

Utilizing population-based clinical and administrative data to estimate the incremental healthcare costs of dementia and frailty among community-residing care recipients



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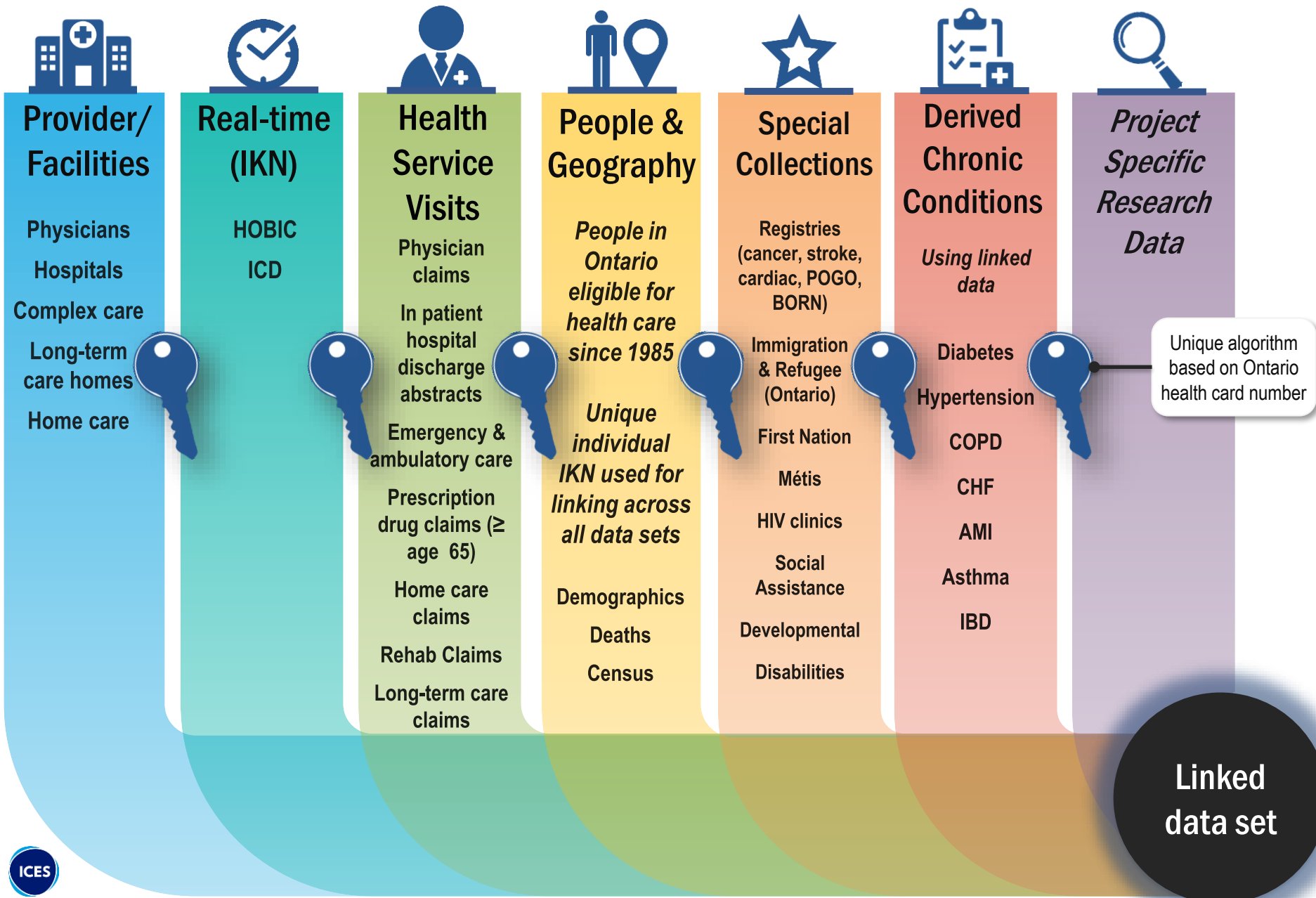
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Introduction & Objective

