Severe Symptoms	8.48[c]	1.86, 38.73
51-60: Moderate Symptoms	2.44	0.52, 11.53
61-70: Some Mild Symptoms	3.45[e]	0.81, 14.65
71-100: Transient Symptoms	reference	reference
Occupation Categorization (Aggregated)		
FS	4.98[c]	1.62, 15.32
OPS Support	2.40[c]	1.41, 4.08
Other	reference	reference
Rank		
Officer	reference	reference
SNCM	4.93[d]	1.35, 18.05
JNCM	4.12[d]	1.15, 14.73

Abbreviations: FS, Facility Support; OPS Support, Operations Support; MI, Multiple Imputation used; JNCM, Junior Non-commissioned Member; SNCM, Senior Non-commissioned Member.
[a] Delay to care is calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date, for diagnoses attributed to an Afghanistan deployment (n=415).
[b] A backwards elimination selection process identified the following variables for removal from the final assessment model, listed in their order of removal: Live-in Dependents, Years of Service, Element, DSM IV – AXIS III and Age.
[c] p-value ≤ 0.01
[d] p-value ≤ 0.05
[e] p-value ≤ 0.10
Otherwise, p-value >0.10

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The occupation categorization was modified following the assessment of its unadjusted relationship with medical release, keeping facility support and operations support, which had elevated hazard ratios, but aggregating other occupational categories, which did not. Attrition risk was higher for the facility support (aHR, 4.98 [95% CI, 1.62-15.32]) and operations support (aHR, 2.40 [95% CI, 1.41-4.08]) categories relative to the aggregated occupational category. Facility support included occupations such as construction engineers, fire fighters, plumber/gas fitter, and technicians in: water, fuels and the environment, electrical distribution, plumbing and heating, refrigeration and mechanical systems, and weather systems processing. Operations support included occupations such as logistics support, air traffic controllers, supply technicians, traffic technicians, postal clerks, administrative clerks, financial clerks, resource management support clerks, and mobile support equipment operators.

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DISCUSSION

Key Findings:

Our study's primary objective was to explore the association of mental disorder diagnosis era and delay to care with medically-related attrition. We observed that an unfavorable occupational prognosis was more likely for individuals diagnosed before 30-April-2008 (aHR = 1.77). Also as hypothesized, those with the longest delay to care (> 21 months) had a higher risk of medical release relative to those with an intermediate delay (aHR = 2.47). There was no significant difference in outcome between those with short and intermediate delays to care.

We identified several other independent risk factors for medically-related attrition, including: disorder severity, diagnosis mix (specifically, PTSD co-morbid with a depressive disorder), being a non-commissioned member, and being in certain occupational categories. A number of potential risk factors had no significant relationship with the primary outcome, including DSM Axis II co-morbidity, complicating musculoskeletal or other medical problems, a past history of mental disorders, age, years of service, sex, marital status, live-in dependents, component (Regular or Reserve Forces), and element (Army, Navy or Air Force).

Comparison with Other Findings:

We could not identify other studies that compared military occupational outcome from one time period to another among individuals with mental disorders. While there is evidence that PTSD remission rates have been increasing over time,[39] the effect on attrition is unknown. Studies on the association of prognosis relative to the timing of

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care are sparse, though consistent with our findings, Maguen and colleagues[32] found indications that veterans who initiated PTSD treatment earlier after deployment return were more likely to see symptom improvement.

Our finding of a less favorable occupational outcome among individuals with more severe illness and in lower ranks mirrors the unadjusted findings from others.[17, 23, 24] In contrast, while we observed a less favorable outcome for certain occupations, these occupations differed from ones identified by others (combat arms occupations).[17, 24] Other studies identified gender,[17] service length,[17, 24] and diagnosis[17, 23, 24] to be associated with outcomes in their adjusted models. We did not find significant associations for gender or service length in our adjusted models but we did for diagnosis mix. However, these other studies were among different populations, used premature release from service[17, 24] or return to occupational fitness[23] as outcomes and they emanate from other military organizations in which these and other prognostic factors may play out differently.

Strengths and Limitations:

This study's primary strength is that it explores an important but under-researched issue: the effects of mental health service renewal and delay to care on occupational prognosis of military mental health problems. We were able to control for a broad range of potential confounders, notably severity and various forms of medical and psychiatric comorbidity. The time-to-event analytic approach allowed for an efficient use of the data.

This study's primary limitation is its observational nature: We sought to explore changes in prognosis as a function of diagnosis era, itself a proxy for evolutionary changes in the CAF mental health system. It is possible that unmeasured factors could account for the observed improvement in prognosis. We were unable to identify precise implementation time-points for the many concurrent changes, precluding identification of the drivers of the more favorable outcomes seen over time. We could not control for unmeasured factors related to care-seeking behaviours and the timing of first care which are potentially associated with occupational prognosis.

We calculated delay to care using the most recent Afghanistan-related deployment return date prior to diagnosis and not the unknown timing of the precipitating incident or symptom-onset. While our sample size was large enough to identify at least some significant predictors (notably those related to our primary objective), there was limited power to detect differences for some comparisons. Finally, there is a possibility that our favorable findings reflect a delay to medically-related attrition, a beneficial short-term outcome, as opposed to a shift from releases for medical reasons to releases for other reasons (e.g., term of service completed), a beneficial long-term outcome.

Implications:

A sizable fraction of personnel who deployed in support of the CAF mission in Afghanistan will be diagnosed with a service-related mental disorder and almost 30% of those who do will medically release within 5 years. Those who medically release will take their substantial military experience (15.5 years, on average) with them when they

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leave. This speaks to the sizable impact of service-related mental disorders on military organizations and to the benefits of efforts to reduce medically-related attrition.

We found encouraging evidence that occupational prognosis for post-deployment mental disorders improved significantly over the past 12 years in the CAF. Since many possible sources of confounding were addressed, we believe that this finding is related to mental health system changes. Further research may permit identification of the relative contribution of each of the many implemented changes.

We also found that those who presented for care relatively late (> 21 months after return) had poorer occupational prognosis. However, while prognosis tended to be poorer for individuals with a short delay to care relative to those with a medium delay, this did not achieve statistical significance. The decision to seek care is a complicated one. Illness perceptions and concerns such as stigma, career-impact of care-seeking, eligibility for later benefits, confidence in care provision, uncertainty of need, etc. can influence care-seeking;[26] we did not measure these factors. Assessment of these would be helpful in future research. While our findings on delay to care and prognosis are encouraging, definitive studies are needed to assess specific interventions to shorten the delay to care (e.g., anti-stigma programs, screening).

Decreases in delay to care were an explicit target of CAF mental health services renewal and we found that shorter delays were independently associated with more favorable outcomes. Hence, if these promotion activities were successful, our estimate of the beneficial effect of mental health services renewal (captured by diagnosis era) may be conservative.

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Some of our findings may help clinicians prognosticate more effectively, at least with occupational prognosis. Interestingly, a past history of mental health problems, medical comorbidity, Axis II comorbidity, and Axis I comorbidity patterns other than PTSD comorbid with depressive disorder were not associated with an unfavorable occupational outcome.

In contrast, non-commissioned members had a four-fold greater risk of medical release relative to officers. Those in two occupational categories also had an elevated risk. This is surprising, given that the mental health-related fitness standards largely do not differ by rank or occupation. We have no clear explanation for these phenomena.

Conclusion:

The CAF and other military organizations have invested heavily in their mental health systems. We found that these investments were associated with an encouraging decrease in medically-related attrition and that shorter delays to care may also lead to better occupational outcomes. These findings speak to the potential impact of mental health services renewal and efforts to shorten delay to care. The high prevalence of deployment related mental disorders, their sizeable risk for medically-related attrition and the substantial expertise inevitably lost during medical release all reinforce the potential impact of these efforts.

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Figure 1: Kaplan-Meier estimates of the probability of a medical release from military service with increasing time from mental disorder diagnosis by diagnosis era. The diagnosis era was defined using a median split: before 30-Apr-2008 (sample n= 235, weighted N=2659) and 30-Apr-2008 or later (sample n= 273, weighted N=2678).
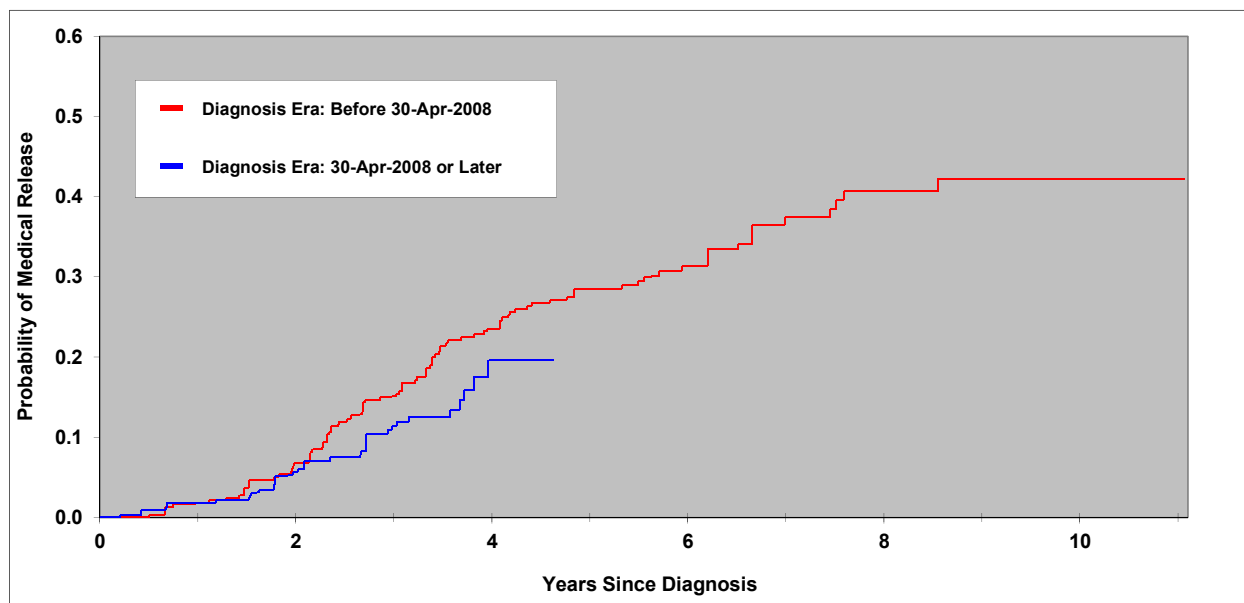
Figure 2: Kaplan-Meier estimates of the probability of a medical release from military service with increasing time from a mental disorder diagnosis by delay to care. Delay was calculated from the most recent Afghanistan deployment return date to the diagnosis date of an Afghanistan deployment-related disorder. Delays to care were categorized into tertiles: short (≤ 245 days; sample n= 138, weighted N=1355), medium (246 to 636 days; sample n= 144, weighted N=1394) and long (≥ 637 days; sample n= 133, weighted N=1360).

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed
		Case-control study—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed
		Case-control study—If applicable, explain how matching of cases and controls was addressed
		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion

Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Do shorter delays to care and mental health system renewal translate into better occupational outcome after mental disorder diagnosis in a cohort of Canadian military personnel who returned from an Afghanistan deployment?

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Do shorter delays to care and mental health system renewal translate into better occupational outcome after mental disorder diagnosis in a cohort of Canadian military personnel who returned from an Afghanistan deployment?

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Keywords: military, mental health, attrition, delay to care

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ABSTRACT

Objective: Mental disorders in military personnel result in high rates of attrition. Military organizations have strengthened their mental health systems and attempted to overcome barriers to care in order to see better outcomes. This study investigated the roles of mental health services renewal and delay to care in Canadian Armed Forces (CAF) personnel diagnosed with mental disorders.

