

# Geriatric Syndrome Risk Factors Among Hospitalized Postacute Medicare Patients

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**M**edicare postacute spending has become a key driver of geographic variation in per capita fee-for-service (FFS) Medicare spending, reaching \$60 billion in 2015.<sup>1,2</sup> Postacute care offers important rehabilitation and recuperation services for patients after an acute hospital stay. These services include care in home health and skilled nursing, inpatient rehabilitation, and long-term care facilities. Recent efforts have aimed to reduce spending and increase value in postacute settings (ie, skilled nursing value-based purchasing and bundled payments for care improvement initiatives). In the same time period of rising postacute care use, Medicare Advantage (MA), an alternative to FFS Medicare, has become increasingly important, as nearly one-third of Medicare beneficiaries are enrolled in MA. Capitated MA plans may benefit financially by carefully selecting and coordinating postdischarge care compared with payers who are not at financial risk.<sup>3</sup> Despite health care services becoming increasingly bundled and paid according to the quality of care, it is unclear how these types of capitated systems best serve their high-risk patients in postacute services compared with FFS systems.

Studies have examined differential postacute use between MA and FFS patients, finding that MA patients utilize less postacute care and lower intensity of these services.<sup>4-6</sup> Kumar et al<sup>5</sup> found that MA patients are less cognitively impaired upon postacute admission than FFS patients and that after adjusting for ability to perform activities of daily living, pain, body mass index, and cognitive scores from the Minimum Data Set, MA patients are more likely to be discharged to the community successfully and have shorter skilled nursing facility (SNF) stays. Waxman et al<sup>6</sup> found that MA beneficiaries use less home health overall than FFS beneficiaries, after adjusting for patient demographics and socioeconomic factors. Huckfeldt et al<sup>4</sup> examined cohorts of patients with joint replacement, stroke, and heart failure and found that MA patients are less likely to be admitted to inpatient rehabilitation facilities and have shorter lengths of stay in SNFs than FFS patients, while finding no large differences in observable characteristics, such as comorbidities measured by the Elixhauser Index, between the 2 cohorts.

Of particular policy and clinical interest within the cohort of postacute care users are the frail elderly and high-cost and high-need

## ABSTRACT

**OBJECTIVES:** To assess the association of geriatric syndrome risk factors with postacute utilization among hospitalized Medicare patients (both Medicare Advantage [MA] and fee-for-service [FFS] cohorts) and to examine patterns of postacute care for MA and FFS cohorts with high geriatric syndrome risk.

**STUDY DESIGN:** Secondary data analysis using encounter-level data from the State Inpatient Databases (SID) of the Healthcare Cost and Utilization Project.

**METHODS:** The sample included 3.1 million Medicare hospitalizations from the Florida SID (2010 to 2014). We used multivariate linear regression to examine the impact of a geriatric syndrome risk measure, assessed as high risk, moderate risk, or nonrisk, on outcomes in MA and FFS cohorts. Outcome measures included postacute destination and inpatient utilization. We then examined if this risk measure was associated with differences in outcomes between MA and FFS cohorts.

**RESULTS:** Patients with high geriatric syndrome risk (in both MA and FFS cohorts) are less likely to be discharged to home or to home health care. They also have longer inpatient lengths of stay and higher inpatient costs. This risk measure also explains differences in postacute skilled nursing destination between MA and FFS cohorts.

**CONCLUSIONS:** Geriatric syndrome risk factors not only play a role in postacute care and inpatient utilization in MA and FFS cohorts but also explain different utilizations between MA and FFS cohorts. This study's results can be applied to guide discharge planning among a group of high-risk patients and evaluate alternative delivery models for this high-cost, high-need cohort.

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## TAKEAWAY POINTS

Geriatric syndrome risk factors act as important predictors of health care utilization in Medicare patients.

- ▶ Policy attention is needed to appropriately account for risk factors prevalent in aging older adults when evaluating delivery system models.
- ▶ Hospitals and postacute facilities can utilize existing administrative data to effectively target high-risk patients.
- ▶ Continued efforts to monitor how capitated and noncapitated systems differ in their care delivery of postacute services are needed.

populations with disabilities and multimorbid conditions.<sup>7,8</sup> Fifty-one percent of patients discharged to SNFs, rehabilitation facilities, and long-term care facilities are 80 years and older, and 40% of Medicare hospitalizations in this age group end with a stay in these facilities.<sup>9</sup> Much of the care delivered to this cohort of medically complex elderly patients is inadequate, particularly during care transitions.<sup>10-12</sup> For example, care processes can break down during handoffs due to lack of reconciliation of medication regimens, preparation of the patient and caregiver, and completion of follow-up care.<sup>10</sup> Recent research suggests that functional status and frailty factors outperform comorbidity in predicting outcomes of acute care.<sup>13-16</sup> Studies that examine the role of functional and cognitive indicators in FFS Medicare use assessment-based data and find that these factors are prevalent and lead to higher postacute utilization and cost that cuts across clinical conditions.<sup>17-20</sup> However, few studies examine the role of these frailty and other multimorbid risk factors captured in administrative claims data on health care utilization between a capitated system such as MA and an FFS system.<sup>8,21-23</sup>

The motivations of this study are 2-fold. First, rather than using assessment data that are time and resource intensive to obtain, could risk identification of frailty, functional, and cognitive factors—collectively known as geriatric syndrome<sup>24</sup>—using existing administrative data sources predict postacute utilization in MA and FFS cohorts beyond what is explained by traditional measures of comorbidity? The study examines this question by using a previously validated geriatric syndrome risk measure captured in administrative data in predicting postacute utilization in hospitalized MA and FFS Medicare cohorts.<sup>25</sup> The second is motivated by the question of whether capitated systems, such as MA, provide for a population with geriatric characteristics differently compared with noncapitated and non-risk-bearing systems, such as FFS. The study examines this by assessing whether these geriatric syndrome characteristics could explain some of the differences previously seen in postacute use between MA and FFS hospitalized cohorts.