- Frailty and dementia have emerged as clinical and health system priorities (prevalence, impact on QOL, and resource use)
- Frailty defined: increased vulnerability to stressors arising from multi-system dysfunction and subsequent loss of homeostatic reserve and resiliency (Bergman et al., 2007)
 - Strong predictor of disability, falls, institutionalization and mortality
- Bidirectional relationship between frailty and cognitive impairment in older adults (Godin et al, 2017), but little evidence exists on the joint impact of frailty and dementia on healthcare use and costs
- Economic evaluations can inform resource use/ intensity, and assist policymakers in planning needs for our aging population
- **Our objective: To estimate the 1-year direct costs of all publicly-funded medical care associated with frailty among home care clients in Ontario with and without dementia**

ICES CORE Data Repository: Coded and Linkable



Methods

- Design/ Population: Cohort study, including all long-stay home care clients aged 50-105y with RAI-HC assessment from in FY2014 (n=159,570)
- Cohort was stratified by dementia status (prevalent y/n) measured at index RAI-HC assessment (OHIP, DAD, ODB data)
- Frailty Index (FI) - measured as the proportion of accumulated to potential health deficits (among 66 items, RAI-HC data)
 - Psychosocial well-being, mood, cognition, communication, functional status and activity level, incontinence, disease diagnoses, health symptoms, nutritional status and medications
 - Categorized as robust (FI<0.2), pre-frail ($0.2 \leq FI \leq 0.3$), frail (FI>0.3)
- Covariates: age, sex, urban/rural residence, health region, income quintile, marital status, case-mix (Johns Hopkins CADGs), prior 1y medical costs
- Followed clients prospectively for 1-year (in bi-monthly intervals) for which we obtained costs for patient encounters paid for by the Ontario MOHLTC

Analysis: Incremental Costing

- Part One: generalized gamma accelerated failure-time regression model
- Part Two: GLM (gamma distr.) for intervals where death was observed
- Part Three: GLM (gamma distr.) for intervals where death was not observed
- Combine recycled predictions from each regression:

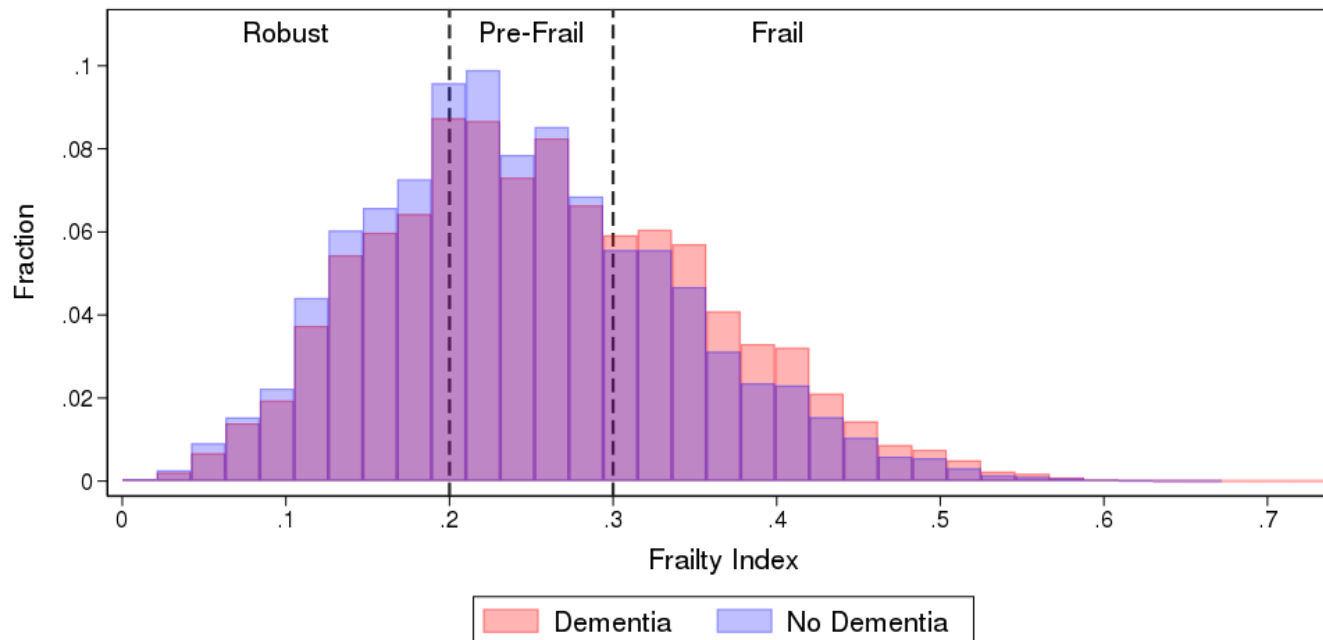
$$\text{Predicted costs}_{k,i} = Pr(\text{surv}_{k \rightarrow k+1,i}) \times [\text{haz}[dth]_{k,i} \times \text{Costs}_{dth,k,i} + (1 - [\text{haz}[dth]_{k,i} \times \text{Costs}_{no\ dth,k,i})]$$