Design: Administrative data were used to identify a retrospective cohort of 30,513 CAF personnel who deployed in support of the mission in Afghanistan. Study subjects included 508 individuals with a mental disorder diagnosis identified from CAF medical records of a weighted, stratified random sample of 2014 individuals selected from the study cohort. Weighted Cox proportional hazards regression assessed the association of diagnosis era and delay to care with the outcome, after controlling for a broad range of potential confounders (e.g., disorder severity, comorbidity). Taylor series linearization methods and sample design weights were applied in generating descriptive and regression analysis statistics.

Primary Outcome: The outcome was release from military service for medical reasons, assessed using administrative data for the 508 individuals with a mental disorder diagnosis.

Results: 17.5% [95% CI: 16.0-19.0] of the cohort had a mental disorder diagnosis after an Afghanistan-related deployment, of which 21.3% [95% CI: 17.2-25.5] had a medical release over a median follow-up of 3.5 years. Medical release risk was elevated for individuals diagnosed before 30-Apr-2008 relative to those with more recent diagnoses (aHR, 1.77 [95% CI, 1.01-3.11]) and for individuals with a long delay to care (> 21 months after return) relative to those with intermediate delays (8 to 21 months, aHR, 2.47 [95% CI, 1.28-4.76]).

Conclusions: Mental health services renewal in the CAF was associated with a better occupational outcome for those diagnosed with mental disorders. Longer delays to care were associated with a less favorable outcome.

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Strengths and limitations of this study

- This study demonstrates that two modifiable factors, mental health system change and delay to care, have associations with medically-related attrition rates among personnel with a mental disorder in a previously deployed Canadian military cohort. After controlling for potential confounding variables, the accumulation of change in the Canadian military's mental health system was determined to be associated with lower rates of medically-related attrition. Long delays to care were associated with higher rates medically-related attrition.

- Disorder severity, diagnosis mix (specifically, PTSD co-morbid with a depressive disorder), being a non-commissioned service member, and being in certain occupational categories were also determined to be independently associated with medically-related attrition rates.

- Diagnosis era was a proxy for changes in the CAF mental health system. It was not possible to identify precise implementation time-points for the many concurrent mental health system changes, precluding identification of the drivers of the more favorable outcomes seen over time.

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INTRODUCTION

Since 2001, millions of military personnel have deployed to the conflicts in Southwest Asia; many have returned with mental health problems.[1, 2] In Canada, 13.5% of personnel who deployed in support of the mission in Afghanistan were diagnosed with a service-related mental disorder within four years after their return.[2] For those in high-threat locations, rates approached 30% after seven years.[2]

Mental health problems have a pronounced impact on military occupational fitness,[3-17] which in turn can lead to attrition when personnel fail to meet stringent military occupational fitness requirements. Attrition is the largest single mental health-related cost for employers[18] and it has particular salience for military organizations, given their extensive and specialized training requirements.

Many factors influence adverse military occupational outcomes such as attrition.[5-8, 10, 17, 19-24] In addition to mental health problems,[3-17] factors include age,[5-8, 10, 19-21, 24] gender,[5-7, 10, 17, 19-22] race/ethnicity,[6, 8, 19] rank,[5, 10, 17, 19, 20, 23, 24] component (Regular or Reserve Force),[19] years of service,[10, 17, 23, 24] marital status,[10, 22, 24] element (Army, Navy or Air Force),[5, 21] and education.[10]

Research on factors influencing outcome among those with mental disorders is sparse. Associations have been seen with diagnosis,[17, 23] illness severity,[23, 24] years of service,[17, 23, 24] combat occupation,[17, 24] rank,[17, 23, 24] gender,[17, 24] age,[24] marital status,[24] presence of comorbid conditions,[17] and treatment,[17] factors that are mostly non-modifiable.

The Canadian Armed Forces (CAF) has reinforced its mental health system over the past 15 years.[25] The number of mental health providers has more than doubled.

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Seven multidisciplinary centers now provide standardized assessment and treatment of service-related mental health problems. Lower levels of stigma and other barriers to care have been seen in comparison to other military organizations,[26] perhaps as a result of de-stigmatization efforts.[27] Extensive resilience and mental health training is embedded throughout individuals' careers and across the deployment cycle, which includes in-depth post-deployment mental health screening.[28] The past decade has also seen policy changes that make it easier for personnel who recover from mental disorders to remain in uniform. Other nations have engaged in similar efforts.[29, 30]

Mental disorders have been shown to be associated with attrition,[13, 31] both before and after the current conflicts in Southwest Asia, but there are no formal assessments of changes in prognosis over time. Additionally, the temporal changes in the CAF mental health system that targeted reductions in barriers to care-seeking as one of its objectives were expected to impact those who would otherwise not seek care as well as reduce care-seeking delays in others. However, delay to care can potentially act independently on medically-related attrition, as it is has been asserted that early care for PTSD and other mental disorders has the potential to improve long-term prognosis. Unfortunately, there is very little research supporting this assertion.[32]

This study investigates risk factors for medically-related attrition among personnel who deployed in support of the CAF mission in Afghanistan and were diagnosed with a mental disorder. We hypothesized that those who were diagnosed later in the course of the conflict and those who presented for care earlier would independently show more favourable outcomes.

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METHODS

Study Population and Sampling:

The study cohort consists of all CAF personnel (N = 30,513) who initiated a deployment outside of North America and Europe in support of the Afghanistan mission from 01-October-2001 through 31-December-2008. Over the duration of the mission, 158 CAF personnel died on-duty. A weighted, stratified random sample of 2045 individuals was identified and medical records of 2014 were reviewed; medical records were inaccessible for 31 individuals before the end of the chart-review phase of the study, either because they were in transition to a new location or were in active use for reasons other than treatment. The sampling strata were defined by deployment location and apparent mental health services use, strata relevant to the parent study's primary objective.[2]

The current study was limited to 508 of the 2014 individuals whose chart review indicated that they had a mental disorder diagnosis dated after the start date of their first Afghanistan-related deployment.

Data Collection:

As discussed elsewhere,[2] deployment details came from administrative databases. Mental disorder diagnoses, mental disorder history, and clinician-identified attributions to service were abstracted from medical records over the period of 22-June-2010 to 30-May-2011. The evaluations of service-related mental disorders are done in 1 of 7 CAF regional mental health centres and they follow a common, collaborative assessment model that includes psychological testing and consultation with, at

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minimum, a psychiatrist and a psychologist. The clinicians comment on the association between the diagnosis and military service because this can have implications in terms of veterans' benefits.

Data on release from service, demographics, and military characteristics came from administrative databases (extract date: 15-December-2012). Data linkages were based on service number, a unique CAF-specific personal identifier.

Outcome Definition:

The primary outcome was release from military service for medical reasons (i.e., medically-related attrition). The broad categories for release, and their representation in the cohort, include: misconduct (0%); unsatisfactory service (0%); service completed (3.7%); medical (5.4%); and voluntary (19.9%). Medical releases result when individuals are determined to be unfit to perform the full range of their duties as a consequence of a health problem.[33]

Military personnel in the CAF have an occupational fitness requirement, one that takes into consideration the potential duties required under the demanding and unpredictable conditions of operational deployments. This requirement is enshrined in the principle of "Universality of Service," which the CAF enforces by requiring all personnel to be able to perform certain common military tasks and to be deployable to any environment with little medical support. Individuals who are persistently in violation of Universality of Service will be released from service.

When CAF personnel are diagnosed with a medical condition, their clinician determines whether the diagnosis or treatment may interfere with duties. This

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assessment is a sequential process; it begins with a thorough examination, followed by a comprehensive description of medical employment limitations. Clinicians assign a set of codes ("medical categories") that summarize the medical employment limitations' impact on duties. Persistent medical employment limitations and medical categories are validated by physicians in the Medical Standards Section of the CAF, ensuring a standardized application.

While some persistent medical employment limitations will ultimately lead to a release from military service, others will be accommodated. Individuals whose validated limitations are likely to violate Universality of Service undergo an administrative review; those determined to be in violation will ultimately be released.

Covariates of Interest:

The primary covariates of interest were: 1) diagnosis era, a proxy for evolutionary enhancements to the CAF mental health system and changes in medical fitness determination practices for individuals with mental disorders, and 2) delay to diagnosis and care, calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date. The most recent Afghanistan-related deployment return date, prior to a diagnosis, was the most relevant reference point for delay calculations; a majority of the cohort had a single deployment (80%) and it's very rare for an individual to deploy with a significant mental health problem. The median date (30-April-2008) categorized diagnosis dates into two eras. This was based on initial investigations that suggested changes in the medically-related attrition outcome after 2008. Delay to care was categorized into tertiles: ≤ 245 days (≤ 8 months), 246 to 636 days (8 to 21

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months), and ≥ 637 days (> 21 months). The delay intervals were chosen based on initial investigations that suggested a non-linear, u-shaped, relationship between delay to care and the outcome.

Potential Confounders:

Potential confounders identified in other studies[2-17, 19-24] included: sex; age; element (Army, Navy or Air Force); component (Regular or Reserve Force); rank category; military occupation; years of service; marital status; and presence of live-in dependents. Military occupation was categorized into 8 groups:[34] facility support (FS); health services (HS); information management (IM); intelligence, surveillance and reconnaissance (ISR); operations support (OPS Support); operations technicians (OPS Tech); specialist; and operations (OPS), which included combat arms occupations.

Diagnosis-related covariates included indication of a previous history of mental disorder diagnoses and each DSM-IV-TR (DSM) axis, excluding Axis IV. Axis I diagnosis codes were categorized into 7 groups based on conceptual considerations and disorder patterns: 4 single diagnosis categories of PTSD, Depressive Disorder (i.e., Major Depression or Dysthymic Disorder), Adjustment Disorder or single 'Other' disorder, and 3 comorbid categories of both PTSD and Depressive Disorder only, all other comorbid combinations with PTSD and any other non-PTSD comorbid combination.   Axis II information was dichotomized for presence of a personality disorder or trait, while Axis III information was categorized for presence of a relevant musculoskeletal condition, other condition or none. Functional status (reflected by Axis V, the Global Assessment of Functioning) was categorized into 4 groups: 0-50 (severe

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symptoms); 51-60 (moderate symptoms); 61-70 (mild symptoms); and 71-100 (transient symptoms).

Data Analysis:

The data were analyzed using SAS for Windows, version 9.3, and sampling weights accounted for the design effect. Taylor Series Linearization methods[35] were used to determine 95% confidence intervals (CI's) for descriptive statistics. Missing values were identified for marital status, the presence of live-in dependents, and DSM Axis V. The fully conditional specification multiple imputation method[36] was implemented when analyzing these covariates.

Weighted Kaplan-Meier methods[37] generated event probabilities. Zero-time was defined as the diagnosis date. Event-time was the medical release date. Individuals were censored at the earlier of non-medical release date or database extraction date. 95% CI's for Kaplan-Meier estimates were generated using bootstrap methods.[38]

Weighted Cox regression assessed the association of medical release with covariates; results were expressed as hazard ratios (HR's) and their 95% CI's, generated using Taylor Series Linearization methods.[35] The 2 primary covariates of interest (i.e., diagnosis era and delay to care) were forced into a regression model that included potential confounders selected using a two-stage approach. Initially, weighted Cox regressions assessed the unadjusted relationship between each potential confounder and medical release; covariates with a Wald test p-value less than 0.15 were included in a multivariate model. In the second stage, backwards elimination removed potential confounders using a Wald test p-value threshold of 0.05. Delay to

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care was handled as an interaction term (delay by whether the diagnosis was Afghanistan deployment-related). This approach optimized the use of available data; Afghanistan deployment-related diagnoses use Afghanistan-related deployment return date as a relevant proxy for symptom-onset timing in delay calculations while other diagnoses use Afghanistan-related deployment return date as an imprecise proxy of this timing. Delay to care hazard ratios were only assessed among those with Afghanistan deployment-related diagnoses. Regression diagnostic plots were reviewed with respect to the proportional hazards assumption.[37]

Ethics: The research protocol was approved by Veritas Research Ethics Board (Dorval, QC).