## METHODS

## Data Sources

The Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) include all inpatient discharge abstracts across payers,

including information on type of insurance payer and discharge destination. This study focuses on Florida hospitals from 2010 to 2014. The sample contains encounters of Medicare beneficiaries who had an inpatient hospital stay and who were subsequently discharged to home or to a postacute facility, defined as a discharge to skilled nursing, home health, inpatient rehabilitation, or a long-term care hospital. Encounters with other discharges were excluded (ie, left against medical advice,

died, discharged to hospice care), as were encounters of patients who did not reside in Florida or were younger than 65 years and encounters from hospitals with fewer than 10 Medicare postacute discharges each year. Encounters in which the patient originated from a nursing home, was hospitalized, and was subsequently discharged to a nursing home could not be separated and excluded from the data. Encounters were determined to be covered by FFS Medicare or MA by primary payer type for the inpatient stay. In the Florida data, more than 45% of all inpatient encounters were attributable to Medicare patients, and 31% of these Medicare encounters were attributable to MA. Of Medicare encounters, 89% had discharges to home and postacute facilities, with hospice care as the next most prevalent discharge destination (4%) and inpatient death as the next most prevalent discharge status (3%). This study was approved by the institutional review board of Johns Hopkins University (#00008241).

## Study Variables and Measures

**Geriatric syndrome risk.** The geriatric syndrome risk measure was constructed from diagnosis codes using the *International Classification of Diseases, Ninth Revision, Clinical Modification* from the inpatient hospitalization and is an extension of the “frailty” marker in the Johns Hopkins University Adjusted Clinical Groups (ACG) System, a case-mix system based on diagnoses assigned by providers.<sup>26</sup> The original measure was developed in the Medicare cohort to predict health care utilization using factors pertinent to activities of daily living and has been since adapted by clinicians and geriatricians to capture concepts prevalent in frail older adults and in adults with disabilities or other multimorbid and geriatric conditions.<sup>26,27</sup> It is a modified version of capturing frailty in administrative claims data sets.<sup>28</sup> It was not our goal to develop or validate a geriatric syndrome risk measure on a patient population using postacute care. Instead, it was our intent to explore the availability of information in administrative claims data in describing a wide range of geriatric risk factors relevant to older patients in the MA and FFS patient populations and to assess its potential predictive value in health care utilization between the 2 cohorts. We do so using a previously validated geriatric syndrome risk measure that was developed—based on the literature, past claims-based risk adjustment research, and input from geriatricians—to capture factors

relevant for population health management and clinical care for an older population.

The geriatric syndrome risk measure includes the presence of particular cognitive and functional conditions: vision problems, urinary and fecal incontinence, difficulty walking, history of falls, pressure ulcers, dementia/cognitive impairment, lack of social support, weight loss, and malnutrition. A higher risk measure has been shown to predict higher health care utilization and outcomes beyond traditional comorbidity measures in cohorts of older adults,<sup>25,29</sup> and when compared against a validated survey-based frailty measure on health utilization and functional outcomes, this measure performed as well if not better in performance metrics in a cohort of FFS Medicare patients.<sup>25</sup> Further details of the definition of each condition, specific diagnosis codes, and its performance against a validated frailty measure can be found in prior work.<sup>25,29,30</sup> Examples of diagnoses in each condition are included in **Appendix Table 1** (eAppendix available at [ajmc.com](http://ajmc.com)).

We categorized the MA and FFS cohort into 3 categories based on the summation of the conditions and from previous use of the measure: nonrisk (meeting 0 conditions), moderate risk (meeting 1 condition), and high risk (meeting  $\geq 2$  conditions).<sup>25,29</sup> The most prevalent conditions were dementia (10.6% of the sample) and falls (10.1%), with 1% of encounters having 3 or more conditions. A more detailed distribution of these factors in the current sample can be found in **eAppendix Tables 2 and 3**.

**Risk adjustment.** Encounter-level patient demographic adjusters include age, race, and sex, derived from the HCUP hospital discharge file. Because we were interested in the association of geriatric syndrome risk factors and outcomes beyond a traditional comorbidity measure, we also adjusted for the Charlson Comorbidity Index (CCI) score, constructed from diagnosis codes of the inpatient hospitalization.<sup>31</sup> The CCI was used because of its feasibility using only inpatient claims codes, compared with other comorbidity measures that utilize both outpatient and inpatient information.<sup>32</sup>

Finally, socioeconomic factors from the Area Health Resources Files and the American Community Survey were used to merge to the patients' county of residence. The number of SNFs, home health agencies, and physicians per capita were used as supply-side controls to control for potential access to postacute facilities and intensity of hospital care. Controls for socioeconomic status were also used and include county's percentage of poverty, percentage of unemployment, and median income quartile, as well as an indicator for metropolitan status. These controls were used because MA plans tend to operate in urban counties with higher FFS spending.<sup>33</sup> Family composition was also controlled by using the county's percentage of adults older than 65 years who are married, as literature has suggested that family support may influence discharge destinations.<sup>34</sup>

**Outcome variables.** Several outcome measures were constructed. Using discharge destination information from the SID, a binary indicator was first constructed for the probability of discharge home, equaling 1; otherwise, 0. Second, among encounters that were discharged to postacute care (skilled nursing, home health,

inpatient rehabilitation, and long-term care hospital), the probability of discharge to each destination was also examined and coded as a binary measure equaling 1 for the target destination; otherwise, 0. Third, to measure the intensity of inpatient utilization prior to being discharged to postacute care, both the length of stay and total cost of the inpatient hospital stay were examined among encounters that were discharged to postacute care. The HCUP data report total inpatient facility charges, which can be converted to costs by multiplying the hospital's cost-to-charge ratio obtained from HCUP. The cost-to-charge ratio is calculated annually for each hospital using information from the hospital's Medicare Cost Reports.