Incremental effects = differences between robust, pre-frail and frail groups
With 95% CIs derived via bootstrapping with 500 replicates
(Basu and Manning, 2010)

Findings

Select characteristics and distribution of Frailty Index

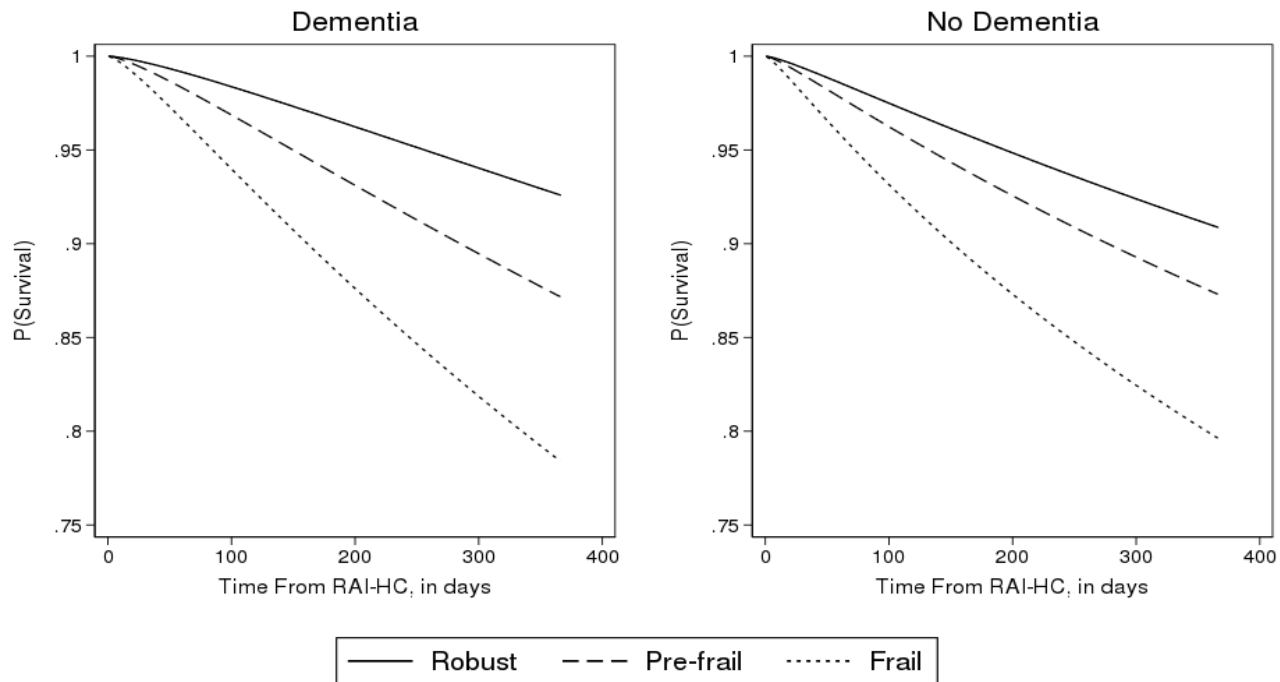
Factor	Dementia (n=42,828, 26.8%)			No Dementia (n=116,742, 73.2%)		
	Robust	Pre-Frail	Frail	Robust	Pre-Frail	Frail
N (overall: 159,570)	12,989 (30.3%)	16,072 (37.5%)	13,767 (32.1%)	39,559 (33.9%)	47,298 (40.5%)	29,885 (25.6%)
Age, mean (standard deviation)	82.1 (8.0)	83.5 (7.8)	84.0 (7.7)	78.2 (11.5)	79.2 (11.1)	79.5 (11.1)
Male Sex	5064 (39.0%)	5836 (36.3%)	4976 (36.1%)	15135 (38.3%)	15752 (33.3%)	9909 (33.2%)