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RESULTS

Study Cohort Characteristics:

Medical records were reviewed for 2014 individuals and inaccessible for an additional 31. Of the 2014 individuals, 508 who had a mental disorder diagnosis after the start of their first Afghanistan-related deployment comprised the study sample, representing 5337 individuals in the cohort (17.5%, 95% CI: 16.0-19.0).

The study subset consisted largely of men in the Regular Forces of the Army (Table 1). At the time of their diagnosis, a majority of individuals were younger than 40, married, had no live-in dependents, and had less than 20 years of military service. Although 46.0% of the study subset were in the "Operations" occupation category, 79.6% of these were combat arms occupations. Table 1 summarizes the distribution and bivariate associations of these characteristics with medically-related attrition.

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Table 1: Demographic and Military Characteristics of the Study Subset (weighted N = 5,337; sample n = 508) and their Unadjusted Association with Medically-related Attrition.

Characteristic	Un-weighted Sample No.	Weighted %	Medical Release		Unadjusted HR	95% CI
			%	95% CI		
Occupation Categorization[e]						
FS	12	2.7	54.8	24.4, 85.3	5.36[a]	2.21, 12.98
HS	28	4.8	12.6	0.9, 24.3	0.76	0.26, 2.26
IM	31	4.8	18.2	5.0, 31.5	0.79	0.32, 2.00
ISR	22	3.5	21.3	4.2, 38.5	1.29	0.57, 2.92
OPS Support	96	15.4	29.9	19.0, 40.8	1.75[c]	0.98, 3.12
OPS Tech	58	16.0	21.2	9.3, 33.1	0.81	0.36, 1.80
Specialist	34	6.8	15.7	2.7, 28.6	0.86	0.34, 2.18
OPS	227	46.0	18.6	12.7, 24.5	reference	reference
Occupation Categorization (Aggregated)[e]						
FS	12	2.7	54.8	24.4, 85.3	5.75[a]	2.46, 13.46
OPS Support	96	15.4	29.9	19.0, 40.8	1.88[b]	1.11, 3.20
Other	400	81.9	18.6	14.2, 23.0	reference	reference
Component						
Reserve Forces	23	6.7	12.7	0, 28.7	0.68	0.16, 2.81
Regular Forces	485	93.3	21.9	17.6, 26.2	reference	reference
Element[e]						
Air Force	66	12.9	26.9	13.9, 39.9	2.21[c]	0.94, 5.22
Navy	65	21.0	17.4	7.3, 27.5	reference	reference
Army	377	66.1	21.5	16.8, 26.2	1.84[c]	0.95, 3.57
Rank[e]						
Officer	48	10.4	4.9	0, 9.8	reference	reference
SNCM	130	24.8	25.4	16.3, 34.5	6.10[a]	1.92, 19.33
JNCM	330	64.7	22.4	17.2, 27.6	4.63[a]	1.51, 14.17
Sex						
Female	62	9.8	25.2	14.5, 36.0	1.25	0.74, 2.11
Male	446	90.2	20.9	16.4, 25.4	reference	reference
Age[e]						
≤ 29	140	27.9	11.2	5.5, 16.8	reference	reference
30 – 39	234	44.5	24.7	18.3, 31.1	1.85[c]	0.98, 3.47
≥ 40	134	27.6	26.1	17.4, 34.8	2.38[b]	1.20, 4.72
Years of Service[e]						
≤ 9	214	43.1	16.3	10.7, 22.0	reference	reference
10 – 19	194	35.5	24.6	17.5, 31.6	1.42	0.86, 2.35
≥ 20	100	21.4	26.0	16.0, 35.9	1.84[b]	1.01, 3.37
Marital Status (MI)[f]						
Married	350	68.7	23.1	17.8, 28.3	reference	reference
Single – never married	100	20.0	14.5	7.5, 21.4	0.58[c]	0.32, 1.06
Divorced/ Widowed/ Separated	49	9.7	17.5	5.9, 29.1	0.70	0.33, 1.49
Unspecified	9	1.6	55.3	18.7, 92.0		
Live-in Dependents (MI)[e,f]						
Yes	232	42.8	27.3	20.4, 34.2	1.61[b]	1.03, 2.53
No	246	50.8	16.5	11.4, 21.6	reference	reference
Unspecified	30	6.4	19.5	3.5, 35.5		

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Abbreviations: FS, Facility Support; HS, Health Services; IM, Information Management; ISR, Intelligence, Surveillance and Reconnaissance; OPS Support, Operations Support; OPS Tech, Operations Technicians; OPS, Specialist; and Operations; MI, Multiple imputation used; JNCM, Junior Non-commissioned Member; SNCM, Senior Non-commissioned Member.
[a] p-value ≤ 0.01
[b] p-value ≤ 0.05
[c] p-value ≤ 0.1
[d] p-value ≤ 0.15
Otherwise, p-value >0.15
[e] The Wald test p-value was less than 0.15 for variables: Occupation Categorization, Element, Rank, Age, Years of Service and Live-in Dependents (MI).
[f] Multiple imputation was used to compute the unadjusted HR for variables: Marital Status (MI) and Live-in Dependents (MI).

Mental Disorder Diagnoses:

Table 2 summarizes the distribution of clinical characteristics and their unadjusted association with medically-related attrition. A majority of diagnoses (82.0%; 95% CI: 78.3-85.7) were service-related; 77.0% were attributed to Afghanistan-related deployments and 5.0% were attributed to other deployments. PTSD was the most diagnosed condition (49.1%; 95% CI: 44.2-53.9), followed by Depressive Disorder (i.e., Major Depression or Dysthymic Disorder) (44.7%; 95% CI: 39.5-49.8). PTSD was often a comorbid diagnosis: It occurred alone in 15.7% (95% CI: 12.1-19.4); with Depressive Disorder only in 14.3% (95% CI: 10.9-17.7); and with any other disorder(s) in 19.1% (95% CI: 15.6-22.5).

The median diagnosis date was 30-April-2008 (range: 19-November-2001 to 24-January-2011). The mean delay to care among individuals with an Afghanistan-related mental disorder diagnosis was 551 days (95% CI: 500-602 days; median: 400 days).

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Table 2: Clinical Characteristics among Individuals of the Study Subset (weighted N = 5,337; sample n = 508) and their Unadjusted Association with Medically-related Attrition.

Clinical Characteristic	Un-weighted Sample No.	Weighted %	Medical Release %	Medical Release 95% CI	Unadjusted HR	(95% CI)
Diagnosis Timing[f] (Median Split)						
Apr 30, 2008 or Later	273	50.2	12.1	7.6, 16.6	reference	reference
Before Apr 30, 2008	235	49.8	30.6	23.9, 37.4	1.45[e]	0.87, 2.42
Delay to Care[a,f] (Tertile Split)						
Short: ≤ 245 days	138	33.0	27.3	19.4, 35.2	1.69[d]	0.93, 3.08
Medium: 246 to 636 days	144	33.9	14.7	8.4, 20.9	reference	reference
Long: ≥ 637 days	133	33.1	23.1	14.1, 32.1	2.24[c]	1.17, 4.30
Mental Disorder Diagnosis History						
Yes	142	28.4	23.0	15.1, 30.8	0.84	0.52, 1.37
None Indicated	366	71.6	20.7	15.8, 25.6	reference	reference
Mental Disorder Diagnoses						
Any PTSD	272	49.1	28.9	22.8, 35.0	2.22[b]	1.36, 3.63
No PTSD	236	50.9	14.0	8.6, 19.4	reference	reference
Any Non-PTSD Anxiety	128	26.8	14.7	7.9, 21.6	0.54[c]	0.31, 0.95
No Non-PTSD Anxiety	380	73.2	23.7	18.7, 28.8	reference	reference
Any Adjustment Disorder	128	23.6	17.3	9.4, 25.3	0.73	0.41, 1.31
No Adjustment Disorder	380	76.4	22.5	17.7, 27.4	reference	reference
Any Depressive Disorder	228	44.7	25.6	19.0, 32.2	1.58[c]	1.00, 2.48
No Depressive Disorder	280	55.3	17.9	12.5, 23.2	reference	reference
Any Bipolar Disorder	6	1.7	35.7	0, 79.0	1.34	0.51, 3.54
No Bipolar Disorder	502	98.3	21.1	16.9, 25.2	reference	reference
Any Other Mood Disorder	7	1.7	9.8	0, 28.7	0.25	0.03, 2.30
No Other Mood Disorder	501	98.3	21.5	17.3, 25.7	reference	reference
Any Somatoform Disorder	6	1.5	79.9	44.5, 100	4.52[c]	1.16, 17.64
No Somatoform Disorder	502	98.5	20.4	16.3, 24.6	reference	reference
Any Substance Abuse Disorder	83	16.1	19.3	9.7, 28.9	0.93	0.52, 1.66
No Substance Abuse Disorder	425	83.9	21.7	17.1, 26.3	reference	reference
Mental Disorder Diagnosis Case-mix[f]						
PTSD Only	79	15.7	25.5	13.8, 37.2	1.50	0.58, 3.88
Depressive Disorder Only	58	13.4	20.4	7.1, 33.7	1.46	0.51, 4.20
Other Single Diagnosis Only	47	10.8	4.0	0.0, 8.4	0.21[c]	0.05, 0.87
Adjustment Disorder Only	59	10.7	18.2	5.6, 30.7	reference	reference
PTSD and Depressive Disorder	80	14.3	33.8	22.5, 45.2	2.38[d]	0.97, 5.82
PTSD and Other	113	19.1	28.0	18.7, 37.3	1.82	0.75, 4.41
Any Other Combination (excl. PTSD)	72	15.9	12.7	3.7, 21.7	0.74	0.25, 2.22
DSM IV – AXIS II Personality Disorder/Trait						
Yes	70	14.3	20.7	9.1, 32.3	0.97	0.50, 1.89

None Indicated	438	85.7	21.4	17.0, 25.9	reference	reference
DSM IV – AXIS III General Medical Conditions Present[f]						
Musculoskeletal	126	24.6	31.2	21.7, 40.6	1.92[c]	1.15, 3.21
Other	117	22.5	22.8	13.5, 32.0	1.42	0.80, 2.53
None Indicated	265	52.9	16.1	11.1, 21.1	reference	reference
DSM IV – AXIS V Global Assessment of Functioning (MI)[f,g]						
0-50: Severe Symptoms	46	7.5	42.5	27.6, 57.4	9.32[b]	2.89, 30.09
51-60: Moderate Symptoms	152	27.8	19.7	13.1, 26.4	2.98[d]	0.89, 9.95
61-70: Mild Symptoms	163	33.7	25.3	17.0, 33.6	3.76[c]	1.23, 11.49
71-100: Transient Symptoms	55	11.7	7.1	1.8, 12.3	reference	reference
Unspecified	92	19.3	17.0	7.6, 26.5		

Abbreviations: MI, Multiple Imputation used;
[a] Delay to care is calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date, for diagnoses attributed to an Afghanistan deployment (n=415).
[b] p-value ≤ 0.01
[c] p-value ≤ 0.05
[d] p-value ≤ 0.1
[e] p-value ≤ 0.15
Otherwise, p-value >0.15
[f] The Wald test p-value was less than 0.15 for variables: Diagnosis Timing, Delay to Care, Mental Disorder Diagnosis Case-mix (including any PTSD, any non-PTSD Anxiety Disorder, any Depressive Disorder and any Somatoform Disorder), DSM IV - AXIS III General Medical Conditions Present and DSM IV - AXIS V Global Assessment of Functioning (MI).
[g] Multiple imputation was used to compute the unadjusted HR for variable: DSM IV – AXIS V Global Assessment of Functioning (MI).

