ORIGINAL RESEARCH

Frailty Trends in an Older Veteran Subpopulation 1 Year Prior and Into the COVID-19 Pandemic Using CAN Scores

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Background: We studied the effects of the first year of the COVID-19 pandemic on frailty trends in a subset of older veterans at the Phoenix Veterans Affairs Health Care System.
Methods: We identified 3538 and 6103 veterans aged 70 to 75 years as of February 8, 2019, with a calculated Care Assessment Need (CAN) score of ≥ 75 for 1-year mortality and hospitalization, respectively. After excluding veterans with insufficient 2020 and 2021 data, we compared the difference in 1-year mortality and hospitalization CAN scores from 2019 to 2020 with 2020 to 2021 using a paired *t* test.

Results: The difference in mean (SD) 1-year mortality CAN scores from 2020 to 2021 was 0.2 (13.4) when compared with the previous year's -4.9 (12.5) ($P < .0001$), indicating increased frailty. The difference in 1-year hospitalization CAN scores from 2020 to 2021 was -1.5 (12.0) when compared with the previous year's -2.8 (9.9) ($P < .0001$).
Conclusions: Frailty in our veteran subpopulation as calculated by 1-year mortality CAN scores increased in the first year of the COVID-19 pandemic when compared with a recovering trend the previous year.

Frailty is an age-associated, nonspecific vulnerability to adverse health outcomes. Frailty can also be described as a complex of symptoms characterized by impaired stress tolerance due to a decline in the functionality of different organs.[1] The prevalence of frailty varies widely depending on the method of measurement and the population studied.[2-4] It is a nonconstant factor that increases with age. A deficit accumulation frailty index (FI) is one method used to measure frailty.[5] This approach sees frailty as a multidimensional risk state measured by quantity rather than the nature of health concerns. A deficit accumulation FI does not require physical testing but correlates well with other phenotypic FIs.[6] It is, however, time consuming, as ≥ 30 deficits need to be measured to offer greater stability to the frailty estimate.

Health care is seeing increasing utilization of big data analytics to derive predictive models and help with resource allocation. There are currently 2 existing automated tools to predict health care utilization and mortality at the US Department of Veterans Affairs (VA): the VA Frailty Index (VA-FI-10) and the Care Assessment Need (CAN). VA-FI-10 is an *International Statistical Classification of Diseases, Tenth Revision* (*ICD-10*) update of the VA-FI that was created in March 2021. The VA-FI-10 is a claims-based frailty assessment tool using 31 health deficits. Calculating the VA-FI-10 requires defining an index date and lookback period (typically 3 years) relative to which it will be calculated.[7]

CAN is a set of risk-stratifying statistical models run on veterans receiving VA primary care services as part of a patient aligned care team (PACT) using electronic health record data.[8] Each veteran is stratified based on the individual's risks of hospitalization, death, and hospitalization or death. These 3 events are predicted for 90-day and 1-year time periods for a total of 6 distinct outcomes. CAN is currently on its third iteration (CAN 2.5) and scores range from 0 (low) to 99 (high). CAN scores are updated weekly. The 1-year hospitalization probabilities for all patients range from 0.8% to 93.1%. For patients with a CAN score of 50, the probability of being hospitalized within a year ranges from 4.5% to 5.2%, which increases to 32.2% to 36% for veterans with a CAN score of 95. The probability range widens significantly (32.2%-93.1%) for patients in the top 5 CAN scores (95-99).