Findings

1-year adjusted survival functions

Significant difference in 1-year mortality by frailty level, more so for clients with dementia



Survival Time Ratio	
Clients with dementia	
Robust	3.02*
Pre-Frail	1.77*
Frail	[Ref.]
Clients without dementia	
Robust	2.68*
Pre-Frail	1.83*
Frail	[Ref.]

Footnote: Estimated from accelerated failure-time model with gamma distribution, stratified by dementia, using bootstrap sampling with 500 replicates. Curves are adjusted for age, sex, Local Health Integration Network, rurality, income quintile, primary care model, case-mix, marital status and prior 1-year costs (quintile). RAI-HC = Resident Assessment Instrument for Home Care (index).

Findings

Incremental costs by level of frailty

	Average Cost	Incremental Cost	Intensity*	Survival**
Dementia				
Overall	\$30,500			
Frailty Level				
Robust	\$24,900			
Pre-Frail	\$30,500	\$5,600	\$6,600	-\$1,000
Frail	\$35,800	\$5,300	\$7,400	-\$2,100
<i>Frail v Robust</i>		\$10,800	\$13,600	-\$2,700
No Dementia				
Overall	\$29,000			
Frailty Level				
Robust	\$23,400			
Pre-Frail	\$28,800	\$5,400	\$6,100	-\$1,000
Frail	\$35,700	\$7,000	\$8,800	-\$1,900
<i>Frail v Robust</i>		\$12,400	\$14,500	-\$2,200

Frailty (vs. robust) associated with \$10,800 increase in 1y costs. Large survival effects bring down overall incr. cost

*Frailty (vs. robust): \$12,400 increase in 1y costs.
Vs. Dementia: generally larger intensity of utilization effects, smaller survival effects*

Notes:

*Intensity (of utilization) – difference in costs between groups, *holding survival constant at the less robust frailty level*

**Survival – difference in costs between groups, *holding intensity of utilization constant at the more robust frailty level*

All values are presented in 2015 \$CAD, rounded to nearest hundred

Limitations

- Cost data from third-party payer perspective. Out-of-pocket expenses and those paid for by private insurance are not counted. We likely underestimate costs and incremental differences from a societal perspective, *particularly for dementia* (where informal care costs are thought to represent the most significant proportion of total economic costs of care)
- Frailty only measured at baseline, but FI likely to have worsened (improved) over follow-up leading to greater (less) use of healthcare services costs
- Findings are generalizable to the long-stay home care sector, but less certain about cost differences in the general population

Key Messages

- Frailty is associated with higher healthcare costs for clients with and without dementia
- Average frail home care client is in the top 5% of high-cost users
 - High-cost adults in ON consume \$27,600 per year in costs (Goel et al., 2018)
- Highlights need for screening and prevention to delay frailty onset and/or progression, and interventions to improve frailty trajectories
- Cost differences largely attributable to costly resource utilization, but differences in mortality are significant and should be considered in future economic evaluations, especially with longer follow-up
- Additional research required to tease apart dimensions of the FI and associations with incremental costs

Thank you!

Frailty Index:

Campitelli MA, et al. The prevalence and health consequences of frailty in a population-based older home care cohort: a comparison of different measures. *BMC Geriatrics*. 2016 Jul 7;16(1):133

Maxwell CJ, et al. Variation in the health outcomes associated with frailty among home care clients: relevance of caregiver stress and client sex. *BMC Geriatrics*. *In Press*.

Dementia, validated algorithm:

Jaakkimainen LR, et al. Identification of Physician-Diagnosed Alzheimer's Disease and Related Dementias in Population-Based Administrative Data: A Validation Study Using Family Physicians' Electronic Medical Records. *J Alzheimers Dis*. 2016 Aug 10;54(1):337–49.