Medically-Related Attrition:

As of 15-December-2012, 35.5% (95% CI: 30.8-40.3) had released from service, 21.3% (95% CI: 17.2-25.5) were medical releases and 14.2% (95% CI: 10.7-17.8) were for other reasons (i.e., 12.7% voluntary releases; 1.5% service completion releases). Mean follow-up time from diagnosis to the earlier of release or censor date was 1456 days (95% CI: 1373-1538 days); the median was 1267 days (3.5 years). Individuals who medically released had a mean of 15.5 years of service (95% CI: 13.7-17.3) at the time of release while those without a medical release had 13.0 years (95% CI: 12.2-13.8) at censor date.

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At 5 years of follow-up, an estimated 25.8% (95% CI: 20.2-31.4) medically

released compared with 13.7% (95% CI: 10.1-17.3) releasing for other reasons. There

was separation in the Kaplan-Meier curves for medical release by diagnosis era (Figure

1). Follow-up time was limited for more recent diagnoses; the maximum was 4.6 years.

At 4.5 years of follow-up, an estimated 26.8% (95% CI: 20.2-33.3) of those diagnosed

before 30-April-2008 (median) had medically released compared with 19.7% (95% CI:

12.1-27.2) thereafter. However, the unadjusted hazard ratio comparing diagnosis eras

was not statistically significant (HR, 1.45 [95% CI, 0.87-2.42]) (Table 2).

At 5 years of follow-up, an estimated 29.1% (95% CI: 22.5-35.8) of individuals

whose mental disorder diagnosis was Afghanistan deployment-related had medically

released. Figure 2 displays the Kaplan-Meier curves for medical release as a function

of delay to care among individuals with an Afghanistan deployment-related diagnosis.

Separation in the curves was again noted: At 5 years of follow-up, an estimated 28.3%

(95% CI: 18.7-37.8) of those with a short delay to care (≤ 245 days) medically released

compared to 19.5% (95% CI: 10.6-28.5) with a medium delay (246 to 636 days) and

46.4% (95% CI: 27.4-65.4) with a long delay (≥ 637 days). While medical release risk

was elevated for individuals having either short or long delays to care, relative to those

with medium delays, the unadjusted hazard ratio was not statistically significant for short

delays (HR, 1.69 [95% CI, 0.93-3.08]) but it was for long delays (HR, 2.24 [95% CI,

1.17-4.30]) (Table 2).

Cox Proportional Hazards Regression:

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The mental disorder history, DSM Axis II, component, sex, and marital status potential confounders were discarded during assessment of their unadjusted relationship with medical release; DSM Axis III, element, age category, years of service, and live-in dependents were discarded during the backwards elimination regression. The final model that assessed the primary covariates controlled for diagnosis case-mix, military occupation, DSM Axis V (functional impairment), and rank category.

The adjusted model (Table 3) showed that individuals diagnosed before the median date of 30-Apr-2008 had a higher medical release risk relative to those diagnosed more recently (adjusted HR (aHR), 1.77 [95% CI, 1.01-3.11]). Among individuals with an Afghanistan deployment-related mental disorder, those with a long delay to care had a higher medical release risk relative to those with a medium delay (aHR, 2.47 [95% CI, 1.28-4.76]); there was no statistically significant difference in risk between those with short and intermediate delays to care (aHR, 1.55 [95% CI, 0.85-2.83]).

Medically-related attrition risk varied by diagnosis mix (Table 3). Individuals with both a PTSD and Depression diagnosis had a higher risk relative to those with adjustment disorder alone (aHR, 2.88 [95% CI, 1.05-7.88]). However, while individuals with PTSD alone, Depression alone or PTSD with other mental disorder diagnoses had comparably elevated medical release risks relative to those with adjustment disorder alone, these were not statistically significant. The medically-related attrition risk was also higher for individuals in the Axis V severe symptoms category (aHR, 8.48 [95% CI, 1.86-38.73]) relative to those with transient symptoms and elevated but not statistically

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significant for individuals with moderate or mild symptoms. Additionally, medically-

related attrition risk was higher for individuals in both the junior (aHR, 4.12 [95% CI,

1.15-14.73]) and senior (aHR, 4.93 [95% CI, 1.35-18.05]) non-commissioned member

rank categories relative to officers.

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Table 3: Cox Proportional Hazard Regression Assessment of the Adjusted Association of Demographic, Military and Clinical Characteristics with Medical Release, following a Backwards Elimination Selection Process[b].

Characteristic	Adjusted HR	95% CI
Diagnosis Timing (Median Split)		
Apr 30, 2008 or Later	reference	reference
Before Apr 30, 2008	1.77[d]	1.01, 3.11
Delay to Care[a] (Tertile Split)		
Short: ≤ 245 days	1.55	0.85, 2.83
Medium: 246 to 636 days	reference	reference
Long: ≥ 637 days	2.47[c]	1.28, 4.76
Mental Disorder Diagnosis Case-mix		
PTSD Only	2.17	0.77, 6.07
Depressive Disorder Only	2.29	0.68, 7.65
Other Single Diagnosis Only	0.32	0.07, 1.48
Adjustment Disorder Only	reference	reference
PTSD and Depressive Disorder	2.88[d]	1.05, 7.88
PTSD and Other	1.99	0.72, 5.48
Any Other Combination (excl. PTSD)	1.05	0.29, 3.78
DSM IV – AXIS V Global Assessment of Functioning (MI)		
0-50: Severe Symptoms	8.48[c]	1.86, 38.73
51-60: Moderate Symptoms	2.44	0.52, 11.53
61-70: Some Mild Symptoms	3.45[e]	0.81, 14.65
71-100: Transient Symptoms	reference	reference
Occupation Categorization (Aggregated)		
FS	4.98[c]	1.62, 15.32
OPS Support	2.40[c]	1.41, 4.08
Other	reference	reference
Rank		
Officer	reference	reference
SNCM	4.93[d]	1.35, 18.05
JNCM	4.12[d]	1.15, 14.73

Abbreviations: FS, Facility Support; OPS Support, Operations Support; MI, Multiple Imputation used; JNCM, Junior Non-commissioned Member; SNCM, Senior Non-commissioned Member.
[a] Delay to care is calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date, for diagnoses attributed to an Afghanistan deployment (n=415).
[b] A backwards elimination selection process identified the following variables for removal from the final assessment model, listed in their order of removal: Live-in Dependents, Years of Service, Element, DSM IV – AXIS III and Age.
[c] p-value ≤ 0.01
[d] p-value ≤ 0.05
[e] p-value ≤ 0.10
Otherwise, p-value >0.10

The occupation categorization was modified following the assessment of its unadjusted relationship with medical release, keeping facility support and operations support, which had elevated hazard ratios, but aggregating other occupational categories, which did not. Attrition risk was higher for the facility support (aHR, 4.98 [95% CI, 1.62-15.32]) and operations support (aHR, 2.40 [95% CI, 1.41-4.08]) categories relative to the aggregated occupational category. Facility support included occupations such as construction engineers, fire fighters, plumber/gas fitter, and technicians in: water, fuels and the environment, electrical distribution, plumbing and heating, refrigeration and mechanical systems, and weather systems processing. Operations support included occupations such as logistics support, air traffic controllers, supply technicians, traffic technicians, postal clerks, administrative clerks, financial clerks, resource management support clerks, and mobile support equipment operators.

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DISCUSSION

Key Findings:

Our study's primary objective was to explore the association of mental disorder diagnosis era and delay to care with medically-related attrition. We observed that an unfavorable occupational prognosis was more likely for individuals diagnosed before 30-April-2008 (aHR = 1.77). Also as hypothesized, those with the longest delay to care (> 21 months) had a higher risk of medical release relative to those with an intermediate delay (aHR = 2.47). There was no significant difference in outcome between those with short and intermediate delays to care.

We identified several other independent risk factors for medically-related attrition, including: disorder severity, diagnosis mix (specifically, PTSD co-morbid with a depressive disorder), being a non-commissioned member, and being in certain occupational categories. A number of potential risk factors had no significant relationship with the primary outcome, including DSM Axis II co-morbidity, complicating musculoskeletal or other medical problems, a past history of mental disorders, age, years of service, sex, marital status, live-in dependents, component (Regular or Reserve Forces), and element (Army, Navy or Air Force).

Comparison with Other Findings:

We could not identify other studies that compared military occupational outcome from one time period to another among individuals with mental disorders. While there is evidence that PTSD remission rates have been increasing over time,[39] the effect on attrition is unknown. Studies on the association of prognosis relative to the timing of

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care are sparse, though consistent with our findings, Maguen and colleagues[32] found indications that veterans who initiated PTSD treatment earlier after deployment return were more likely to see symptom improvement.

Our finding of a less favorable occupational outcome among individuals with more severe illness and in lower ranks mirrors the unadjusted findings from others.[17, 23, 24] In contrast, while we observed a less favorable outcome for certain occupations, these occupations differed from ones identified by others (combat arms occupations).[17, 24] Other studies identified gender,[17] service length,[17, 24] and diagnosis[17, 23, 24] to be associated with outcomes in their adjusted models. We did not find significant associations for gender or service length in our adjusted models but we did for diagnosis mix. However, these other studies were among different populations, used premature release from service[17, 24] or return to occupational fitness[23] as outcomes and they emanate from other military organizations in which these and other prognostic factors may play out differently.

Strengths and Limitations:

This study's primary strength is that it explores an important but under-researched issue: the effects of mental health service renewal and delay to care on occupational prognosis of military mental health problems. We were able to control for a broad range of potential confounders, notably severity and various forms of medical and psychiatric comorbidity. The time-to-event analytic approach allowed for an efficient use of the data.

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This study's primary limitation is its observational nature: We sought to explore changes in prognosis as a function of diagnosis era, itself a proxy for evolutionary changes in the CAF mental health system. It is possible that unmeasured factors could account for the observed improvement in prognosis. We were unable to identify precise implementation time-points for the many concurrent changes, precluding identification of the drivers of the more favorable outcomes seen over time. We could not control for unmeasured factors related to care-seeking behaviours and the timing of first care which are potentially associated with occupational prognosis.

It was not possible to distinguish medically-related attrition that was due to physical issues from those that were due to mental health issues; however, augmented data for a subset of the individuals in this study suggests that the vast majority of medical releases among study subjects were at least partially attributed to a mental disorder.

We calculated delay to care using the most recent Afghanistan-related deployment return date prior to diagnosis and not the unknown timing of the precipitating incident or symptom-onset. While our sample size was large enough to identify at least some significant predictors (notably those related to our primary objective), there was limited power to detect differences for some comparisons. Finally, there is a possibility that our favorable findings reflect a delay to medically-related attrition, a beneficial short-term outcome, as opposed to a shift from releases for medical reasons to releases for other reasons (e.g., term of service completed), a beneficial long-term outcome.

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Implications:

A sizable fraction of personnel who deployed in support of the CAF mission in Afghanistan will be diagnosed with a service-related mental disorder and almost 30% of those who do will medically release within 5 years. Those who medically release will take their substantial military experience (15.5 years, on average) with them when they leave. This speaks to the sizable impact of service-related mental disorders on military organizations and to the benefits of efforts to reduce medically-related attrition.

We found encouraging evidence that occupational prognosis for post-deployment mental disorders improved significantly over the past 12 years in the CAF. Since many possible sources of confounding were addressed, we believe that this finding is related to mental health system changes. Further research may permit identification of the relative contribution of each of the many implemented changes.

We also found that those who presented for care relatively late (> 21 months after return) had poorer occupational prognosis. However, while prognosis tended to be poorer for individuals with a short delay to care relative to those with a medium delay, this did not achieve statistical significance. The decision to seek care is a complicated one. Illness perceptions and concerns such as stigma, career-impact of care-seeking, eligibility for later benefits, confidence in care provision, uncertainty of need, etc. can influence care-seeking;[26] we did not measure these factors. Assessment of these would be helpful in future research. While our findings on delay to care and prognosis are encouraging, definitive studies are needed to assess specific interventions to shorten the delay to care (e.g., anti-stigma programs, screening).

