A Longitudinal Analysis of Functional Disability, Recovery, and Nursing Home Utilization After Hospitalization for Ambulatory Care Sensitive Conditions Among Community-Living Older Persons

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BACKGROUND/OBJECTIVE: Hospitalizations for ambulatory care sensitive conditions (ACSCs) are considered potentially preventable. With little known about the functional outcomes of older persons after ACSC-related hospitalizations, our objectives were to describe: (1) the 6-month course of postdischarge functional disability, (2) the cumulative monthly probability of functional recovery, and (3) the cumulative monthly probability of incident nursing home (NH) admission.

METHODS: The analytic sample included 251 ACSC-related hospitalizations from a cohort of 754 nondisabled, community-living persons aged 70 years and older who were interviewed monthly for up to 19 years. Patient-reported disability scores in basic, instrumental, and mobility activities ranged from 0 to 13. Functional recovery was defined as returning within 6 months of discharge to a total disability score less than or equal to that immediately preceding hospitalization.

RESULTS: The mean age was 85.1 years, and the mean disability score was 5.4 in the month prior to the ACSC-related hospitalization. After the ACSC-related hospitalization, total disability scores peaked at month 1 and improved modestly over the next 5 months, but remained greater than the pre-hospitalization score. Functional recovery was achieved by 70% of patients, and incident NH admission was experienced by 50% within 6 months after the 251 ACSC-related hospitalizations.

CONCLUSIONS: During the 6 months after an ACSC-related hospitalization, older persons exhibited total disability scores that were higher than those immediately preceding hospitalization, with 3 of 10 not achieving functional recovery and half experiencing incident NH admission. These findings provide evidence that older persons experience clinically meaningful adverse patient-reported outcomes after ACSC-related hospitalizations. *Journal of Hospital Medicine* 2021;16:469-475. © 2021 Society of Hospital Medicine

Acute illnesses requiring hospitalization serve as a sentinel event, with many older adults requiring assistance with activities of daily living (ADLs) upon discharge.[1-3] Older adults who are frail experience even higher rates of hospital-associated disability, and rates of recovery to baseline functional status have varied.[4,5] Loss of independence in ADLs has been associated with nursing home (NH) utilization, caregiver burden, and mortality.[6]

To date, studies have characterized functional trajectories before and after hospitalization in older persons for broad medical conditions, noting persistence of disability and incomplete recovery to baseline functional status.[7] Prior evaluations have also noted the long-term disabling impact of critical conditions such as acute myocardial infarction, stroke, and sepsis,[8,9] but a knowledge gap exists regarding the subsequent functional disability, recovery, and incident NH admission among older persons who are hospitalized for ambulatory care sensitive conditions (ACSCs). Often considered potentially preventable with optimal ambulatory care,[10,11] ACSCs represent acute, chronic, and vaccine-preventable conditions, including urinary tract infection, congestive heart failure, diabetes mellitus, and pneumonia. Investigating the aforementioned patient-centered measures post hospitalization could provide valuable supporting evidence for the continued recognition of ACSC-related hospitalizations in national quality payment programs set forth by the Centers for Medicare & Medicaid Services (CMS).[12] Demonstrating adverse outcomes after ACSC-related hospitalizations may help support interventions that target potentially preventable ACSC-related hospitalizations, such as home-based care or telehealth, with the goal of improving functional outcomes and reducing NH admission in older persons.

To address these gaps, we evaluated ACSC-related hospitalizations among participants of the Precipitating Events Project (PEP), a 19-year longitudinal study of community-living persons who were initially nondisabled in their basic function-

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al activities. In the 6 months following an ACSC-related hospitalization, our objectives were to describe: (1) the 6-month course of postdischarge functional disability, (2) the cumulative monthly probability of functional recovery, and (3) the cumulative monthly probability of incident NH admission.

METHODS

Study Population

Participants were drawn from the PEP study, an ongoing, prospective, longitudinal study of 754 community-dwelling persons aged 70 years or older.[13] Potential participants were members of a large health plan in greater New Haven, Connecticut, and were enrolled from March 1998 through October 1999. As previously described,[14] persons were oversampled if they were physically frail, as denoted by a timed score >10 seconds on the rapid gait test. Exclusion criteria included significant cognitive impairment with no available proxy, life expectancy less than 12 months, plans to leave the area, and inability to speak English. Participants were initially required to be nondisabled in four basic activities of daily living (bathing, dressing, walking across a room, and transferring from a chair). Eligibility was determined during a screening telephone interview and was confirmed during an in-home assessment. Of the eligible members, 75.2% agreed to participate in the project, and persons who declined to participate did not significantly differ in age or sex from those who were enrolled. The Yale Human Investigation Committee approved the study protocol, and all participants provided verbal informed consent.