### Statistical Method

A multivariate linear regression model was constructed to first estimate the predicted probability of discharge home within each MA and FFS cohort. Then, for encounters discharged to postacute destinations, we separately estimated 4 models using binary outcomes (for example, outcome for skilled nursing discharge was coded equaling 1; otherwise, 0). For these binary outcomes, the coefficients indicate the predicted probability of each outcome. Further, we separately estimated 2 models of inpatient utilization (length of stay and inpatient cost) among encounters discharged to the 4 postacute destinations. First, base models of demographic characteristics, CCI score, and socioeconomic status were run in predicting outcomes. Then, the geriatric syndrome risk measure was added to test if it was independently associated with utilization and outcomes.

To compare MA and FFS encounters, separate multivariate linear regressions were run to estimate differences in each outcome (discharge home, discharges to each of the 4 postacute destinations, and inpatient lengths of stay and cost) between the 2 cohorts. A binary indicator was set to 1 if the encounter was covered by MA and 0 if covered by FFS. All models adjusted for demographic characteristics, CCI score, geriatric syndrome risk, and socioeconomic factors. All models adjusted for the discharging hospital and the year of the hospital discharge, and models clustered error terms at the hospital level to account for correlation of model within hospitals.

## RESULTS

A total of 3,098,369 inpatient Medicare encounters discharged to home or postacute facilities occurred during 2010–2014 in Florida. Fifty-two percent of these discharges were to a postacute facility. Thirty-one percent of all discharges to home and postacute care were covered by MA, whereas 27% of all discharges to postacute care were covered by MA (**Table 1**). Of postacute discharges, patients with FFS coverage were older and more likely to be women and White. Additional clinical characteristics indicate that FFS patients were not sicker as measured by the CCI, but they were more likely to be categorized as geriatric syndrome high risk than MA discharges. Eleven percent of FFS patients discharged to postacute care were categorized as high risk compared with 8% of MA discharges to

**TABLE 1.** Characteristics of Hospitalized Florida Medicare Patients Discharged to Home and Postacute Care (2010-2014)<sup>a</sup>

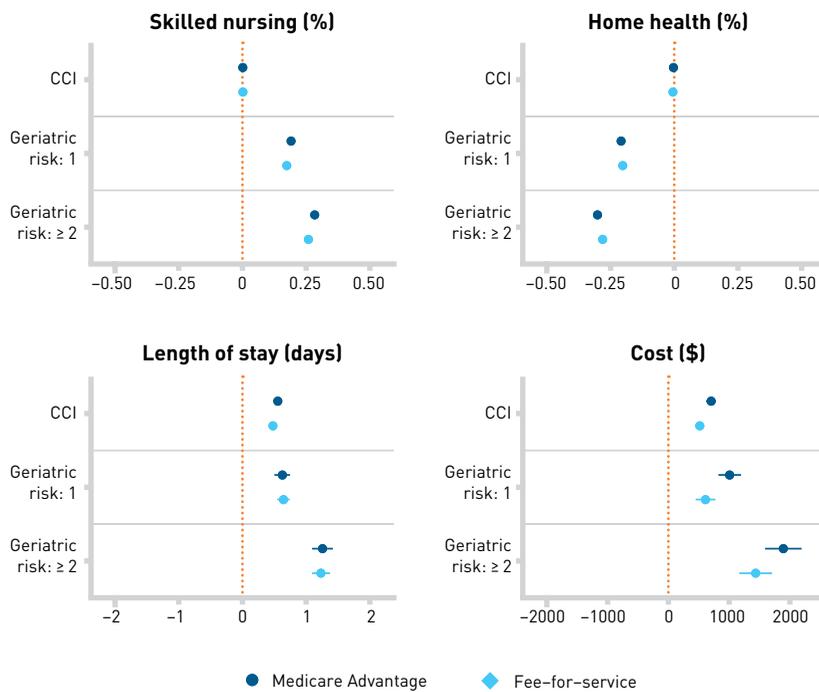
	All discharges		Postacute discharges		Home discharges	
	MA	FFS	MA	FFS	MA	FFS
Number of episodes	975,134	2,123,235	434,084	1,179,792	541,050	943,443
<b>Demographic characteristics</b>						
Female	54.6%	56.5%	57.5%	59.8%	52.1%	52.3%
Age in years, mean (SD)	77.0 (7.8)	78.7 (8.3)	78.6 (8.0)	80.3 (8.3)	75.9 (7.4)	76.9 (7.9)
<b>Race</b>						
White	65.7%	81.7%	67.0%	82.1%	63.2%	81.0%
Black	12.1%	7.2%	12.0%	7.6%	12.2%	6.7%
Hispanic	20.5%	9.7%	17.5%	8.9%	22.8%	10.7%
Asian/Pacific Islander	0.5%	0.5%	0.4%	0.5%	0.5%	0.6%
Native American	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Other	1.2%	0.9%	1.1%	0.9%	1.3%	1.0%
<b>Clinical characteristics</b>						
Charlson Comorbidity Index score, mean (SD)	2.0 (2.0)	2.1 (2.1)	2.2 (2.1)	2.2 (2.1)	1.8 (1.9)	1.9 (2.0)
<b>Geriatric syndrome risk category<sup>b</sup></b>						
0 (nonrisk)	78.4%	71.6%	65.9%	59.9%	88.9%	87.1%
1 (medium risk)	17.3%	21.5%	26.1%	29.1%	9.9%	11.2%
≥2 (high risk)	4.3%	7.0%	8.1%	11.0%	1.2%	1.7%
<b>Socioeconomic characteristics<sup>c</sup></b>						
Unemployment rate	8.9%	9.0%	8.8%	9.0%	8.9%	9.1%
Poverty	16.7%	16.1%	16.5%	16.1%	16.8%	16.2%
<b>Median household income</b>						
1 (poorest quartile)	30.3%	26.4%	29.3%	26.8%	31.0%	26.0%
2	29.4%	28.2%	29.9%	28.4%	28.9%	27.9%
3	22.9%	24.9%	23.0%	24.7%	22.8%	25.1%
4 (wealthiest quartile)	17.5%	20.6%	17.8%	20.2%	17.3%	21.0%
Skilled nursing facilities per capita, mean (SD)	0.03 (0.02)	0.04 (0.02)	0.03 (0.02)	0.04 (0.02)	0.03 (0.02)	0.04 (0.02)
Home health agencies per capita, mean (SD)	0.09 (0.07)	0.07 (0.06)	0.09 (0.07)	0.07 (0.06)	0.09 (0.08)	0.07 (0.06)
Physicians per capita, mean (SD)	0.06 (0.06)	0.06 (0.07)	0.06 (0.06)	0.06 (0.07)	0.07 (0.06)	0.06 (0.07)
Aged > 65 years and married	52.5%	54.9%	52.5%	54.7%	52.6%	55.1%
Metropolitan area	99.1%	96.7%	99.2%	97.2%	99.0%	96.2%
<b>Outcome</b>						
Discharge home	55.5%	44.4%				
Length of inpatient stay, days, mean (SD)	4.7 (4.7)	5.4 (5.5)	6.5 (5.8)	6.9 (6.3)	3.5 (3.6)	3.9 (4.6)
Total cost of inpatient stay, \$, mean (SD)	10,087 (10,900)	10,105 (10,822)	13,279 (13,790)	12,149 (12,587)	8099 (8913)	8278 (10,196)
30-day readmissions	14.9%	17.4%	18.2%	20.7%	12.2%	12.6%
<b>Discharge to postacute care</b>						
Skilled nursing	20.0%	27.1%	44.9%	48.8%		
Home health	22.4%	24.0%	50.4%	43.2%		
Inpatient rehabilitation	1.6%	3.7%	3.7%	6.6%		
Long-term care hospital	0.5%	0.8%	1.0%	1.4%		