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Decreases in delay to care were an explicit target of CAF mental health services renewal and we found that shorter delays were independently associated with more favorable outcomes. Hence, if these promotion activities were successful, our estimate of the beneficial effect of mental health services renewal (captured by diagnosis era) may be conservative.

Some of our findings may help clinicians prognosticate more effectively, at least with occupational prognosis. Interestingly, a past history of mental health problems, medical comorbidity, Axis II comorbidity, and Axis I comorbidity patterns other than PTSD comorbid with depressive disorder were not associated with an unfavorable occupational outcome.

In contrast, non-commissioned members had a four-fold greater risk of medical release relative to officers. Those in two occupational categories also had an elevated risk. This is surprising, given that the mental health-related fitness standards largely do not differ by rank or occupation. We have no clear explanation for these phenomena.

Conclusion:

The CAF and other military organizations have invested heavily in their mental health systems. We found that these investments were associated with an encouraging decrease in medically-related attrition and that shorter delays to care may also lead to better occupational outcomes. These findings speak to the potential impact of mental health services renewal and efforts to shorten delay to care. The high prevalence of deployment related mental disorders, their sizeable risk for medically-related attrition

and the substantial expertise inevitably lost during medical release all reinforce the

potential impact of these efforts.

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Disclosures: Both authors are employees of the Canadian Department of National Defence and funding for this research came via this federal government department.

Data sharing statement: No additional data available.

Ethics approval: This research was approved by Veritas Research Ethics Board (Dorval, QC).

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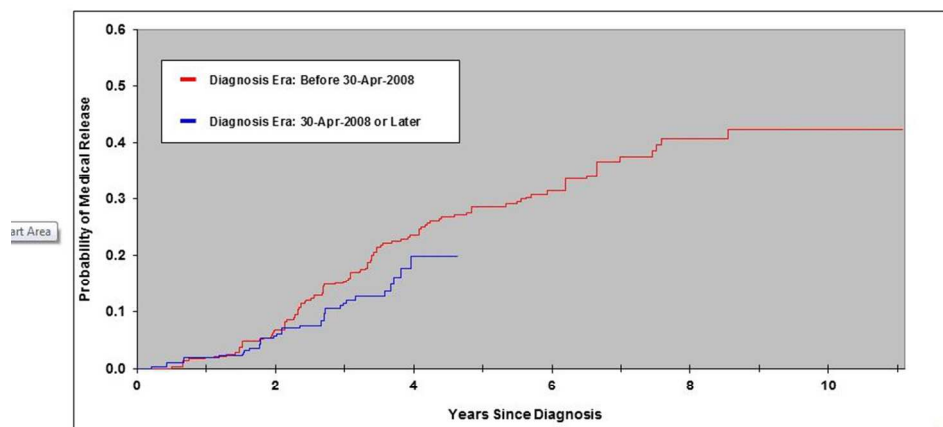   Accessed 20 December 2013.

Figure 1: Kaplan-Meier estimates of the probability of a medical release from military service with increasing time from mental disorder diagnosis by diagnosis era. The diagnosis era was defined using a median split: before 30-Apr-2008 (sample n= 235, weighted N=2659) and 30-Apr-2008 or later (sample n= 273, weighted N=2678).
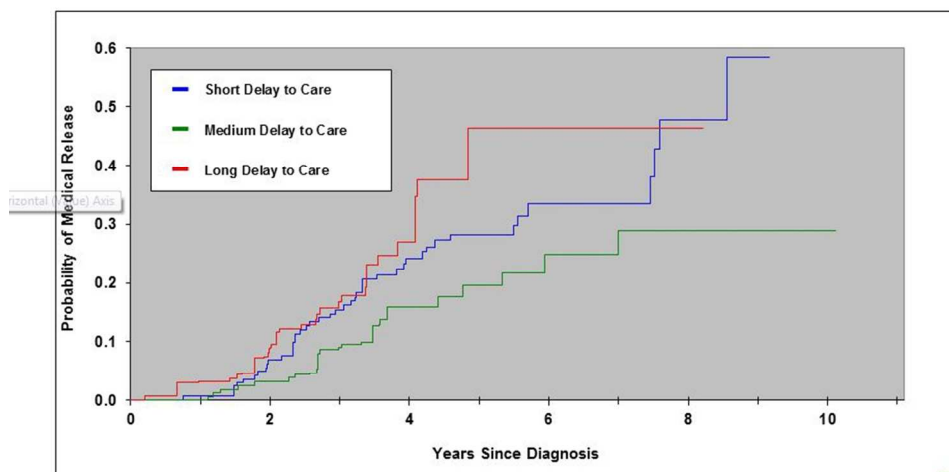
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262x163mm (96 x 96 DPI)

Figure 2: Kaplan-Meier estimates of the probability of a medical release from military service with increasing time from a mental disorder diagnosis by delay to care. Delay was calculated from the most recent Afghanistan deployment return date to the diagnosis date of an Afghanistan deployment-related disorder. Delays to care were categorized into tertiles: short (≤ 245 days; sample n= 138, weighted N=1355), medium (246 to 636 days; sample n= 144, weighted N=1394) and long (≥ 637 days; sample n= 133, weighted N=1360).

Figure 2: Kaplan-Meier estimates of the probability of a medical release from military service with increasing time from a mental disorder diagnosis by delay to care. Delay was calculated from the most recent Afghanistan deployment return date to the diagnosis date of an Afghanistan deployment-related disorder. Delays to care were categorized into tertiles: short (≤ 245 days; sample n= 138, weighted N=1355), medium (246 to 636 days; sample n= 144, weighted N=1394) and long (≥ 637 days; sample n= 133, weighted N=1360).
255x184mm (96 x 96 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed
		Case-control study—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed
		Case-control study—If applicable, explain how matching of cases and controls was addressed
		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion

Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Do shorter delays to care and mental health system renewal translate into better occupational outcome after mental disorder diagnosis in a cohort of Canadian military personnel who returned from an Afghanistan deployment?

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Do shorter delays to care and mental health system renewal translate into better occupational outcome after mental disorder diagnosis in a cohort of Canadian military personnel who returned from an Afghanistan deployment?

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Keywords: military, mental health, attrition, delay to care

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ABSTRACT

Objective: Mental disorders in military personnel result in high rates of attrition. Military organizations have strengthened their mental health systems and attempted to overcome barriers to care in order to see better outcomes. This study investigated the roles of mental health services renewal and delay to care in Canadian Armed Forces (CAF) personnel diagnosed with mental disorders.

Design: Administrative data were used to identify a retrospective cohort of 30,513 CAF personnel who deployed in support of the mission in Afghanistan. Study subjects included 508 individuals with a mental disorder diagnosis identified from CAF medical records of a weighted, stratified random sample of 2014 individuals selected from the study cohort. Weighted Cox proportional hazards regression assessed the association of diagnosis era and delay to care with the outcome, after controlling for a broad range of potential confounders (e.g., disorder severity, comorbidity). Taylor series linearization methods and sample design weights were applied in generating descriptive and regression analysis statistics.

Primary Outcome: The outcome was release from military service for medical reasons, assessed using administrative data for the 508 individuals with a mental disorder diagnosis.

Results: 17.5% [95% CI: 16.0-19.0] of the cohort had a mental disorder diagnosis after an Afghanistan-related deployment, of which 21.3% [95% CI: 17.2-25.5] had a medical release over a median follow-up of 3.5 years. Medical release risk was elevated for individuals diagnosed before 30-Apr-2008 relative to those with more recent diagnoses (aHR, 1.77 [95% CI, 1.01-3.11]) and for individuals with a long delay to care (> 21 months after return) relative to those with intermediate delays (8 to 21 months, aHR, 2.47 [95% CI, 1.28-4.76]).

Conclusions: Mental health services renewal in the CAF was associated with a better occupational outcome for those diagnosed with mental disorders. Longer delays to care were associated with a less favorable outcome.

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Strengths and limitations of this study

- This study demonstrates that two modifiable factors, mental health system change and delay to care, have associations with medically-related attrition rates among personnel with a mental disorder in a previously deployed Canadian military cohort. After controlling for potential confounding variables, the accumulation of change in the Canadian military's mental health system was determined to be associated with lower rates of medically-related attrition. Long delays to care were associated with higher rates medically-related attrition.

- Disorder severity, diagnosis mix (specifically, PTSD co-morbid with a depressive disorder), being a non-commissioned service member, and being in certain occupational categories were also determined to be independently associated with medically-related attrition rates.

- Diagnosis era was a proxy for changes in the CAF mental health system. It was not possible to identify precise implementation time-points for the many concurrent mental health system changes, precluding identification of the drivers of the more favorable outcomes seen over time.

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INTRODUCTION

Since 2001, millions of military personnel have deployed to the conflicts in Southwest Asia; many have returned with mental health problems.[1,2] In Canada, 13.5% of personnel who deployed in support of the mission in Afghanistan were diagnosed with a service-related mental disorder within four years after their return.[2] For those in high-threat locations, rates approached 30% after seven years.[2]

Mental health problems have a pronounced impact on military occupational fitness,[3-17] which in turn can lead to attrition when personnel fail to meet stringent military occupational fitness requirements. Attrition is the largest single mental health-related cost for employers[18] and it has particular salience for military organizations, given their extensive and specialized training requirements.

Many factors influence adverse military occupational outcomes such as attrition.[5-8, 10, 17, 19-24] In addition to mental health problems,[3-17] factors include age,[5-8, 10, 19-21, 24] gender,[5-7, 10, 17, 19-22] race/ethnicity,[6, 8, 19] rank,[5, 10, 17, 19, 20, 23, 24] component (Regular or Reserve Force),[19] years of service,[10, 17, 23, 24] marital status,[10, 22, 24] element (Army, Navy or Air Force),[5, 21] and education.[10]

Research on factors influencing outcome among those with mental disorders is sparse. Associations have been seen with diagnosis,[17, 23] illness severity,[23, 24] years of service,[17, 23, 24] combat occupation,[17, 24] rank,[17, 23, 24] gender,[17, 24] age,[24] marital status,[24] presence of comorbid conditions,[17] and treatment,[17] factors that are mostly non-modifiable.

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The Canadian Armed Forces (CAF) has reinforced its mental health system over the past 15 years.[25] The number of mental health providers has more than doubled. Seven multidisciplinary centers now provide standardized assessment and treatment of service-related mental health problems. Lower levels of stigma and other barriers to care have been seen in comparison to other military organizations,[26] perhaps as a result of de-stigmatization efforts.[27] Extensive resilience and mental health training is embedded throughout individuals' careers and across the deployment cycle, which includes in-depth post-deployment mental health screening.[28] The past decade has also seen policy changes that make it easier for personnel who recover from mental disorders to remain in uniform. Other nations have engaged in similar efforts. [29, 30]

Mental disorders have been shown to be associated with attrition,[13, 31] both before and after the current conflicts in Southwest Asia, but there are no formal assessments of changes in prognosis over time. Additionally, the temporal changes in the CAF mental health system that targeted reductions in barriers to care-seeking as one of its objectives were expected to impact those who would otherwise not seek care as well as reduce care-seeking delays in others. However, delay to care can potentially act independently on medically-related attrition, as it is has been asserted that early care for PTSD and other mental disorders has the potential to improve long-term prognosis. Unfortunately, there is very little research supporting this assertion.[32]

This study investigates risk factors for medically-related attrition among personnel who deployed in support of the CAF mission in Afghanistan and were diagnosed with a mental disorder. We hypothesized that those who were diagnosed

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later in the course of the conflict and those who presented for care earlier would

independently show more favourable outcomes.

