

Background

Over one million older adults in Canada are medically frail; this number is expected to double to over two million by 2030. In primary care, the goals of caring for those who are frail are to:

- Prevent or delay increasing frailty severity
- Improve function and quality of life
- Avoid unnecessary admission to hospital or long-term care

Study Purpose: To develop a frailty definition for use in a primary care electronic medical record database.

Methods

The goal is patient panel identification of frailty through CPCSSN data presentation tools.

Data: Clinicians provided assessments of frailty using the Rockwood Clinical Frailty Scale on a subset of their patients who were over the age of 65.

Analysis: Clinical Frailty Scores provided the reference set for machine learning techniques (classification and regression trees) to build frailty algorithms to identify patients at increased risk of frailty. Sensitivity and specificity analyses were used to assess model performance.

Data Collection Tool: Rockwood Clinical Frailty Scale

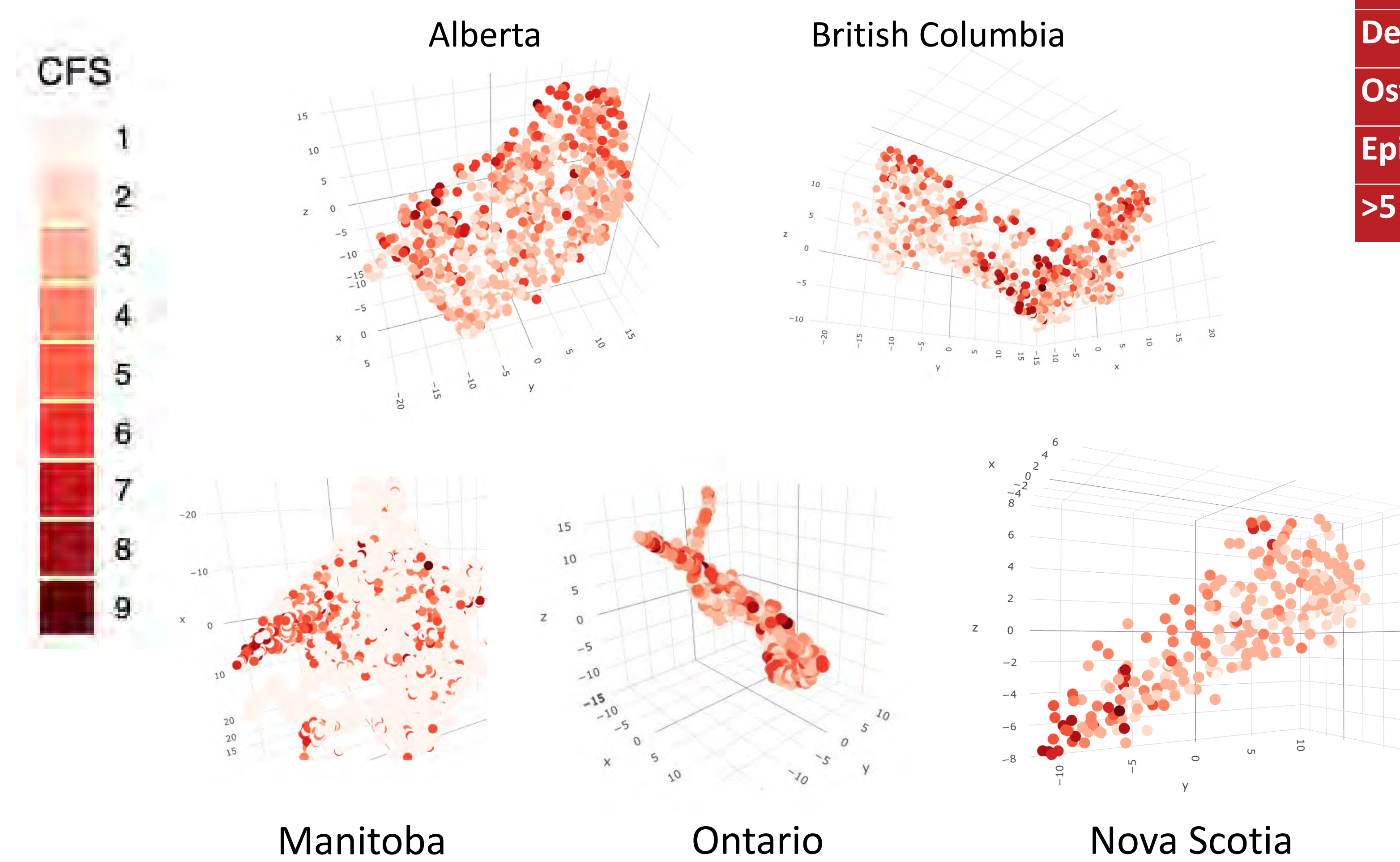
Clinical Frailty Scale*

- 1 Very Fit** – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.
- 2 Well** – People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g. seasonally.
- 3 Managing Well** – People whose medical problems are well controlled, but are not regularly active beyond routine walking.
- 4 Vulnerable** – While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up", and/or being tired during the day.
- 5 Mildly Frail** – These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.
- 6 Moderately Frail** – People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.
- 7 Severely Frail** – Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).
- 8 Very Severely Frail** – Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.
- 9 Terminally Ill** – Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise evidently frail.