Data Collection

From 1998 to 2017, comprehensive home-based assessments were completed by trained research nurses at baseline and at 18-month intervals over 234 months (except at 126 months), and telephone interviews were completed monthly through June 2018, to obtain information on disability over time. For participants who had significant cognitive impairment or who were unavailable, we interviewed a proxy informant using a rigorous protocol with demonstrated reliability and validity.[14] All incident NH admissions, including both short- and long-term stays, were identified using the CMS Skilled Nursing Facility claims file and Long Term Care Minimum Data Set. Deaths were ascertained by review of obituaries and/or from a proxy informant, with a completion rate of 100%. A total of 688 participants (91.2%) had died after a median follow-up of 108 months, while 43 participants (5.7%) dropped out of the study after a median follow-up of 27 months. Among all participants, data were otherwise available for 99.2% of 85,531 monthly telephone interviews.

Assembly of Analytic Sample

PEP participants were considered for inclusion in the analytic sample if they had a hospitalization with an ACSC as the primary diagnosis on linked Medicare claims data. The complete list of ACSCs was defined using specifications from the Agency for Healthcare Research and Quality,[15] and was assembled using the *International Classification of Disease, Ninth Revision, Clinical Modification* (ICD-9-CM) classification prior to October 1, 2015, and *ICD Tenth Revision, Clinical Modification* (ICD-10-CM) classification after October 1, 2015 (Appendix Table 1). Examples of ACSCs include congestive heart failure, dehydration, urinary tract infection, and angina without procedure. As performed previously,[16,17] two ACSCs (low birthweight; asthma in younger adults 18-39 years) were not included in this analysis because they were not based on full adult populations.

ACSC-related hospitalizations were included through December 2017. Participants could contribute more than one ACSC-related hospitalization over the course of the study based on the following criteria: (1) participant did not have a prior non-ACSC-related hospitalization within an 18-month interval; (2) participant did not have a prior ACSC-related hospitalization or treat-and-release emergency department (ED) visit within an 18-month interval (to ensure independence of observations if the participant was still recovering from the prior event and because some of the characteristics within Table 1 are susceptible to change in the setting of an intervening event and, hence, would not accurately reflect the status of the participant prior to ACSC-related hospitalization); (3) participant was not admitted from a NH; (4) participant did not have an in-hospital intensive care unit (ICU) stay (because persons with critical illness are a distinct population with frequent disability and prolonged recovery, as previously described[18]), in-hospital death, or death before first follow-up interview (because our aim was to evaluate disability and recovery after the hospitalization[7]).

Assembly of the primary analytic sample is depicted in the Appendix Figure. Of the 814 patients who were identified with ACSC-related hospitalizations, 107 had a prior non-ACSC-related hospitalization and 275 had a prior ACSC-related hospitalization or a treat-and-release ED visit within an 18-month interval. Of the remaining 432 ACSC-related hospitalizations, 181 were excluded: 114 patients were admitted from a NH, 38 had an in-hospital ICU stay, 3 died in the hospital, 11 died before their first follow-up interview, and 15 had withdrawn from the study. The primary analytic sample included the remaining 251 ACSC-related hospitalizations, contributed by 196 participants. Specifically, nine participants contributed three ACSC-related hospitalizations each, 37 participants contributed two hospitalizations each, and the remaining 150 participants contributed one hospitalization each. During the 6-month follow-up period, 40 participants contributing ACSC-related hospitalizations died after a median (interquartile range [IQR]) of 4 (2-5) months, and 1 person refused continued participation.

Comprehensive Assessments

During the comprehensive in-home assessments, data were obtained on demographic characteristics. Age was measured in years at the time of the ACSC-related hospitalization. In addition, we describe factors from the comprehensive assessment immediately prior to the ACSC-related hospitalization, grouped into two additional domains related to disability[19]: health-related and cognitive-psychosocial. The health-related factors included nine self-reported, physician-diagnosed chronic conditions and frailty. The cognitive-psychosocial factors included social support, cognitive impairment, and depressive symptoms.