CAN scores are a potential screening tool for frailty among older adults; they are generated automatically and provide acceptable diagnostic accuracy. Hence, the CAN score may be a useful tool for primary care practitioners for the detection of frailty in their patients. The CAN score has shown a moderate positive association with the FRAIL Scale.[9,10] The population-based studies that have used the FI approach (differing FIs, depending on

the data available) give robust results: People accumulate an average of 0.03 deficits per year after the age of 70 years.[11] Interventions to delay or reverse frailty have not been clearly defined with heterogeneity in the definition of frailty and measurement of frailty outcomes.[12,13] The prevalence of frailty in the veteran population is substantially higher than the prevalence in community populations with a similar age distribution. There is also mounting evidence that veterans accumulate deficits more rapidly than their civilian counterparts.[14]

COVID-19 was declared a pandemic in March 2020 and had many impacts on global health that were most marked in the first year. These included reductions in hospital visits for non-COVID-19 health concerns, a reduction in completed screening tests, an initial reduction in other infectious diseases (attributable to quarantines), and an increase or worsening of mental health concerns.[15,16]

We aimed to investigate whether frailty increased disproportionately in a subset of older veterans in the first year of the COVID-19 pandemic when compared with the previous year using CAN scores. This single institution, longitudinal cohort study was determined to be exempt from institutional review board review but was approved by the Phoenix VA Health Care System (PVAHCS) Research and Development Committee.

METHODS

The Office of Clinical Systems Development and Evaluation (CSDE–10E2A) produces a weekly CAN Score Report to help identify the highest-risk patients in a primary care panel or cohort. CAN scores range from 0 (lowest risk) to 99 (highest risk), indicating how likely a patient is to experience hospitalization or death compared with other VA patients. CAN scores are calculated with statistical prediction models that use data elements from the following Corporate Data Warehouse (CDW) domains: demographics, health care utilization, laboratory tests, medical conditions, medications, and vital signs (eAppendix available online at 10.12788/fp.0385).

The CAN Score Report is generated weekly and stored on a CDW server. A patient will receive all 6 distinct CAN scores if

TABLE 1 Patient Baseline Characteristics

Criteria	Care Assessment Need events	
	Mortality (n = 3532)	Hospitalization (n = 6046)
Sex, No. (%)		
Male	3488 (98.8)	5874 (97.2)
Female	44 (1.2)	172 (2.8)
Age, mean (SD), y	71.8 (1.3)	71.7 (1.3)

**TABLE 2** Difference in 1-Year Care Assessment Need Scores

Variables	No.	Difference in mean score (95% CI)		P value
		2019 to 2020	2020 to 2021	
Mortality	3532	-4.9 (-5.3 to -4.5)	0.2 (-0.3 to 0.6)	< .0001
Hospitalization	6046	-2.8 (-3.1 to -2.6)	-1.5 (-1.8 to -1.2)	< .0001

they are: (1) assigned to a primary care PACT on the risk date; (2) a veteran; (3) not hospitalized in a VA facility on the risk date; and (4) alive as of the risk date. New to CAN 2.5 is that patients who meet criteria 1, 2, and 4 but are hospitalized in a VA facility on the risk date will receive CAN scores for the 1-year and 90-day mortality models.

Utilizing VA Informatics and Computing Infrastructure (VA HSR RES 13-457, US Department of Veterans Affairs [2008]), we obtained 2 lists of veterans aged 70 to 75 years on February 8, 2019, with a calculated CAN score of ≥ 75 for 1-year mortality and 1-year hospitalization on that date. A veteran with a CAN score of ≥ 75 is likely to be prefrail or frail.[9,10] Veterans who did not have a corresponding calculated CAN score on February 7, 2020, and February 12, 2021, were excluded. COVID-19 was declared a public health emergency in the United States on January 31, 2020, and the World Health Organization declared COVID-19 a pandemic on March 11, 2020.[17] We picked February 7, 2020, within this time frame and without any other special significance. We picked additional CAN score calculation dates approximately 1 year prior and 1 year after this date. Veterans had to be alive on February 12, 2021, (the last date of the CAN score) to be included in the cohorts.

Statistical Analyses

The difference in CAN score from one year to the next was calculated for each patient.