Costing using health administrative data in Ontario:

Wodchis WP, et al. Guidelines on Person-Level Costing Using Administrative Databases in Ontario. Vol. 1, Working Paper Series. Toronto: Health System Performance Research Network (HSPRN); 2013

Three-Part Costing estimator:

Basu A, Manning WG. Estimating lifetime or episode-of-illness costs under censoring. *Health Econ*. 2010;19: 1010–1028.

Supplemental: Descriptive Data 1

Factor	Dementia (n=42,828, 26.8%)			No Dementia (n=116,742, 73.2%)		
	Robust	Pre-Frail	Frail	Robust	Pre-Frail	Frail
N (overall: 159,570)	12,989 (30.3%)	16,072 (37.5%)	13,767 (32.1%)	39,559 (33.9%)	47,298 (40.5%)	29,885 (25.6%)
Age, mean (standard deviation)	82.1 (8.0)	83.5 (7.8)	84.0 (7.7)	78.2 (11.5)	79.2 (11.1)	79.5 (11.1)
Male Sex	5064 (39.0%)	5836 (36.3%)	4976 (36.1%)	15135 (38.3%)	15752 (33.3%)	9909 (33.2%)
Marital status						
Married	5617 (43.2%)	6535 (40.7%)	5849 (42.5%)	14638 (37.0%)	16603 (35.1%)	11356 (38.0%)
Widowed	5639 (43.4%)	7816 (48.6%)	6593 (47.9%)	16286 (41.2%)	21471 (45.4%)	13515 (45.2%)
Separated/ Divorced	996 (7.7%)	1037 (6.5%)	769 (5.6%)	4313 (10.9%)	5262 (11.1%)	3056 (10.2%)
Never married/ Other	737 (5.7%)	684 (4.3%)	556 (4.0%)	4322 (10.9%)	3962 (8.4%)	1958 (6.6%)
Rural resident	1438 (11.1%)	1900 (11.8%)	1425 (10.4%)	5059 (12.8%)	6443 (13.6%)	4294 (14.4%)
Income quintile						
Q1 (low)	2698 (20.8%)	3330 (20.7%)	2715 (19.7%)	10088 (25.5%)	12335 (26.1%)	7540 (25.2%)
Q2	2671 (20.6%)	3265 (20.3%)	2828 (20.5%)	8720 (22.0%)	10459 (22.1%)	6398 (21.4%)
Q3	2518 (19.4%)	3211 (20.0%)	2823 (20.5%)	7663 (19.4%)	8980 (19.0%)	5860 (19.6%)
Q4	2548 (19.6%)	3261 (20.3%)	2840 (20.6%)	6898 (17.4%)	8453 (17.9%)	5440 (18.2%)
Q5 (high)	2554 (19.7%)	3005 (18.7%)	2561 (18.6%)	6190 (15.6%)	7071 (14.9%)	4647 (15.5%)
Primary Care Model						
Family Health Group (FHG)	2939 (22.6%)	3692 (23.0%)	3275 (23.8%)	8794 (22.2%)	10467 (22.1%)	6696 (22.4%)
Family Health Org (FHO)	3873 (29.8%)	4672 (29.1%)	3818 (27.7%)	11421 (28.9%)	13359 (28.2%)	7982 (26.7%)
Family Health Team (FHT)	3850 (29.6%)	4498 (28.0%)	3489 (25.3%)	11549 (29.2%)	13817 (29.2%)	8420 (28.2%)
Not Enrolled	1780 (13.7%)	2566 (16.0%)	2552 (18.5%)	6183 (15.6%)	7646 (16.2%)	5390 (18.0%)
Other Model	547 (4.2%)	644 (4.0%)	633 (4.6%)	1612 (4.1%)	2009 (4.2%)	1397 (4.7%)