FFS, fee-for-service; MA, Medicare Advantage.

<sup>a</sup>Medicare discharges to home and postacute services in Florida, 2010-2014; excluded discharges in hospitals with fewer than 10 postacute discharges each year and discharges of patients who did not reside in Florida and who were younger than 65 years. All comparisons between MA and FFS are significant at the  $P < .01$  level.

<sup>b</sup>Geriatric syndrome risk markers are from the Johns Hopkins Adjusted Clinical Groups risk adjustment methodology.

<sup>c</sup>Socioeconomic characteristics based on patients' county of residence.

**FIGURE 1.** Estimated Effect of CCI and Geriatric Syndrome Risk Measures on Resource Use for FFS and MA Patients Using Postacute Care<sup>a</sup>

CCI, Charlson Comorbidity Index; FFS, fee-for-service; MA, Medicare Advantage.

<sup>a</sup>Medicare discharges to postacute care in Florida during 2010-2014. Associations adjust for patients' demographic information (age, sex, race/ethnicity), patients' county of residence information (poverty, median income, unemployment, married, metropolitan status, number of skilled nursing facilities/home health agencies/physicians per capita), hospital-level and year fixed effects, and robust standard errors clustered at the hospital level. Adjusted CCI and geriatric syndrome risk categories on use of skilled nursing (in percentage), home health (in percentage), inpatient length of stay (in days), and inpatient costs (in dollars). Geriatric syndrome risk categories of 1 (moderate) and  $\geq 2$  (high) are compared against reference of 0 (no geriatric syndrome risk). For example, MA discharges with high geriatric syndrome risk are 25 percentage points more likely to be discharged to skilled nursing than nonrisk discharges. Associations in which the 95% CI does not cross 0 are statistically significant at the  $P < .01$  level. See eAppendix Tables 4 and 5 for further description.

postacute care. Because skilled nursing and home health encompass the majority of discharges to postacute care, we focus our discussion on these 2 destinations.

### Postacute Destination by Geriatric Syndrome Risk

Geriatric syndrome risk is a robust predictor of postacute destination (Figure 1). In base models, the CCI was not statistically associated with most postacute destinations (it was statistically associated in the FFS cohort discharged to home health and MA and FFS cohorts discharged to long-term care hospitals, but the magnitude of the association was very small; see eAppendix Table 4). When the geriatric syndrome risk measure was added, it was independently and statistically associated with discharges to skilled nursing and home health. Among MA encounters discharged to postacute care, geriatric syndrome moderate-risk encounters were 19 percentage points ( $P < .01$ ) more likely and high-risk encounters were 28 percentage points ( $P < .01$ ) more likely to be discharged to skilled nursing than nonrisk encounters. The same pattern held true for FFS encounters.