FIGURE 1 CONSORT Diagram
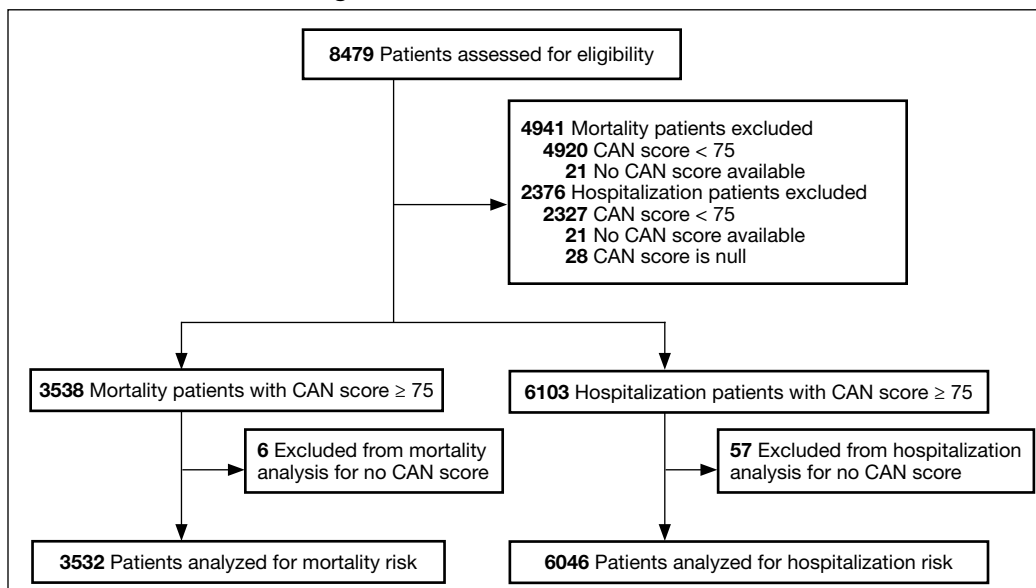
Abbreviation: CAN, Care Assessment Need.

The difference between 2019 and 2020 was compared with the difference between 2020 to 2021 using a paired *t* test. Yearly CAN score values were analyzed using repeated measures analysis of variance. The number of patients that showed an increase in CAN score (ie, increased risk of either mortality or hospitalization within the year) or a decrease (lower risk) was compared using the χ^2 test. IBM SPSS v26 and GraphPad Prism v18 were used for statistical analysis. $P < .05$ was considered statistically significant.

RESULTS

There were 3538 veterans at PVAHCS who met the inclusion criteria and had a 1-year mortality CAN score ≥ 75 on February 8, 2019. We excluded 6 veterans from the final analysis due to lack of 1-year mortality CAN score for 2020 or 2021. The final number included in the analysis was 3532 (Figure 1). The mean (SD) age was 71.8 (1.3) years. There were 3488 male (98.8%) and 44 female (1.2%) veterans represented (Table 1). Our data show a decrease in mean 1-year mortality CAN score in this subset of older frail veterans by 4.9 (95% CI, -5.3 to -4.5) in the year preceding the COVID-19 pandemic (Table 2). The 1-year mean mortality CAN score increased significantly by 0.2 (95% CI, -0.3 to 0.6; $P < .0001$ vs pre-COVID) in this same subset of patients after the first year of

the COVID-19 pandemic (Figure 2). Mean CAN scores for 1-year mortality were 81.5 (95% CI, 81.2 to 81.7), 76.5 (95% CI, 76.1 to 77.0), and 76.7 (95% CI, 76.2 to 77.2) for 2019, 2020, and 2021, respectively.

In the hospitalization group, there were 6046 veterans in the analysis; 57 veterans missing a 1-year hospitalization CAN score that were excluded. The mean age was 71.7 (1.3) years and included 5874 male (97.2%) and 172 female (2.8%) veterans. There was a decline in mean 1-year hospitalization CAN scores in our subset of frail older veterans by 2.8 (95% CI, -3.1 to -2.6) in the year preceding the COVID-19 pandemic. This mean decline slowed significantly to 1.5 (95% CI, -1.8 to -1.2; $P < .0001$) after the first year of the COVID-19 pandemic. Mean CAN scores for 1-year hospitalization were 84.6 (95% CI, 84.4 to 84.8), 81.8 (95% CI, 81.5 to 82.1), and 80.2 (95% CI, 79.9 to 80.6) for 2019, 2020, and 2021, respectively.