Supplemental: Descriptive Data 2

Factor	Dementia (n=42,828, 26.8%)			No Dementia (n=116,742, 73.2%)		
	Robust	Pre-Frail	Frail	Robust	Pre-Frail	Frail
N (overall: 159,570)	12,989 (30.3%)	16,072 (37.5%)	13,767 (32.1%)	39,559 (33.9%)	47,298 (40.5%)	29,885 (25.6%)
Case-Mix (CADGs)						
1 Acute Minor	10559 (81.3%)	13900 (86.5%)	12505 (90.8%)	34723 (87.8%)	42751 (90.4%)	27658 (92.5%)
2 Acute Major	11052 (85.1%)	14442 (89.9%)	12809 (93.0%)	36398 (92.0%)	44321 (93.7%)	28489 (95.3%)
3 Likely to Recur	8758 (67.4%)	11840 (73.7%)	10816 (78.6%)	30086 (76.1%)	37574 (79.4%)	24587 (82.3%)
4 Asthma	482 (3.7%)	780 (4.9%)	839 (6.1%)	2543 (6.4%)	4051 (8.6%)	2788 (9.3%)
5 Chronic Medical Unstable	8055 (62.0%)	11621 (72.3%)	11033 (80.1%)	30859 (78.0%)	39613 (83.8%)	26476 (88.6%)
6 Chronic Medical Stable	9770 (75.2%)	13024 (81.0%)	11535 (83.8%)	33580 (84.9%)	41789 (88.4%)	26784 (89.6%)
7 Chronic Specialty Stable	1068 (8.2%)	1586 (9.9%)	1394 (10.1%)	4430 (11.2%)	6005 (12.7%)	3719 (12.4%)
8 Eye/ Dental	2588 (19.9%)	3282 (20.4%)	2487 (18.1%)	8538 (21.6%)	10352 (21.9%)	6344 (21.2%)
9 Chronic Specialty Unstable	2787 (21.5%)	3964 (24.7%)	3256 (23.7%)	10460 (26.4%)	13582 (28.7%)	8445 (28.3%)
10 Psychosocial	6339 (48.8%)	8587 (53.4%)	8290 (60.2%)	16311 (41.2%)	21227 (44.9%)	15650 (52.4%)
11 Preventive/ Administrative	5130 (39.5%)	7521 (46.8%)	7773 (56.5%)	18719 (47.3%)	24300 (51.4%)	17375 (58.1%)
Prior 1y Total Costs (Quintile)						
Q1 (low)	5686 (43.8%)	3918 (24.4%)	1489 (10.8%)	10189 (25.8%)	7783 (16.5%)	2847 (9.5%)
Q2	3074 (23.7%)	3827 (23.8%)	2040 (14.8%)	8713 (22.0%)	10006 (21.2%)	4249 (14.2%)
Q3	2005 (15.4%)	3402 (21.2%)	2823 (20.5%)	7562 (19.1%)	10141 (21.4%)	6016 (20.1%)
Q4	1321 (10.2%)	2882 (17.9%)	3739 (27.2%)	6689 (16.9%)	9736 (20.6%)	7548 (25.3%)
Q5 (high)	903 (7.0%)	2043 (12.7%)	3676 (26.7%)	6406 (16.2%)	9632 (20.4%)	9225 (30.9%)
Outcomes during Follow-Up						
Admitted to Long-Term Care	3091 (23.8%)	5148 (32.0%)	5372 (39.0%)	2583 (6.5%)	5879 (12.4%)	6721 (22.5%)
Died	992 (7.6%)	2309 (14.4%)	3409 (24.8%)	3972 (10.0%)	6777 (14.3%)	7013 (23.5%)

Supplemental: Sensitivity Analyses

	Crude/ Unadjusted		GLM with gamma distr.	
	Average Cost	Incremental Cost	Average Cost	Incremental Cost
Dementia				
Overall	\$32,400		\$32,400	
Frailty Level				
Robust	\$22,400		\$24,900	
Pre-Frail	\$31,500	\$9,100	\$32,200	\$7,400
Frail	\$42,900	\$11,400	\$38,400	\$6,200
<i>Frail v Robust</i>		\$20,500		\$13,600
No Dementia				
Overall	\$31,300		\$31,200	
Frailty Level				
Robust	\$23,500		\$25,000	
Pre-Frail	\$30,700	\$7,200	\$31,000	\$6,000
Frail	\$42,400	\$11,700	\$38,700	\$7,700
<i>Frail v Robust</i>		\$18,900		\$13,600