Among MA and FFS encounters discharged to postacute care, geriatric syndrome moderate-risk encounters were 20 percentage points ( $P < .01$ ) less likely and high-risk were 28 to 30 percentage points ( $P < .01$ ) less likely to be discharged to home health than nonrisk encounters. Inpatient rehabilitation and long-term care hospital results are shown in eAppendix Table 4, but we do not see large percentage-point differences among users of inpatient rehabilitation or long-term care hospitals.

Geriatric syndrome risk is also a robust predictor of inpatient utilization among encounters discharged to postacute care. In both MA and FFS cohorts (Figure 1), geriatric syndrome high-risk encounters subsequently discharged to any postacute destination stayed longer in the inpatient setting and cost more than nonrisk encounters (MA, 1.25 days and \$1892 [ $P < .01$ ]; FFS, 1.23 days and \$1433 [ $P < .01$ ]).

Geriatric syndrome high-risk encounters were also less likely to be discharged home (eAppendix Table 5). Among MA and FFS encounters, geriatric syndrome high-risk encounters were 35 to 40 percentage points ( $P < .01$ ) less likely and moderate-risk encounters were 24 to 26 percentage points ( $P < .01$ ) less likely to be discharged home compared with nonrisk encounters.

### Postacute Destination by Source of Coverage

Geriatric syndrome risk explains some of the differences in postacute destination between

MA and FFS discharges (Figure 2 and Table 2). When adjusting only for a traditional measure of comorbidity, MA encounters were more likely to be discharged home than FFS (8 percentage points;  $P < .01$ ) and, among postacute discharges, less likely to be discharged to skilled nursing (2 percentage points;  $P < .01$ ) than FFS. When geriatric syndrome risk is added, the difference between MA and FFS in the probability of discharge to home falls to 6 percentage points from 8 percentage points, a relative reduction of 4%. Notably, when geriatric syndrome risk is added to the model, there is no statistically significant difference between MA and FFS in the probability of discharge to skilled nursing. After adjusting for geriatric syndrome risk, inpatient cost differences between MA and FFS encounters discharged to postacute care decrease to \$585 from \$610.

## DISCUSSION

We find that geriatric syndrome risk factors that can be measured using existing administrative data are associated with higher postacute

utilization among hospitalized Medicare patients. That is, inpatient encounters with high geriatric syndrome risk are more likely to have longer and more expensive inpatient stays, less likely to be discharged home, and more likely to use high-intensity postacute destinations (ie, skilled nursing vs home health). We do not see large differences in inpatient rehabilitation or long-term care hospital utilization, potentially because of low prevalence in discharges to these 2 destinations. Further, we find that after controlling for geriatric syndrome risk factors, unadjusted utilization differences between MA and FFS Medicare patient discharges become insignificant or attenuated. After accounting for geriatric syndrome risk, there were no differences in the use of skilled nursing among MA and FFS inpatient encounters.

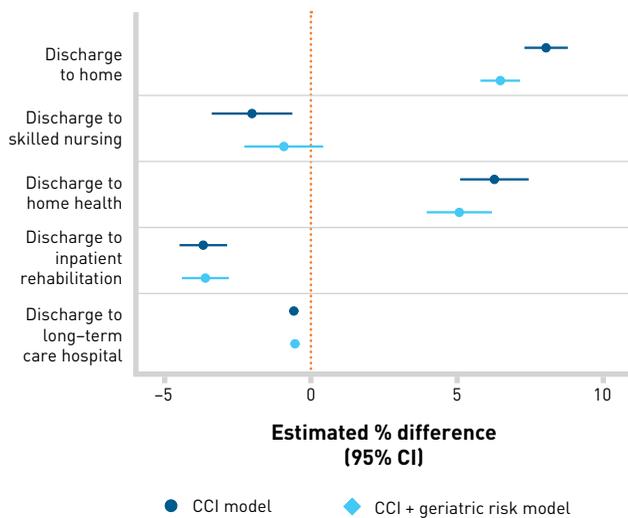
The added value of the factors that make up the geriatric syndrome risk measure indicates that these factors may be important to incorporate into risk adjustment for payment or quality reporting, especially when comparing across different payment programs. This study demonstrates that geriatric syndrome risk factors, as conceptualized here, can be captured using existing administrative data, are predictive of utilization, and do narrow differences across payment models when assessing utilization and costs. It appears that, in some instances, the MA program utilizes postacute care differentially from FFS Medicare for their high-risk enrollees, but it is unclear whether these differences are efficient for the Medicare program as a whole. Risk-adjusted capitation or value-based payment policies that do not currently incorporate these types of factors may be penalizing providers who care for cohorts with disproportionately higher levels of geriatric syndrome risk. Moreover, quality reporting that does not account for these measures may also be under- or overestimating the quality of care provided. For example, research has demonstrated that high-cost patients (ie, long-term/short-term nursing home care and home health care users) enrolled in MA plans have an increased rate of leaving MA and joining FFS Medicare.<sup>35-37</sup> Coupled with the fact that federal policies have expanded benefit packages aimed at older adults with chronic conditions,<sup>38</sup> accurately assessing how capitated systems best serve their high-risk patients in postacute services will be an important policy question as enrollment in MA increases and health care services are increasingly delivered outside the inpatient setting.