Assessment of Disability

Complete details about the assessment of disability have been previously described.[13,14,19,20] Briefly, disability was assessed during the monthly telephone interviews, and included four basic activities (bathing, dressing, walking across a room, and transferring from a chair), five instrumental activities (shopping, housework, meal preparation, taking medications, and managing finances), and three mobility activities (walking a quarter mile, climbing a flight of stairs, and lifting or carrying 10 lb). Participants were asked, "At the present time, do you need help from another person to [complete the task]?" Disability was operationalized as the need for personal assistance or an inability to perform the task. Participants were also asked about a fourth mobility activity, "Have you driven a car during the past month?" Those who responded no were classified as being disabled in driving.[19]

The number of disabilities overall and for each functional domain (basic, instrumental, and mobility) was summed. Possible disability scores ranged from 0 to 13, with a score of 0 indicating complete independence in all of the items, and a score of 13 indicating complete dependence. Worse postdischarge disability was defined as a total disability score (0-13) at the first telephone interview after an ACSC-related hospitalization that was greater than the total disability score from the telephone interview immediately preceding hospitalization.

Outcome Measures

The primary outcome was the number of disabilities in all 13 basic, instrumental, and mobility activities in each of the 6 months following discharge from an ACSC-related hospitalization. To determine whether our findings were consistent across the three functional domains, we also evaluated the number of disabilities in the four basic, five instrumental, and four mobility activities separately. As secondary outcomes, we evaluated: (1) the cumulative probability of recovery within the 6-month follow-up time frame after an ACSC-related hospitalization, with "recovery" defined as return to the participant's pre-ACSC-related hospitalization total disability score, and (2) the cumulative probability of incident NH admission within the 6 months after an ACSC-related hospitalization. Aligned with CMS and prior literature,[21,22] we defined a short-term NH stay as ≤100 days and a long-term NH stay as >100 days.

Statistical Analysis

Pre-ACSC-related hospitalization characteristics were summarized by means (SDs) and frequencies with proportions. We determined the mean number of disabilities in each of the 6 months following hospital discharge, with the prehospitalization value included as a reference point. We also determined the mean (SD) number of disabilities for the three subscales of disability (basic activities of daily living [BADLs], instrumental activities of daily living [IADLs], and mobility activities). We calculated the cumulative probability of recovery within 6 months of hospital discharge. Finally, we determined the cumulative probability of incident NH admission during the 6 months after hospital discharge.

TABLE 1. **Characteristics From the Comprehensive Assessment Immediately Prior to ACSC-Related Hospitalization (N = 251)**

Characteristic	Measurement details	No. (%) or mean (SD)
Demographics		
Age, y	NA	85.1 (6.0)
Female sex	NA	162 (64.5)
Non-Hispanic White	NA	214 (85.3)
Lives alone	NA	129 (51.4)
Education <12 y	NA	103 (41.0)
Health-related		
Mean no. of chronic conditions	9 self-reported, physician-diagnosed conditions[a]	2.8 (1.3)
		150 (59.8)
Frailty	Fried phenotype[b]	
Cognitive-Psychosocial		
Low social support	MOS score ≤18	62 (24.7)
Cognitive impairment	MMSE score <24	69 (27.5)
Depressive symptoms	CES-D score ≥20	54 (21.5)

[a] Chronic conditions included hypertension, myocardial infarction, heart failure, stroke, diabetes, arthritis, hip fracture, chronic lung disease, and cancer (other than minor skin cancers).

[b] Based on the following five standard criteria: weight loss, exhaustion, low physical activity, muscle weakness, and slow walking speed.

Abbreviations: BMI, body mass index; CES-D, Center for Epidemiological Studies-Depression Scale; MMSE, Mini-Mental State Examination; MOS, Medical Outcomes Study Social Support Survey; NA, not applicable

To test the robustness of our main results, we conducted a sensitivity analysis assessing disability scores of the 150 participants that contributed only one ACSC-related hospitalization. All analyses were performed using Stata, version 16.0, statistical software (StataCorp).

RESULTS

Table 1 shows the characteristics of the 251 ACSC-related hospitalizations immediately prior to hospitalization. Participants' mean (SD) age was 85.1 (6.0) years, and the mean total disability score was 5.4. The majority were female, non-Hispanic White, frail, and lived alone. As shown in Appendix Table 2, the three most common reasons for ACSC-related hospitalizations were congestive heart failure (n = 69), bacterial pneumonia (n = 53), and dehydration (n = 44).