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METHODS

Study Population and Sampling:

The study cohort consists of all CAF personnel (N = 30,513) who initiated a deployment outside of North America and Europe in support of the Afghanistan mission from 01-October-2001 through 31-December-2008. Over the duration of the mission, 158 CAF personnel died on-duty. A weighted, stratified random sample of 2045 individuals was identified and medical records of 2014 were reviewed; medical records were inaccessible for 31 individuals before the end of the chart-review phase of the study, either because they were in transition to a new location or were in active use for reasons other than treatment. The sampling strata were defined by deployment location and apparent mental health services use, strata relevant to the parent study's primary objective.[2]

The current study was limited to 508 of the 2014 individuals whose chart review indicated that they had a mental disorder diagnosis dated after the start date of their first Afghanistan-related deployment.

Data Collection:

As discussed elsewhere,[2] deployment details came from administrative databases. Mental disorder diagnoses, mental disorder history, and clinician-identified attributions to service were abstracted from medical records over the period of 22-June-2010 to 30-May-2011. The evaluations of service-related mental disorders are done in 1 of 7 CAF regional mental health centres and they follow a common, collaborative assessment model that includes psychological testing and consultation with, at

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minimum, a psychiatrist and a psychologist. The clinicians comment on the association between the diagnosis and military service because this can have implications in terms of veterans' benefits.

Data on release from service, demographics, and military characteristics came from administrative databases (extract date: 15-December-2012). Data linkages were based on service number, a unique CAF-specific personal identifier.

Outcome Definition:

The primary outcome was release from military service for medical reasons (i.e., medically-related attrition). The broad categories for release, and their representation in the cohort, include: misconduct (0%); unsatisfactory service (0%); service completed (3.7%); medical (5.4%); and voluntary (19.9%). Medical releases result when individuals are determined to be unfit to perform the full range of their duties as a consequence of a health problem.[33]

Military personnel in the CAF have an occupational fitness requirement, one that takes into consideration the potential duties required under the demanding and unpredictable conditions of operational deployments. This requirement is enshrined in the principle of "Universality of Service," which the CAF enforces by requiring all personnel to be able to perform certain common military tasks and to be deployable to any environment with little medical support. Individuals who are persistently in violation of Universality of Service will be released from service.

When CAF personnel are diagnosed with a medical condition, their clinician determines whether the diagnosis or treatment may interfere with duties. This

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assessment is a sequential process; it begins with a thorough examination, followed by a comprehensive description of medical employment limitations. Clinicians assign a set of codes ("medical categories") that summarize the medical employment limitations' impact on duties. Persistent medical employment limitations and medical categories are validated by physicians in the Medical Standards Section of the CAF, ensuring a standardized application.

While some persistent medical employment limitations will ultimately lead to a release from military service, others will be accommodated. Individuals whose validated limitations are likely to violate Universality of Service undergo an administrative review; those determined to be in violation will ultimately be released.

Covariates of Interest:

The primary covariates of interest were: 1) diagnosis era, a proxy for evolutionary enhancements to the CAF mental health system and changes in medical fitness determination practices for individuals with mental disorders, and 2) delay to diagnosis and care, calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date. The most recent Afghanistan-related deployment return date, prior to a diagnosis, was the most relevant reference point for delay calculations; a majority of the cohort had a single deployment (80%) and it's very rare for an individual to deploy with a significant mental health problem. The median date (30-April-2008) categorized diagnosis dates into two eras. This was based on initial investigations that suggested changes in the medically-related attrition outcome after 2008. Delay to care was categorized into tertiles: ≤ 245 days (≤ 8 months), 246 to 636 days (8 to 21

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months), and ≥ 637 days (> 21 months). The delay intervals were chosen based on initial investigations that suggested a non-linear, u-shaped, relationship between delay to care and the outcome.

Potential Confounders:

Potential confounders identified in other studies[2-17, 19-24] included: sex; age; element (Army, Navy or Air Force); component (Regular or Reserve Force); rank category; military occupation; years of service; marital status; and presence of live-in dependents. Military occupation was categorized into 8 groups:[34] facility support (FS); health services (HS); information management (IM); intelligence, surveillance and reconnaissance (ISR); operations support (OPS Support); operations technicians (OPS Tech); specialist; and operations (OPS), which included combat arms occupations.

Diagnosis-related covariates included indication of a previous history of mental disorder diagnoses and each DSM-IV-TR (DSM) axis, excluding Axis IV. Axis I diagnosis codes were categorized into 7 groups based on conceptual considerations and disorder patterns: 4 single diagnosis categories of PTSD, Depressive Disorder (i.e., Major Depression or Dysthymic Disorder), Adjustment Disorder or single 'Other' disorder, and 3 comorbid categories of both PTSD and Depressive Disorder only, all other comorbid combinations with PTSD and any other non-PTSD comorbid combination.   Axis II information was dichotomized for presence of a personality disorder or trait, while Axis III information was categorized for presence of a relevant musculoskeletal condition, other condition or none. Functional status (reflected by Axis V, the Global Assessment of Functioning) was categorized into 4 groups: 0-50 (severe

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symptoms); 51-60 (moderate symptoms); 61-70 (mild symptoms); and 71-100 (transient symptoms).

Data Analysis:

The data were analyzed using SAS for Windows, version 9.3, and sampling weights accounted for the design effect. Taylor Series Linearization methods[35] were used to determine 95% confidence intervals (CI's) for descriptive statistics. Missing values were identified for marital status, the presence of live-in dependents, and DSM Axis V. The fully conditional specification multiple imputation method[36] was implemented when analyzing these covariates.

Weighted Kaplan-Meier methods[37] generated event probabilities. Zero-time was defined as the diagnosis date. Event-time was the medical release date. Individuals were censored at the earlier of non-medical release date or database extraction date. 95% CI's for Kaplan-Meier estimates were generated using bootstrap methods.[38]

Weighted Cox regression assessed the association of medical release with covariates; results were expressed as hazard ratios (HR's) and their 95% CI's, generated using Taylor Series Linearization methods.[35] The 2 primary covariates of interest (i.e., diagnosis era and delay to care) were forced into a regression model that included potential confounders selected using a two-stage approach. Initially, weighted Cox regressions assessed the unadjusted relationship between each potential confounder and medical release; covariates with a Wald test p-value less than 0.15 were included in a multivariate model. In the second stage, backwards elimination removed potential confounders using a Wald test p-value threshold of 0.05. Delay to

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care was handled as an interaction term (delay by whether the diagnosis was Afghanistan deployment-related). This approach optimized the use of available data; Afghanistan deployment-related diagnoses use Afghanistan-related deployment return date as a relevant proxy for symptom-onset timing in delay calculations while other diagnoses use Afghanistan-related deployment return date as an imprecise proxy of this timing. Delay to care hazard ratios were only assessed among those with Afghanistan deployment-related diagnoses. Regression diagnostic plots were reviewed with respect to the proportional hazards assumption.[37]

Ethics: The research protocol was approved by Veritas IRB Inc.(Dorval, QC), a privately-operated independent ethics review board.

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RESULTS

Study Cohort Characteristics:

Medical records were reviewed for 2014 individuals and inaccessible for an additional 31. Of the 2014 individuals, 508 who had a mental disorder diagnosis after the start of their first Afghanistan-related deployment comprised the study sample, representing 5337 individuals in the cohort (17.5%, 95% CI: 16.0-19.0).

The study subset consisted largely of men in the Regular Forces of the Army (Table 1). At the time of their diagnosis, a majority of individuals were younger than 40, married, had no live-in dependents, and had less than 20 years of military service. Although 46.0% of the study subset were in the "Operations" occupation category, 79.6% of these were combat arms occupations. Table 1 summarizes the distribution and bivariate associations of these characteristics with medically-related attrition.

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Table 1: Demographic and Military Characteristics of the Study Subset (weighted N = 5,337; sample n = 508) and their Unadjusted Association with Medically-related Attrition.

Characteristic	Un-weighted Sample No.	Weighted %	Medical Release		Unadjusted HR	95% CI
			%	95% CI		
Occupation Categorization[e]						
FS	12	2.7	54.8	24.4, 85.3	5.36[a]	2.21, 12.98
HS	28	4.8	12.6	0.9, 24.3	0.76	0.26, 2.26
IM	31	4.8	18.2	5.0, 31.5	0.79	0.32, 2.00
ISR	22	3.5	21.3	4.2, 38.5	1.29	0.57, 2.92
OPS Support	96	15.4	29.9	19.0, 40.8	1.75[c]	0.98, 3.12
OPS Tech	58	16.0	21.2	9.3, 33.1	0.81	0.36, 1.80
Specialist	34	6.8	15.7	2.7, 28.6	0.86	0.34, 2.18
OPS	227	46.0	18.6	12.7, 24.5	reference	reference
Occupation Categorization (Aggregated)[e]						
FS	12	2.7	54.8	24.4, 85.3	5.75[a]	2.46, 13.46
OPS Support	96	15.4	29.9	19.0, 40.8	1.88[b]	1.11, 3.20
Other	400	81.9	18.6	14.2, 23.0	reference	reference
Component						
Reserve Forces	23	6.7	12.7	0, 28.7	0.68	0.16, 2.81
Regular Forces	485	93.3	21.9	17.6, 26.2	reference	reference
Element[e]						
Air Force	66	12.9	26.9	13.9, 39.9	2.21[c]	0.94, 5.22
Navy	65	21.0	17.4	7.3, 27.5	reference	reference
Army	377	66.1	21.5	16.8, 26.2	1.84[c]	0.95, 3.57
Rank[e]						
Officer	48	10.4	4.9	0, 9.8	reference	reference
SNCM	130	24.8	25.4	16.3, 34.5	6.10[a]	1.92, 19.33
JNCM	330	64.7	22.4	17.2, 27.6	4.63[a]	1.51, 14.17
Sex						
Female	62	9.8	25.2	14.5, 36.0	1.25	0.74, 2.11
Male	446	90.2	20.9	16.4, 25.4	reference	reference
Age[e]						
≤ 29	140	27.9	11.2	5.5, 16.8	reference	reference
30 – 39	234	44.5	24.7	18.3, 31.1	1.85[c]	0.98, 3.47
≥ 40	134	27.6	26.1	17.4, 34.8	2.38[b]	1.20, 4.72
Years of Service[e]						
≤ 9	214	43.1	16.3	10.7, 22.0	reference	reference
10 – 19	194	35.5	24.6	17.5, 31.6	1.42	0.86, 2.35
≥ 20	100	21.4	26.0	16.0, 35.9	1.84[b]	1.01, 3.37
Marital Status (MI)[f]						
Married	350	68.7	23.1	17.8, 28.3	reference	reference
Single – never married	100	20.0	14.5	7.5, 21.4	0.58[c]	0.32, 1.06
Divorced/ Widowed/ Separated	49	9.7	17.5	5.9, 29.1	0.70	0.33, 1.49
Unspecified	9	1.6	55.3	18.7, 92.0		
Live-in Dependents (MI)[e,f]						
Yes	232	42.8	27.3	20.4, 34.2	1.61[b]	1.03, 2.53
No	246	50.8	16.5	11.4, 21.6	reference	reference
Unspecified	30	6.4	19.5	3.5, 35.5		

Mental Disorder Diagnoses:

Table 2 summarizes the distribution of clinical characteristics and their unadjusted association with medically-related attrition. A majority of diagnoses (82.0%; 95% CI: 78.3-85.7) were service-related; 77.0% were attributed to Afghanistan-related deployments and 5.0% were attributed to other deployments. PTSD was the most diagnosed condition (49.1%; 95% CI: 44.2-53.9), followed by Depressive Disorder (i.e., Major Depression or Dysthymic Disorder) (44.7%; 95% CI: 39.5-49.8). PTSD was often a comorbid diagnosis: It occurred alone in 15.7% (95% CI: 12.1-19.4); with Depressive Disorder only in 14.3% (95% CI: 10.9-17.7); and with any other disorder(s) in 19.1% (95% CI: 15.6-22.5).