Further, these findings suggest that such risk adjustment tools could potentially guide a first stage of discharge planning, before relying on time-intensive clinician-completed assessments. Hospitals and postacute facilities could focus on these high-risk patients during the transition period to ensure care for specialized needs or prioritize information transfer across facilities. Health care providers and systems could choose the set of tools that best suits their needs in identifying patients at risk when, for example, comprehensive assessments cannot be done in times of emergencies or nursing home evacuations.<sup>39</sup>

**Limitations**

There are several limitations of our study to be noted. First-time postacute care, long-term care, or readmission to such a long-term

**FIGURE 2.** Impact of MA vs FFS Enrollment on Discharge Destination for Hospitalized Medicare Patients<sup>a</sup>



CCI, Charlson Comorbidity Index; FFS, fee-for-service; MA, Medicare Advantage. <sup>a</sup>Numbers indicate percentage above or below 0% that MA patients are likely to be discharged to each destination compared with FFS patients. Differences in which the 95% CI does not cross 0% are statistically significant at the  $P < .01$  level. Associations adjust for patient characteristics (age, race, gender), patients' county of residence information (poverty, median income, unemployment, married, metropolitan status, number of skilled nursing facilities/home health agencies/physicians per capital), hospital-level and year fixed effects, and robust standard errors clustered at the hospital level. Each result is repeated with only CCI and also CCI and geriatric syndrome risk categories combined. See Table 2 for more description.

facility cannot be differentiated in the HCUP data set. For example, if a patient was admitted to the hospital from a nursing home and then readmitted to the nursing home, we are unable to exclude them from our postacute analyses. Second, MA plans include institutional special needs plans (ISNPs) that may especially target frail elderly patients. We were unable to distinguish these plans from the data set. In 2014, of 1.3 million Medicare Advantage enrollees, 2706 beneficiaries (<1%) were enrolled in ISNP plans in Florida, indicating that they represent a very small fraction of beneficiaries.<sup>40</sup> Third, previous literature has suggested that availability of and access to postacute facilities and providers is an important factor in explaining utilization levels. Although we do not have information on the choice of postacute facilities available to each patient at the time of discharge or the network size of postacute providers contracted with MA plans, we do attempt to control for the supply of each type of postacute provider in the patients' county of residence. Further, the analysis is done at the encounter level, so we are unable to control for the frequency of unique patients being hospitalized.

The geriatric syndrome risk measure was also calculated here using only inpatient data, the quality of which may vary from hospital to hospital (ie, a hospital with a unit for acute care for the elderly may assess frailty and other geriatric syndromes differently compared with hospitals without such units); further modeling

**TABLE 2.** Adjusted Differences in Postacute Care and Hospital Resource Use: FFS and MA Hospitalized Patients<sup>a</sup>

	Among all patients			Postacute patients only			
	Discharged home (%)	Inpatient LOS (days)	Inpatient total cost (\$)	Discharged to setting (%)			
				Skilled nursing	Home health	Inpatient rehabilitation	Long-term care hospital
n	3,098,369	1,613,876	1,613,876	1,613,876	1,613,876	1,613,876	1,613,876
<b>CCI model</b>							
MA vs FFS	8.05*** [0.377]	-0.0871 (0.0546)	610.3*** [83.70]	-2.01*** [0.700]	6.28*** [0.595]	-3.68*** [0.414]	-0.583*** [0.0828]
<b>CCI + geriatric risk model</b>							
MA vs FFS	6.48*** [0.343]	-0.0404 (0.0516)	585.0*** [82.43]	-0.928 (0.685)	5.08*** [0.567]	-3.61*** [0.408]	-0.541*** [0.0789]

CCI, Charlson Comorbidity Index; FFS, fee-for-service; LOS, length of stay; MA, Medicare Advantage.

\*\*\* $P < .01$ .

<sup>a</sup>Medicare discharges to home and postacute services in Florida during 2010-2014. All models adjusted for patient characteristics (age, race, gender, geriatric syndrome risk categories, and CCI score) and patients' county of residence information (poverty, median income, unemployment, married, metropolitan status, and number of skilled nursing facilities/home health agencies/physicians per capita). Models are linear regression models using hospital-level and year fixed effects; robust standard errors clustered at hospital level are in parentheses.

should examine the addition of ambulatory data and other types of frailty risk factors developing in the literature.<sup>21</sup> Previous research using a survey-based assessment for patients admitted to the hospital has found higher prevalence of geriatric syndromes; for example, bladder incontinence was present in 44% of a cohort of 500 patients 70 years and older who were admitted to the hospital.<sup>23</sup> However, our prevalence derived from inpatient claims is in line with previous research demonstrating that 8% of a large FFS Medicare cohort and 11% of a large cohort of older Americans can be categorized as frail through inpatient and outpatient claims.<sup>8,39</sup> Health care providers and systems need to find the right balance of utilizing time- and resource-intensive assessment instruments vs less resource-intensive data-driven techniques to identify patients at risk.

We have attempted to identify and adjust for measurable characteristics between MA and FFS discharges. Although we control for a range of characteristics pertinent to older adults, it is possible that we have not adjusted for all underlying differences across the 2 cohorts. In particular, with regard to the admitted inpatient stay cohorts, prior research has suggested that MA enrollees are less likely to be admitted to the inpatient setting in the first place, suggesting that those who are less healthy may be captured within our MA inpatient sample.<sup>41</sup> Finally, the current data are also limited to Florida during 2010-2014; although it is a large state with a significant proportion of US Medicare beneficiaries, we cannot fully generalize these results to the full Medicare program across the nation.