We also calculated the number of veterans with increasing, stable, and decreasing CAN scores across each of our defined periods in both the 1-year mortality and hospitalization groups. The subset of veterans with stable/ no change in CAN scores was the smallest in both groups (Figure 3).

A previous study used a 1-year combined hospitalization or mortality event CAN score as the most all-inclusive measure

of frailty but determined that it was possible that 1 of the other 5 CAN risk measures could perform better in predicting frailty.[10] We collected and presented data for 1-year mortality and hospitalization CAN scores. There were declines in pandemic-related US hospitalizations for illnesses not related to COVID-19 during the first few months of the pandemic.[18] This may or may not have affected the 1-year hospitalization CAN score data; thus, we used the 1-year mortality CAN score data to predict frailty.

DISCUSSION

We studied frailty trends in an older veteran subpopulation enrolled at the PVAHCS 1 year prior and into the COVID-19 pandemic using CAN scores. Frailty is a dynamic state. Previous frailty assessments aimed to identify patients at the highest risk of death. With the advent of advanced therapeutics for several diseases, the number of medical conditions that are now managed as chronic illnesses continues to grow. There is a role for repeated measures of frailty to try to identify frailty trends.[19] These trends may assist us in resource allocation, identifying interventions that work and those that do not.

Some studies have shown an overall declining lethality of frailty. This may reflect improvements in the care and management of chronic conditions, screening tests, and increased awareness of healthy lifestyles.[20] Another study of frailty trajectories in a veteran population in the 5 years preceding death showed multiple trajectories (stable, gradually increasing, rapidly increasing, and recovering).[19]

The PACT is a primary care model implemented at VA medical centers in April 2010. It is a patient-centered medical home model (PCMH) with several components. The VA treats a population of socioeconomically vulnerable patients with complex chronic illness management needs. Some of the components of a PACT model relevant to our study include facilitated self-management support for veterans in between practitioner visits via care partners, peer-to-peer and transitional care programs, physical activity and diet programs, primary care mental health, integration between primary and specialty care, and

FIGURE 2 Change in Mean (95% CI) CAN Scores for 1-Year Mortality and Hospitalization
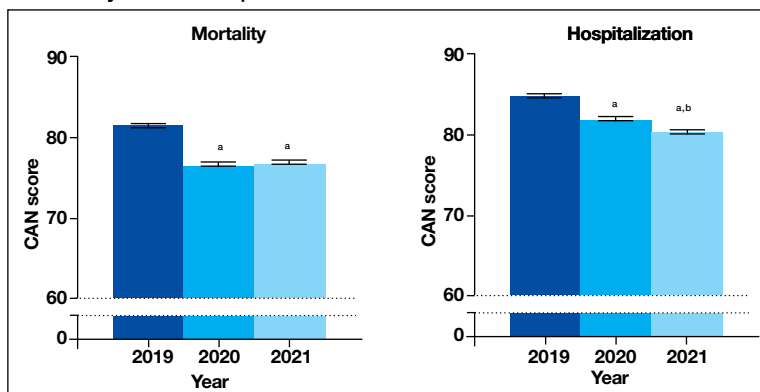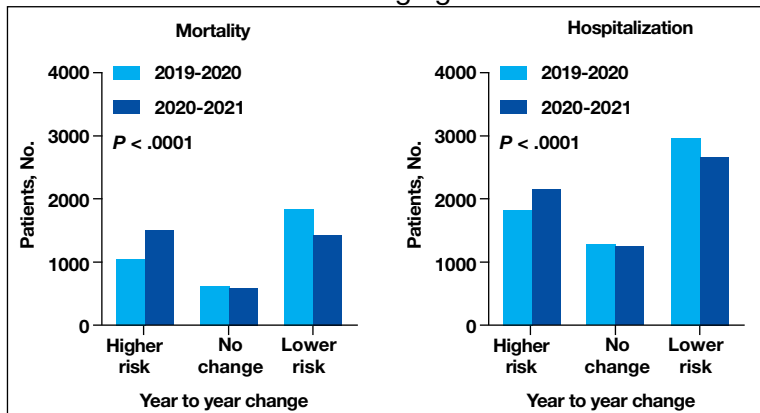

Abbreviation: CAN, Care Assessment Need.
[a]$P < .0001$ vs 2019.
[b]$P < .0001$ vs 2020.