The median diagnosis date was 30-April-2008 (range: 19-November-2001 to 24-January-2011). The mean delay to care among individuals with an Afghanistan-related mental disorder diagnosis was 551 days (95% CI: 500-602 days; median: 400 days).

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Table 2: Clinical Characteristics among Individuals of the Study Subset (weighted N = 5,337; sample n = 508) and their Unadjusted Association with Medically-related Attrition.

Clinical Characteristic	Un-weighted Sample No.	Weighted %	Medical Release %	Medical Release 95% CI	Unadjusted HR	(95% CI)
Diagnosis Timing[f] (Median Split)						
Apr 30, 2008 or Later	273	50.2	12.1	7.6, 16.6	reference	reference
Before Apr 30, 2008	235	49.8	30.6	23.9, 37.4	1.45[e]	0.87, 2.42
Delay to Care[a,f] (Tertile Split)						
Short: ≤ 245 days	138	33.0	27.3	19.4, 35.2	1.69[d]	0.93, 3.08
Medium: 246 to 636 days	144	33.9	14.7	8.4, 20.9	reference	reference
Long: ≥ 637 days	133	33.1	23.1	14.1, 32.1	2.24[c]	1.17, 4.30
Mental Disorder Diagnosis History						
Yes	142	28.4	23.0	15.1, 30.8	0.84	0.52, 1.37
None Indicated	366	71.6	20.7	15.8, 25.6	reference	reference
Mental Disorder Diagnoses						
Any PTSD	272	49.1	28.9	22.8, 35.0	2.22[b]	1.36, 3.63
No PTSD	236	50.9	14.0	8.6, 19.4	reference	reference
Any Non-PTSD Anxiety	128	26.8	14.7	7.9, 21.6	0.54[c]	0.31, 0.95
No Non-PTSD Anxiety	380	73.2	23.7	18.7, 28.8	reference	reference
Any Adjustment Disorder	128	23.6	17.3	9.4, 25.3	0.73	0.41, 1.31
No Adjustment Disorder	380	76.4	22.5	17.7, 27.4	reference	reference
Any Depressive Disorder	228	44.7	25.6	19.0, 32.2	1.58[c]	1.00, 2.48
No Depressive Disorder	280	55.3	17.9	12.5, 23.2	reference	reference
Any Bipolar Disorder	6	1.7	35.7	0, 79.0	1.34	0.51, 3.54
No Bipolar Disorder	502	98.3	21.1	16.9, 25.2	reference	reference
Any Other Mood Disorder	7	1.7	9.8	0, 28.7	0.25	0.03, 2.30
No Other Mood Disorder	501	98.3	21.5	17.3, 25.7	reference	reference
Any Somatoform Disorder	6	1.5	79.9	44.5, 100	4.52[c]	1.16, 17.64
No Somatoform Disorder	502	98.5	20.4	16.3, 24.6	reference	reference
Any Substance Abuse Disorder	83	16.1	19.3	9.7, 28.9	0.93	0.52, 1.66
No Substance Abuse Disorder	425	83.9	21.7	17.1, 26.3	reference	reference
Mental Disorder Diagnosis Case-mix[f]						
PTSD Only	79	15.7	25.5	13.8, 37.2	1.50	0.58, 3.88
Depressive Disorder Only	58	13.4	20.4	7.1, 33.7	1.46	0.51, 4.20
Other Single Diagnosis Only	47	10.8	4.0	0.0, 8.4	0.21[c]	0.05, 0.87
Adjustment Disorder Only	59	10.7	18.2	5.6, 30.7	reference	reference
PTSD and Depressive Disorder	80	14.3	33.8	22.5, 45.2	2.38[d]	0.97, 5.82
PTSD and Other	113	19.1	28.0	18.7, 37.3	1.82	0.75, 4.41
Any Other Combination (excl. PTSD)	72	15.9	12.7	3.7, 21.7	0.74	0.25, 2.22
DSM IV – AXIS II Personality Disorder/Trait						
Yes	70	14.3	20.7	9.1, 32.3	0.97	0.50, 1.89

None Indicated	438	85.7	21.4	17.0, 25.9	reference	reference
DSM IV – AXIS III General Medical Conditions Present[f]						
Musculoskeletal	126	24.6	31.2	21.7, 40.6	1.92[c]	1.15, 3.21
Other	117	22.5	22.8	13.5, 32.0	1.42	0.80, 2.53
None Indicated	265	52.9	16.1	11.1, 21.1	reference	reference
DSM IV – AXIS V Global Assessment of Functioning (MI)[f,g]						
0-50: Severe Symptoms	46	7.5	42.5	27.6, 57.4	9.32[b]	2.89, 30.09
51-60: Moderate Symptoms	152	27.8	19.7	13.1, 26.4	2.98[d]	0.89, 9.95
61-70: Mild Symptoms	163	33.7	25.3	17.0, 33.6	3.76[c]	1.23, 11.49
71-100: Transient Symptoms	55	11.7	7.1	1.8, 12.3	reference	reference
Unspecified	92	19.3	17.0	7.6, 26.5		

Abbreviations: MI, Multiple Imputation used;
[a] Delay to care is calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date, for diagnoses attributed to an Afghanistan deployment (n=415).
[b] p-value ≤ 0.01
[c] p-value ≤ 0.05
[d] p-value ≤ 0.1
[e] p-value ≤ 0.15
Otherwise, p-value >0.15
[f] The Wald test p-value was less than 0.15 for variables: Diagnosis Timing, Delay to Care, Mental Disorder Diagnosis Case-mix (including any PTSD, any non-PTSD Anxiety Disorder, any Depressive Disorder and any Somatoform Disorder), DSM IV - AXIS III General Medical Conditions Present and DSM IV - AXIS V Global Assessment of Functioning (MI).
[g] Multiple imputation was used to compute the unadjusted HR for variable: DSM IV – AXIS V Global Assessment of Functioning (MI).

Medically-Related Attrition:

As of 15-December-2012, 35.5% (95% CI: 30.8-40.3) had released from service, 21.3% (95% CI: 17.2-25.5) were medical releases and 14.2% (95% CI: 10.7-17.8) were for other reasons (i.e., 12.7% voluntary releases; 1.5% service completion releases). Mean follow-up time from diagnosis to the earlier of release or censor date was 1456 days (95% CI: 1373-1538 days); the median was 1267 days (3.5 years). Individuals who medically released had a mean of 15.5 years of service (95% CI: 13.7-17.3) at the time of release while those without a medical release had 13.0 years (95% CI: 12.2-13.8) at censor date.

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At 5 years of follow-up, an estimated 25.8% (95% CI: 20.2-31.4) medically released compared with 13.7% (95% CI: 10.1-17.3) releasing for other reasons. There was separation in the Kaplan-Meier curves for medical release by diagnosis era (Figure 1). Follow-up time was limited for more recent diagnoses; the maximum was 4.6 years. At 4.5 years of follow-up, an estimated 26.8% (95% CI: 20.2-33.3) of those diagnosed before 30-April-2008 (median) had medically released compared with 19.7% (95% CI: 12.1-27.2) thereafter. However, the unadjusted hazard ratio comparing diagnosis eras was not statistically significant (HR, 1.45 [95% CI, 0.87-2.42]) (Table 2).

At 5 years of follow-up, an estimated 29.1% (95% CI: 22.5-35.8) of individuals whose mental disorder diagnosis was Afghanistan deployment-related had medically released. Figure 2 displays the Kaplan-Meier curves for medical release as a function of delay to care among individuals with an Afghanistan deployment-related diagnosis. Separation in the curves was again noted: At 5 years of follow-up, an estimated 28.3% (95% CI: 18.7-37.8) of those with a short delay to care (≤ 245 days) medically released compared to 19.5% (95% CI: 10.6-28.5) with a medium delay (246 to 636 days) and 46.4% (95% CI: 27.4-65.4) with a long delay (≥ 637 days). While medical release risk was elevated for individuals having either short or long delays to care, relative to those with medium delays, the unadjusted hazard ratio was not statistically significant for short delays (HR, 1.69 [95% CI, 0.93-3.08]) but it was for long delays (HR, 2.24 [95% CI, 1.17-4.30]) (Table 2).

Cox Proportional Hazards Regression:

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The mental disorder history, DSM Axis II, component, sex, and marital status potential confounders were discarded during assessment of their unadjusted relationship with medical release; DSM Axis III, element, age category, years of service, and live-in dependents were discarded during the backwards elimination regression. The final model that assessed the primary covariates controlled for diagnosis case-mix, military occupation, DSM Axis V (functional impairment), and rank category.

The adjusted model (Table 3) showed that individuals diagnosed before the median date of 30-Apr-2008 had a higher medical release risk relative to those diagnosed more recently (adjusted HR (aHR), 1.77 [95% CI, 1.01-3.11]). Among individuals with an Afghanistan deployment-related mental disorder, those with a long delay to care had a higher medical release risk relative to those with a medium delay (aHR, 2.47 [95% CI, 1.28-4.76]); there was no statistically significant difference in risk between those with short and intermediate delays to care (aHR, 1.55 [95% CI, 0.85-2.83]).

Medically-related attrition risk varied by diagnosis mix (Table 3). Individuals with both a PTSD and Depression diagnosis had a higher risk relative to those with adjustment disorder alone (aHR, 2.88 [95% CI, 1.05-7.88]). However, while individuals with PTSD alone, Depression alone or PTSD with other mental disorder diagnoses had comparably elevated medical release risks relative to those with adjustment disorder alone, these were not statistically significant. The medically-related attrition risk was also higher for individuals in the Axis V severe symptoms category (aHR, 8.48 [95% CI, 1.86-38.73]) relative to those with transient symptoms and elevated but not statistically

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significant for individuals with moderate or mild symptoms. Additionally, medically-related attrition risk was higher for individuals in both the junior (aHR, 4.12 [95% CI, 1.15-14.73]) and senior (aHR, 4.93 [95% CI, 1.35-18.05]) non-commissioned member rank categories relative to officers.

Table 3: Cox Proportional Hazard Regression Assessment of the Adjusted Association of Demographic, Military and Clinical Characteristics with Medical Release, following a Backwards Elimination Selection Process[b].

Characteristic	Adjusted HR	95% CI
Diagnosis Timing (Median Split)		
Apr 30, 2008 or Later	reference	reference
Before Apr 30, 2008	1.77 [d]	1.01, 3.11
Delay to Care[a] (Tertile Split)		
Short: ≤ 245 days	1.55	0.85, 2.83
Medium: 246 to 636 days	reference	reference
Long: ≥ 637 days	2.47[c]	1.28, 4.76
Mental Disorder Diagnosis Case-mix		
PTSD Only	2.17	0.77, 6.07
Depressive Disorder Only	2.29	0.68, 7.65
Other Single Diagnosis Only	0.32	0.07, 1.48
Adjustment Disorder Only	reference	reference
PTSD and Depressive Disorder	2.88[d]	1.05, 7.88
PTSD and Other	1.99	0.72, 5.48
Any Other Combination (excl. PTSD)	1.05	0.29, 3.78
DSM IV – AXIS V Global Assessment of Functioning (MI)		
0-50: Severe Symptoms	8.48[c]	1.86, 38.73
51-60: Moderate Symptoms	2.44	0.52, 11.53
61-70: Some Mild Symptoms	3.45[e]	0.81, 14.65
71-100: Transient Symptoms	reference	reference
Occupation Categorization (Aggregated)		
FS	4.98[c]	1.62, 15.32
OPS Support	2.40[c]	1.41, 4.08
Other	reference	reference
Rank		
Officer	reference	reference
SNCM	4.93[d]	1.35, 18.05
JNCM	4.12[d]	1.15, 14.73

Abbreviations: FS, Facility Support; OPS Support, Operations Support; MI, Multiple Imputation used; JNCM, Junior Non-commissioned Member; SNCM, Senior Non-commissioned Member.
[a] Delay to care is calculated as the latency from most recent Afghanistan-related deployment return date to diagnosis date, for diagnoses attributed to an Afghanistan deployment (n=415).
[b] A backwards elimination selection process identified the following variables for removal from the final assessment model, listed in their order of removal: Live-in Dependents, Years of Service, Element, DSM IV – AXIS III and Age.
[c] p-value ≤ 0.01
[d] p-value ≤ 0.05
[e] p-value ≤ 0.10
Otherwise, p-value >0.10

The occupation categorization was modified following the assessment of its unadjusted relationship with medical release, keeping facility support and operations support, which had elevated hazard ratios, but aggregating other occupational categories, which did not. Attrition risk was higher for the facility support (aHR, 4.98 [95% CI, 1.62-15.32]) and operations support (aHR, 2.40 [95% CI, 1.41-4.08]) categories relative to the aggregated occupational category. Facility support included occupations such as construction engineers, fire fighters, plumber/gas fitter, and technicians in: water, fuels and the environment, electrical distribution, plumbing and heating, refrigeration and mechanical systems, and weather systems processing. Operations support included occupations such as logistics support, air traffic controllers, supply technicians, traffic technicians, postal clerks, administrative clerks, financial clerks, resource management support clerks, and mobile support equipment operators.