## CONCLUSIONS

Despite these limitations, this study expands our existing knowledge of the role of nontraditional comorbidity factors on health care utilization and outcomes and on how MA utilizes postacute services compared with FFS Medicare. We analyzed data on a particularly vulnerable cohort of hospitalized patients with high geriatric syndrome risk. This study suggests that high-risk hospitalized patients utilize postacute services differently. As services

are increasingly bundled and paid according to the quality of care they provide, it is important to optimally match high-risk patients to appropriate postacute services. Further research is needed to evaluate the efficiency of the MA program on postacute service delivery compared with that of the FFS program, especially among a cohort of high-risk Medicare beneficiaries. ■

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**eAppendix Table 1.** Sample of Geriatric Risk Concept Measures Look-Up Table: ICD-9-CM Codes

(Note this is a partial list, not for application. If further information is desired, please contact authors.)

Absence of fecal control

ICD code	ICD code description (billable codes only)
78760	FULL INCONTINENCE-FECES (Begin 2010)

Decubitus ulcer

ICD code	ICD code description (billable codes only)
7070	DECUBITUS ULCER (End 2004)
70700	DECUBITUS ULCER SITE NOS (Begin 2004)
70701	DECUBITUS ULCER ELBOW (Begin 2004)
70702	DECUBITUS ULCER UP BACK (Begin 2004)
70703	DECUBITUS ULCER LOW BACK (Begin 2004)
70704	DECUBITUS ULCER HIP (Begin 2004)
70705	DECUBITUS ULCER BUTTOCK (Begin 2004)
70706	DECUBITUS ULCER ANKLE (Begin 2004)
70707	DECUBITUS ULCER HEEL (Begin 2004)
70709	DECUBITUS ULCER SITE NEC (Begin 2004)

Dementia

ICD code	ICD code description (billable codes only)
2901	PRESENILE DEMENTIA
29010	PRESENILE DEMENTIA
29011	PRESENILE DELIRIUM
29012	PRESENILE DELUSION
29013	PRESENILE DEPRESSION
2902	SENILE DEMENTIA WITH DELUSIONAL OR DEPRESSIVE FEATURES
29020	SENILE DEMENTIA WITH DELUSIONAL FEATURES
29021	SENILE DEMENTIA WITH DEPRESSIVE FEATURES
2903	SENILE DEMENTIA WITH DELIRIUM
2904	VASCULAR DEMENTIA

Falls

ICD code	ICD code description (billable codes only)
E8842	FALL FROM CHAIR

E8843	FALL FROM WHEELCHAIR (Begin 1995)
E8844	FALL FROM BED
E8845	FALL FROM FURNITURE NEC (Begin 1995)
E8846	FALL FROM COMMUNE (Begin 1995)
V1588	PERSONAL HISTORY OF FALL (Begin 2005)
E884.9	OTHER FALL FROM ONE LEVEL TO ANOTHER
E880.0	FALL, ESCALATOR
E880.1	FALL ON OR FROM SIDEWALK CURB
E880.9	OTHER STAIRS OR STEPS

Malnutrition and/or catabolic illness

ICD code	ICD code description (billable codes only)
261	NUTRITIONAL MARASMUS
262	OTH SEVERE MALNUTRITION
263	MALNUTRITION OF MODERATE DEGREE
263.1	MALNUTRITION OF MILD DEGREE
263.2	ARRESTED DEVELOPMENT FOLLOWING PROTEIN-CALORIE MALNUTRITION
264.2	VITAMIN A DEFICIENCY WITH CORNEAL XEROSIS
264.3	VITAMIN A DEFICIENCY WITH CORNEAL ULCERATION AND XEROSIS
264.4	VITAMIN A DEFICIENCY WITH KERATOMALACIA
264.5	VITAMIN A DEFICIENCY WITH NIGHT BLINDNESS
264.6	VITAMIN A DEFICIENCY WITH XEROPHTHALMIC SCARS OF CORNEA

Social support

ICD code	ICD code description (billable codes only)
V600	LACK OF HOUSING
V601	INADEQUATE HOUSING
V602	ECONOMIC PROBLEM
V604	NO FAMILY ABLE TO CARE
V605	HOLIDAY RELIEF CARE
V609	HOUSING/ECONO CIRCUM NOS

Major problems of urine retention or control

ICD code	ICD code description (billable codes only)
5964	ATONY OF BLADDER
59653	BLADDER PARALYSIS
59655	DETRUSOR SPHINC DYSSYNERG
78834	INCONTINENCE-W/O SENSE
78837	CONTINUOUS LEAKAGE
788.33	Mixed incontinence

Severe vision impairment

ICD code	ICD code description (billable codes only)
3690	PROFOUND IMPAIRMENT, BOTH EYES
36900	BOTH EYES BLIND-WHO DEF
36901	TOT IMPAIRMENT-BOTH EYES
36902	ONE EYE-NEAR TOT/OTH-NOS
36903	ONE EYE-NEAR TOT/OTH-TOT
36904	NEAR-TOT IMPAIR-BOTH EYE
36905	ONE EYE-PROFOUND/OTH-NOS
36906	ONE EYE-PROFOUND/OTH-TOT
36907	ONE EYE-PRFND/OTH-NR TOT
36908	PROFOUND IMPAIR BOTH EYE

**eAppendix Table 2.** Geriatric syndrome risk concepts present in Medicare cohort, (FL 2010-2014)

	<b>MA</b>	<b>FFS</b>	<b>Total</b>
<b>n</b>	975,134	2,123,235	3,098,369
Fall	9.1%	10.5%	10.1%
Difficulty Walking	2.8%	4.1%	3.7%
Dementia	8.0%	11.8%	10.6%
Malnutrition	0.8%	1.4%	1.2%
Weight Loss	3.1%	4.3%	4.0%
Vision Problems	0.6%	0.8%	0.7%
Pressure ulcers	2.0%	3.4%	2.9%
Urinary Incontinence	0.1%	0.1%	0.1%
Fecal Incontinence	0.1%	0.2%	0.2%
Social support issues	0.1%	0.1%	0.1%

Notes: Medicare discharges to home and postacute services in FL 2010-2014; excluded discharges in hospitals with <10 postacute discharges each year, discharge from patients who did not reside in Florida and who were less than 65 years of age. Geriatric syndrome risk markers are from the Johns Hopkins ACG risk adjustment methodology.

