Discordance Between Two Claims-Based Frailty Indices in a Hospitalized Medicare Population

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Background

- Frailty is a clinical syndrome, often seen in the elderly, characterized by a reduction in physiological reserve and increased vulnerability to stressors. Frail patients have an increased risk for adverse health outcomes, including falls, hospitalization, disability, and mortality
- Frail patients are often excluded from clinical trials, creating evidence gaps that real-world data can address. However, observational studies risk producing biased results unless robust methods are used to identify and adjust for frailty
- Multiple claims-based indices have been developed but they often identify different subsets of patients as frail

Objectives

- Implement two published claims-based frailty algorithms in a hospitalized Medicare population
- Identify and describe patients with discordant frailty status
- Evaluate the components of each index and identify drivers of each score in the population

Methods

- We identified all acute inpatient hospitalizations in the Medicare 5% Standard Analytic Files 2017-2022. Patients were excluded if age or sex data was unavailable or if they had < 12 months of continuous Part A and B enrollment prior to admission
- We calculated frailty scores for each admission using the methods developed by Kim et al. and the adaptation of the Risk Analysis Index (RAI) for ICD-10-CM. A comparison of the two indices is shown in Table 1
- For each index and frailty category demographic variables, Charlson Comorbidity Index (CCI), and outcomes associated with the inpatient admission were reported. For patients discharged alive prior to December 2022, 30-day readmission and mortality were calculated
- We considered the indices to be discordant if a patient was classified as Robust or Pre-Frail/Normal in one but Frail or Very Frail in the other. We considered the indices to be strongly discordant if a patient was classified as Robust in one but Frail/Very Frail in the other; or Pre-Frail/Normal in one but Very Frail in the other
- Within each stratum of discordance, we calculated contribution of each component of each index to the total score as (Prevalence*Weight) / $\Sigma_{(All\ Scores\ in\ Stratum)}$

Results

Table 1. Characteristics of the Kim and RAI indices

	Kim	RAI
Development	Medicare claims data	Originally developed using hospital EHR. Adapted for claims using Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample
Validation	Comparison to survey-based frailty index	Mortality
Timeframe	365-days prior to index date (can optionally use 180 days)	Data from index hospitalization only
Data	ICD-9 and ICD-10 diagnosis codes. CPT/HCPCS codes.	Demographics and ICD-10 diagnosis codes
Score Range	0 – 1	0 - 81
Components	93 plus an intercept term	10
Classification	Robust: < 0.15; Pre-Frail: 0.15 to < 0.25 Mildly Frail: 0.25 to < 0.35; Moderately to Severely Frail: 0.35 to 1.0	Robust: < 27 Normal: 27 to < 36 Frail: 36 to < 46 Very Frail: 46 to 81

Table 2. Patient Characteristics and Outcomes by Discordant Status

						Index Hospitalization		30-day Outcomes*	
	N	Mean Age	Male Sex	Charlson Score	Severe Cancer	Death	Discharge to Hospice	Death	Readmission
Total	2,330,515	74	46.3%	3.6	6.1%	3.7%	3.5%	7.1%	16.9%
Both Normal	975,414	70	48.7%	2.1	0.0%	2.1%	0.8%	2.2%	11.6%
Both Frail	451,182	82	44.7%	5.3	11.5%	6.2%	9.0%	16.4%	20.2%
	Any Discordance								
Kim Normal / RAI Frail	297,446	81	54.8%	3.7	30.4%	5.0%	6.8%	12.9%	16.7%
Kim Frail / RAI Normal	606,473	69	39.4%	4.6	0.0%	3.8%	2.3%	5.7%	23.4%
	Strong Discordance								
Kim Normal / RAI Frail	124,305	79	64.8%	4.6	57.4%	5.9%	9.8%	18.0%	18.2%
Kim Frail / RAI Normal	333,069	64	36.0%	4.8	0.0%	3.4%	2.0%	5.1%	25.9%

*Among patients discharged alive prior to December 2022

Table 3. Factors Contributing to Frailty Score Among Strongly Discordant Patients

Kim Normal / RAI Frail						Kim Frail / RAI Normal					
Kim Component	Prevalence	Contribution to Score	RAI Component	Prevalence	Contribution to Score	Kim Component	Prevalence	Contribution to Score	RAI Component	Prevalence	Contribution to Score
Intercept	--	38%	Age	--	57%	Intercept	--	24%	Age	--	86%
Hypertensive disease	77%	4.9%	Severe Cancer	57%	23%	Hereditary and degenerative CNS diseases	44%	4.0%	Male Sex	36%	4.5%
Other forms of heart disease	57%	4.1%	Functional Status	41%	10%	Other forms of heart disease	84%	3.8%	Congestive Heart Failure	33%	4.1%
Encounter without reported diagnosis	69%	3.0%	Male Sex	65%	4.0%	Hypertensive disease	96%	3.8%	Kidney Failure	17%	2.1%
Arthropathies and related disorders	48%	2.5%	Cognitive Decline	18%	2.5%	Organic psychotic conditions	33%	3.6%	Functional Status	4.5%	2.0%
Diseases of male genital organs	32%	2.5%	Congestive Heart Failure	25%	1.6%	Other psychoses	71%	3.4%	Shortness of Breath	11%	0.9%
Ischemic heart disease	34%	2.4%	Weight Loss	13%	0.5%	Wheelchairs, components, and accessories	18%	3.2%	Cognitive Decline	2.2%	0.8%
Symptoms	98%	2.1%	Kidney Failure	5.7%	0.4%	Ischemic heart disease	65%	2.9%	Weight Loss	2.3%	0.2%
Transportation services including ambulance	51%	1.9%	Shortness of Breath	6.3%	0.3%	Arthropathies and related disorders	86%	2.8%	Poor Appetite	0.3%	0.0%
Other metabolic and immunity disorders	84%	1.7%	Poor Appetite	1.9%	0.0%	Neurotic, Personality & Other Mental Disorders	82%	2.5%	Severe Cancer	0.0%	0.0%

Results

- Among 2,330,515 acute inpatient hospitalizations, Kim and RAI were concordant in 61% of cases (42% normal; 19% frail). 39% of cases were discordant (13% identified as frail by RAI and 26% by Kim). 20% were strongly discordant (5% identified as frail by RAI and 14% by Kim)
- Patients identified as frail by RAI but not Kim are older, have higher in-hospital mortality, and are more likely to be discharged to hospice. They also have higher 30-day mortality, but a lower Charlson Score and lower 30-day readmission rate
- RAI score is strongly driven by age and cancer. A patient 75+ years of age cannot be classified as robust and all patients with severe cancer are classified as frail or very frail
- No single component of the Kim index can classify a patient as frail. The fewest possible components would be to have a claim for a hospital bed and a wheelchair without any components that could decrease the score
- Among strongly discordant patients, those classified as frail by RAI had 80% of their score driven by age and cancer status, whereas the top 10 components of the Kim score accounted for only 63% of its total. Similarly, among patients deemed normal by RAI, age alone contributed 86% of the score, compared to just 54% accounted for by the top 10 Kim components

Conclusions

- Kim and RAI identify different populations of frail patients
- RAI's ease of calculation and strong association with mortality may be most useful for assessing patients in a clinical setting
- While frail patients are at increased risk of mortality, frailty is a more complex syndrome distinct from risk of death. Researchers seeking to identify frailty in claims data may prefer the Kim Index

References

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