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DISCUSSION

Key Findings:

Our study's primary objective was to explore the association of mental disorder diagnosis era and delay to care with medically-related attrition. We observed that an unfavorable occupational prognosis was more likely for individuals diagnosed before 30-April-2008 (aHR = 1.77). Also as hypothesized, those with the longest delay to care (> 21 months) had a higher risk of medical release relative to those with an intermediate delay (aHR = 2.47). There was no significant difference in outcome between those with short and intermediate delays to care.

We identified several other independent risk factors for medically-related attrition, including: disorder severity, diagnosis mix (specifically, PTSD co-morbid with a depressive disorder), being a non-commissioned member, and being in certain occupational categories. A number of potential risk factors had no significant relationship with the primary outcome, including DSM Axis II co-morbidity, complicating musculoskeletal or other medical problems, a past history of mental disorders, age, years of service, sex, marital status, live-in dependents, component (Regular or Reserve Forces), and element (Army, Navy or Air Force).

Comparison with Other Findings:

We could not identify other studies that compared military occupational outcome from one time period to another among individuals with mental disorders. While there is evidence that PTSD remission rates have been increasing over time,[39] the effect on attrition is unknown. Studies on the association of prognosis relative to the timing of

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care are sparse, though consistent with our findings, Maguen and colleagues[32] found indications that veterans who initiated PTSD treatment earlier after deployment return were more likely to see symptom improvement.

Our finding of a less favorable occupational outcome among individuals with more severe illness and in lower ranks mirrors the unadjusted findings from others.[17, 23, 24] In contrast, while we observed a less favorable outcome for certain occupations, these occupations differed from ones identified by others (combat arms occupations).[17, 24] Other studies identified gender,[17] service length,[17, 24] and diagnosis[17, 23, 24] to be associated with outcomes in their adjusted models. We did not find significant associations for gender or service length in our adjusted models but we did for diagnosis mix. However, these other studies were among different populations, used premature release from service[17, 24] or return to occupational fitness[23] as outcomes and they emanate from other military organizations in which these and other prognostic factors may play out differently.

Strengths and Limitations:

This study's primary strength is that it explores an important but under-researched issue: the effects of mental health service renewal and delay to care on occupational prognosis of military mental health problems. We were able to control for a broad range of potential confounders, notably severity and various forms of medical and psychiatric comorbidity. The time-to-event analytic approach allowed for an efficient use of the data.

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This study's primary limitation is its observational nature: We sought to explore changes in prognosis as a function of diagnosis era, itself a proxy for evolutionary changes in the CAF mental health system. It is possible that unmeasured factors could account for the observed improvement in prognosis. We were unable to identify precise implementation time-points for the many concurrent changes, precluding identification of the drivers of the more favorable outcomes seen over time. We could not control for unmeasured factors related to care-seeking behaviours and the timing of first care which are potentially associated with occupational prognosis.

It was not possible to distinguish medically-related attrition that was due to physical issues from those that were due to mental health issues for the entire study population. Augmented data on the medical condition attributed to a medical release began to be collected in 2009 and, therefore, was available for only a subset of the individuals in this study (i.e., 46% of those with a medical release). Among these individuals with such data and a medical release, 56% had a mental disorder identified as the primary condition attributed to the medical release; an additional 3% had a mental disorder identified as a secondary condition.

We calculated delay to care using the most recent Afghanistan-related deployment return date prior to diagnosis and not the unknown timing of the precipitating incident or symptom-onset. While our sample size was large enough to identify at least some significant predictors (notably those related to our primary objective), there was limited power to detect differences for some comparisons. Finally, there is a possibility that our favorable findings reflect a delay to medically-related attrition, a beneficial short-term outcome, as opposed to a shift from releases for

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medical reasons to releases for other reasons (e.g., term of service completed), a

beneficial long-term outcome.

Implications:

A sizable fraction of personnel who deployed in support of the CAF mission in

Afghanistan will be diagnosed with a service-related mental disorder and we observed

that almost 30% of those who do will medically release within 5 years. Those who

medically release will take their substantial military experience (15.5 years, on average)

with them when they leave. This speaks to the sizable impact of service-related mental

disorders on military organizations and to the benefits of efforts to reduce medically-

related attrition.

We found encouraging evidence that occupational prognosis for post-deployment

mental disorders improved significantly over the past 12 years in the CAF. Since many

possible sources of confounding were addressed, we believe that this finding is related

to mental health system changes. Further research may permit identification of the

relative contribution of each of the many implemented changes.

We also found that those who presented for care relatively late (> 21 months

after return) had poorer occupational prognosis. However, while prognosis tended to be

poorer for individuals with a short delay to care relative to those with a medium delay,

this did not achieve statistical significance. The decision to seek care is a complicated

one. Illness perceptions and concerns such as stigma, career-impact of care-seeking,

eligibility for later benefits, confidence in care provision, uncertainty of need, etc. can

influence care-seeking;[26] we did not measure these factors. Assessment of these

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would be helpful in future research. While our findings on delay to care and prognosis are encouraging, definitive studies are needed to assess specific interventions to shorten the delay to care (e.g., anti-stigma programs, screening).

Decreases in delay to care were an explicit target of CAF mental health services renewal and we found that shorter delays were independently associated with more favorable outcomes. Hence, if these promotion activities were successful, our estimate of the beneficial effect of mental health services renewal (captured by diagnosis era) may be conservative.

Some of our findings may help clinicians prognosticate more effectively, at least with occupational prognosis. Interestingly, a past history of mental health problems, medical comorbidity, Axis II comorbidity, and Axis I comorbidity patterns other than PTSD comorbid with depressive disorder were not associated with an unfavorable occupational outcome.

In contrast, non-commissioned members had a four-fold greater risk of medical release relative to officers. Those in two occupational categories also had an elevated risk. This is surprising, given that the mental health-related fitness standards largely do not differ by rank or occupation. We have no clear explanation for these phenomena.

Conclusion:

The CAF and other military organizations have invested heavily in their mental health systems. We found that these investments were associated with an encouraging decrease in medically-related attrition and that shorter delays to care may also lead to better occupational outcomes. These findings speak to the potential impact of mental

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health services renewal and efforts to shorten delay to care. The high prevalence of

deployment related mental disorders, their sizeable risk for medically-related attrition

and the substantial expertise inevitably lost during medical release all reinforce the

potential impact of these efforts.

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Data sharing statement: No additional data available.

Ethics approval: This research was approved by Veritas Research Ethics Board (Dorval, QC).

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Figure 1: Kaplan-Meier estimates of the probability of a medical release from military service with increasing time from mental disorder diagnosis by diagnosis era. The diagnosis era was defined using a median split: before 30-Apr-2008 (sample n= 235, weighted N=2659) and 30-Apr-2008 or later (sample n= 273, weighted N=2678).
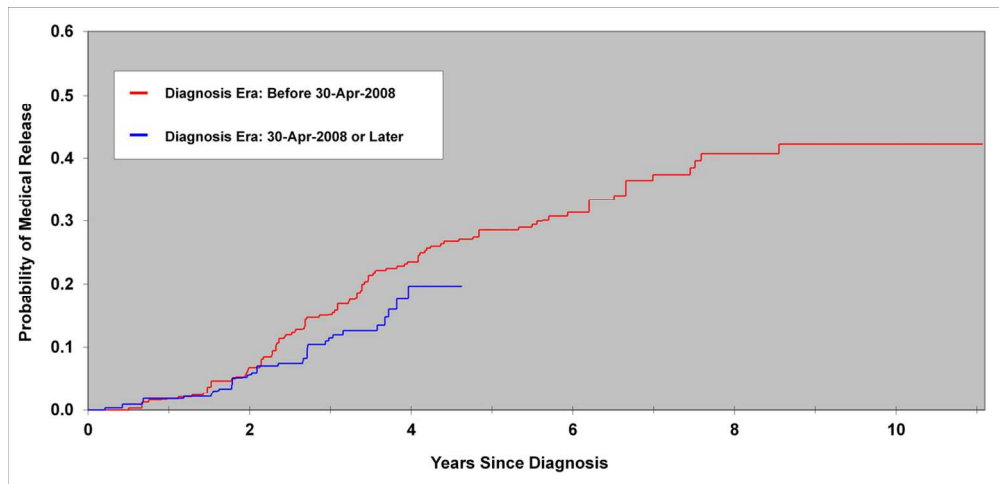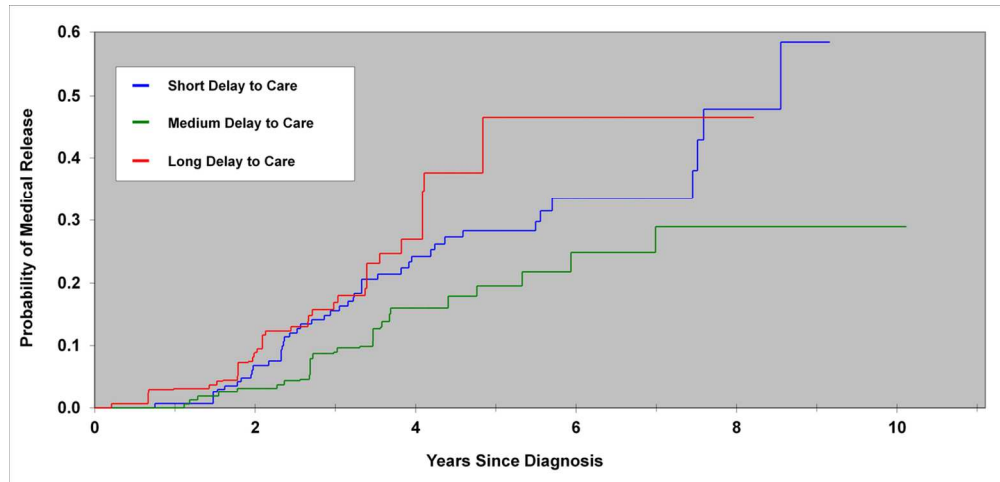122x58mm (300 x 300 DPI)

Figure 2: Kaplan-Meier estimates of the probability of a medical release from military service with increasing time from a mental disorder diagnosis by delay to care. Delay was calculated from the most recent Afghanistan deployment return date to the diagnosis date of an Afghanistan deployment-related disorder. Delays to care were categorized into tertiles: short (≤ 245 days; sample n= 138, weighted N=1355), medium (246 to 636 days; sample n= 144, weighted N=1394) and long (≥ 637 days; sample n= 133, weighted N=1360).
122x59mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed
		Case-control study—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed
		Case-control study—If applicable, explain how matching of cases and controls was addressed
		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses

Discussion

Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.