Scoring frailty in people with dementia
The degree of frailty corresponds to the degree of dementia. Common symptoms in mild dementia include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal. In moderate dementia, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting. In severe dementia, they cannot do personal care without help.

* 1. Canadian Study on Health & Aging. Revised 2008.
2. K. Rockwood et al. A global clinical measure of fitness and frailty in elderly people. CMAJ. 2005;173:489-495.
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Visualizing Frailty Clusters with t-SNE Plots



T-distributed Stochastic Neighbor Embedding Plots are a data exploratory tool that allows for the visualization of whether frail and non-frail patients can be separated by machine learning. If darker and lighter dots are separable, machine learning may be able to separate the patients.

Frailty is generally defined as a medical syndrome with multiple causes, usually characterized by a loss of muscle mass and strength, weakness, weight loss, and decreased physical activity, resulting in an increased risk of health deterioration, functional decline, and overall negative health outcomes.

National Demographic Data (n=4133, age≥65)

	Not Frail CFS 1-3	Vulnerable CFS 4	Mild-Moderately Frail CFS 5-6	Severely Frail CFS 7-9
N (%)	2736 (66.20)	711 (17.30)	568 (13.75)	118 (2.86)
Categorization by Province				
AB, n(%); N=875	573 (65.5)	147 (16.8)	126 (14.4)	29 (3.3)
BC, n(%); N=1147	859 (74.9)	138 (12.0)	122 (10.6)	28 (2.4)
MB, n(%); N=885	585 (66.1)	194 (21.9)	97 (11.0)	9 (1.0)
NS, n(%); N=271	203 (74.9)	37 (16.7)	22 (8.1)	9 (3.3)
ON, n(%); N=982	527 (53.7)	208 (21.2)	203 (20.7)	44 (4.5)
Demographics				
Age, Mean (SD)	72.95 (6.32)	75.94 (7.52)	79.98 (8.48)	83.41 (9.34)
Male, N (%)	1351 (49.4)	308 (43.3)	204 (35.9)	47 (39.8)
Frailty Risk Factors				
Hypertension, N (%)	1959 (86.8)	623 (94.0)	509 (93.4)	97 (87.4)
Diabetes, N (%)	1618 (71.7)	530 (79.9)	415 (76.1)	83 (74.8)
Dementia, N (%)	1120 (49.6)	427 (64.4)	362 (66.4)	87 (78.4)
Depression, N (%)	1339 (59.4)	497 (75.0)	398 (73.0)	72 (64.9)
Osteoarthritis, N (%)	1589 (70.4)	521 (78.6)	411 (75.4)	76 (68.5)
Epilepsy, N (%)	1120 (49.6)	412 (62.1)	321 (58.9)	66 (59.5)
>5 meds last yr, N (%)	1263 (46.2)	428 (60.2)	396 (69.7)	80 (67.8)

Sensitivity and Specificity Analysis

4-Group Frailty Categorization

	NPV	PPV	Sensitivity	Specificity
Not frail	0.439394	0.765376	0.819512	0.360248
Vulnerable	0.824126	0.285	0.267606	0.836384
Mild – Moderately Frail	0.864387	0.376712	0.323529	0.889563
Severely Frail	0.961963	0.285714	0.114286	0.987406

Binary Frailty Categorization

	NPV	PPV	Sensitivity	Specificity	AUC
Frail	0.905332	0.369906	0.57561	0.805421	0.7023

Results

Model performance analyses resulted in a greater ability to accurately detect patients who are not frail relative to those who are frail (high specificity, low sensitivity). Using a binary frailty categorization, the ability to accurately detect patients who are frail improved (sensitivity = 0.58).

Conclusions

- Due to its extremely complex nature, frailty is very difficult to identify in primary care using machine learning methods
- Characteristics related to frailty may not be adequately captured in primary care EMR data, making prediction of frailty difficult
- Frailty as a dichotomous variable (frail/not frail) can be used as a screening flag to identify patients for whom further assessment is required.

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