**eAppendix Table 3.** Geriatric syndrome risk count in Medicare cohort, (FL 2010-2014)

	<b>MA</b>		<b>FFS</b>		<b>Total</b>	
	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>
0	764,237	78.4%	1,520,043	71.6%	2,284,280	73.7%
1	169,057	17.3%	455,603	21.5%	624,660	20.2%
2	35,681	3.7%	122,311	5.8%	157,992	5.1%
3	5,480	0.6%	22,372	1.1%	27,852	0.9%
4	630	0.1%	2,685	0.1%	3,315	0.1%
5	47	0.0%	209	0.0%	256	0.0%
6	<10	0.0%	12	0.0%	14	0.0%

Notes: Medicare discharges to home and postacute services in FL 2010-2014; excluded discharges in hospitals with <10 postacute discharges each year, discharge from patients who did not reside in Florida and who were less than 65 years of age. Geriatric syndrome risk markers are from the Johns Hopkins ACG risk adjustment methodology.

**eAppendix Table 4.** Association of comorbidity and geriatric syndrome risk on probability of postacute destination in MA and FFS hospitalized postacute patients (FL, 2010-2014)

<b>Postacute patients only</b>								
<b>Outcome:</b>	<b>Skilled nursing</b>		<b>Home health</b>		<b>Inpatient rehabilitation</b>		<b>Long term care hospital</b>	
	MA	FFS	MA	FFS	MA	FFS	MA	FFS
n	434,084	1,179,792	434,084	1,179,792	434,084	1,179,792	434,084	1,179,792
Charlson Comorbidity Index	-0.00110 (0.000982)	6.24e-05 (0.000772)	-0.000736 (0.00124)	-0.00278*** (0.000862)	-0.000575 (0.000566)	0.000298 (0.000410)	0.00241*** (0.000282)	0.00242*** (0.000266)
Charlson Comorbidity Index	0.00104 (0.000961)	0.00205*** (0.000764)	-0.00303** (0.00124)	-0.00497*** (0.000825)	-0.000482 (0.000571)	0.000424 (0.000414)	0.00248*** (0.000290)	0.00250*** (0.000274)
Geriatric syndrome risk = 1	0.190*** (0.00446)	0.174*** (0.00460)	-0.208*** (0.00475)	-0.202*** (0.00407)	0.0125*** (0.00168)	0.0228*** (0.00263)	0.00556*** (0.000842)	0.00577*** (0.000828)
Geriatric syndrome risk = 2+	0.283*** (0.00582)	0.259*** (0.00536)	-0.301*** (0.00579)	-0.281*** (0.00545)	0.00730*** (0.00162)	0.00970*** (0.00245)	0.0103*** (0.00153)	0.0118*** (0.00144)
Geriatric syndrome risk = 0 (ref)								

Notes: Medicare discharges to postacute services in Florida during 2010-2014. All models adjusted for patients' demographic information (age, sex, race/ethnicity) and patients' county of residence information (poverty, median income, unemployment, married, metropolitan status, # of SNFs/HHA/physicians per capita). Models are linear regressions models using hospital-level and year fixed

effects, robust SE clustered at hospital level and are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Abbreviations key: skilled nursing facility (SNF), home health agency (HHA), inpatient rehabilitation facility (IRF), and long-term care hospital (LTCH).

**eAppendix Table 5.** Association of comorbidity and geriatric syndrome risk on utilization in MA and FFS hospitalized patients (FL, 2010-2014)

Outcome:	Among all patients		Postacute patients only			
	Discharge Home		IP LOS (days)		IP Cost (\$)	
	MA	FFS	MA	FFS	MA	FFS
n	975,134	2,123,235	434,084	1,179,792	434,084	1,179,792
Charlson Comorbidity Index	-0.0228*** (0.000929)	-0.0206*** (0.000840)	0.548*** (0.0152)	0.470*** (0.0121)	747.3*** (48.02)	518.0*** (36.05)
Charlson Comorbidity Index	-0.0229*** (0.000990)	-0.0208*** (0.000879)	0.556*** (0.0152)	0.478*** (0.0122)	702.3*** (40.79)	519.4*** (36.11)
Geriatric syndrome risk = 1	-0.257*** (0.00352)	-0.241*** (0.00407)	0.624*** (0.0625)	0.643*** (0.0497)	1,008*** (94.58)	608.1*** (82.42)
Geriatric syndrome risk = 2+	-0.404*** (0.00502)	-0.352*** (0.00617)	1.254*** (0.0826)	1.226*** (0.0720)	1,892*** (152.4)	1,433*** (136.8)
Geriatric syndrome risk = 0 (ref)						

Notes: Medicare discharges to home and postacute services in Florida during 2010-2014. All models adjusted for patients' demographic information (age, sex, race/ethnicity) and patients' county of residence information (poverty, median income, unemployment, married, metropolitan status, # of SNFs/HHA/physicians per capita). Models are linear regressions models using hospital-level and year fixed effects, robust SE clustered at hospital level and are in parentheses. \*\*\* p<0.01, \*\*p<0.05, \* p<0.1. Abbreviation key: inpatient length of stay (IP LOS), inpatient cost (IP Cost).