FIGURE 3 Veterans With Changing Risk Status

Change in risk status was measured with increasing (higher risk), stable (no change), and decreasing (lower risk) Care Assessment Need scores.

telehealth.[21] A previous study has shown that VA primary care clinics with the most PCMH components in place had greater improvements in several chronic disease quality measures than in clinics with a lower number of PCMH components.[22]

Limitations

Our study is limited by our older veteran population demographics. We chose only a subset of older veterans at a single VA center for this study and cannot extrapolate the results to all older frail veterans or community dwelling older adults. Robust individuals may also transition to prefrailty and frailty over longer periods; our study monitored frailty trends over 2 years.

CAN scores are not quality measures to improve upon. Allocation and utilization of

additional resources may clinically benefit a patient but increase their CAN scores. Although our results are statistically significant, we are unable to make any conclusions about clinical significance.

CONCLUSIONS

Our study results indicate frailty as determined by 1-year mortality CAN scores significantly increased in a subset of older veterans during the first year of the COVID-19 pandemic when compared with the previous year. Whether this change in frailty is temporary or long lasting remains to be seen. Automated CAN scores can be effectively utilized to monitor frailty trends in certain veteran populations over longer periods.

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Ethics and consent
This retrospective study was determined to be exempt from institutional review board review but was approved by the Phoenix Veterans Affairs Research and Development Committee.

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eAppendix Predictor Variables and Their Usage in the Care Assessment Need 2.5 Model

Predictor variables	1-y hospitalization	1-y mortality
Demographics		
Age group	x	x
Current marital status	x	
Sex		x
Socioeconomic status by decile	x	
VHA enrollment priority groups	x	x
Health care utilization		
Prior 90 days		
Chest X-ray CPTs	x	
Established office visit CPTs	x	x
Prior year		
Consent TIU notes		x
Computed tomography visits	x	
Emergency department visits	x	
Hospital stays and bed days of care	x	
Inpatient admissions	x	
Other nonface visits	x	
Prior 2 years		
21-30 min phone CPTs	x	x
Telephone TIU notes		x
Prior 3 years		
Total visits	x	
Laboratory tests		
Prior year		
Albumin, most recent	x	x
Blood urea nitrogen, most recent	x	x
Low lymphocytes	x	x
White blood cell count, most recent		x
Prior 2 years		
High white blood cell count	x	
Low red blood cell count	x	x
Low sodium		x
Medical conditions and comorbidities		
Prior year		
Charlson-Deyo mortality score	x	x
Combined measure of mental health or PTSD	x	x
Congestive heart failure	x	x
Dementia	x	x
Metastatic cancer	x	x
Prior 2 years		
Count of alcohol diagnoses	x	x
Count of chronic airway obstruction NEC diagnoses	x	x
Medications in prior year		
Antipsychotics	x	x
Benzodiazepines		x
β-agonists, nebulized		x
β blockers	x	x
Furosemide	x	x
Statins	x	x
Nonsteroidal anti-inflammatory drugs		x
Vital signs		
Prior year		
Diastolic blood pressure, most recent	x	x
Pulse, most recent	x	x
Respiration rate, most recent	x	x
Systolic blood pressure, most recent	x	x
Prior 3 years		
Weight, coefficient of variation	x	x

Abbreviations: CPT, current procedural terminology; NEC, not elsewhere classified; PTSD, posttraumatic stress disorder; TIU, text integration utilities; VHA, Veterans Health Administration.