The Figure shows the disability scores during the 6-month follow-up period for total, basic, instrumental, and mobility activities, in panels A, B, C, and D, respectively. The exact values are provided in Appendix Table 3. After hospitalization, disability scores for total, basic, instrumental, and mobility activities peaked at month 1 and tended to improve modestly over the next 5 months, but remained greater, on average, than pre-hospitalization scores. Of the 40 participants who died within the 6-month follow-up period, 36 (90%) had worse disability scores in their last month of life than in the month prior to their ACSC-related hospitalization.

Table 2 shows the cumulative probability of functional recovery after ACSC-related hospitalizations. Recovery was incomplete,

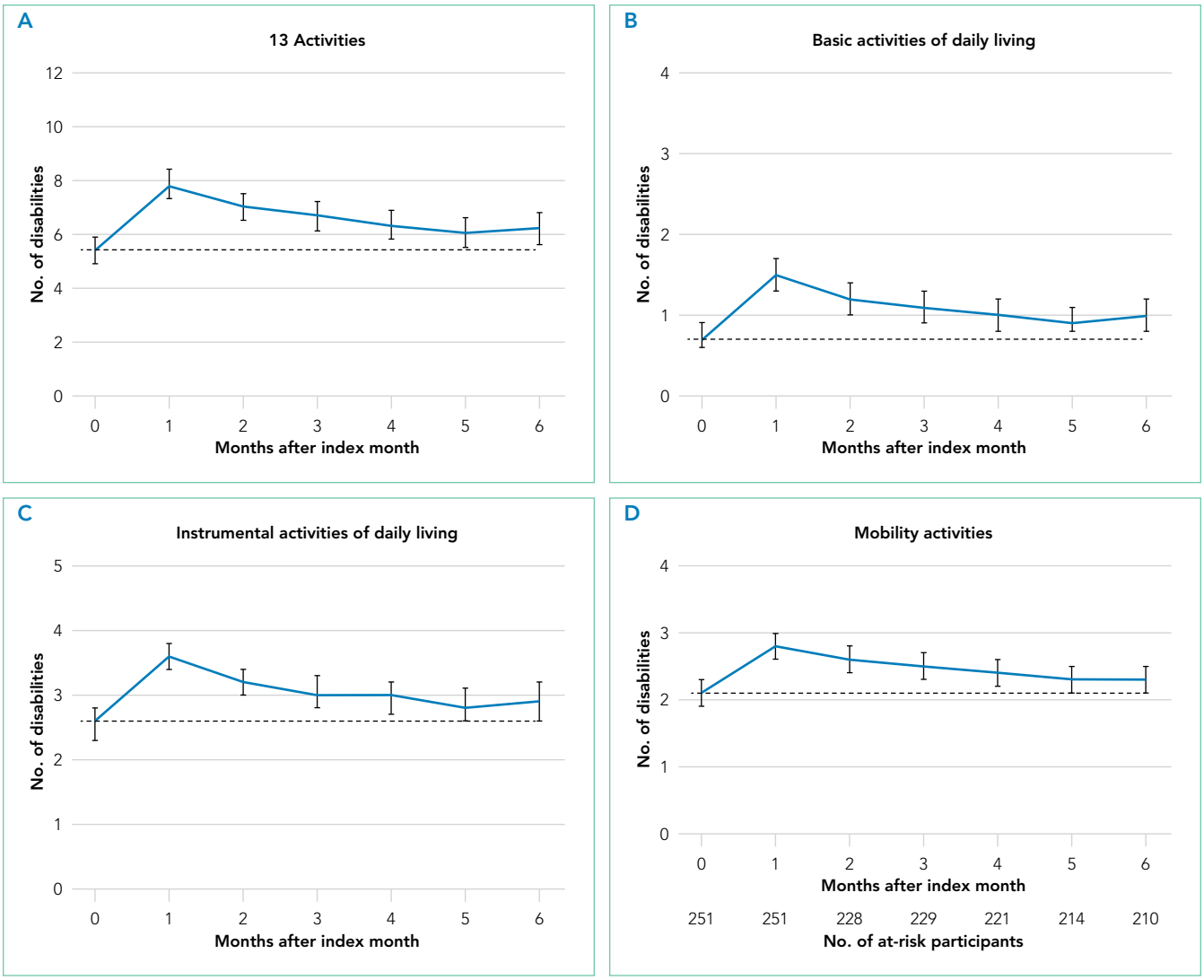

FIG. Course of Disability Within 6 Months After an ACSC-Related Hospitalization. Month 0 represents the disability score immediately preceding ACSC-related hospitalization. The bars denote 95% CIs.
Abbreviation: ACSC, ambulatory care sensitive condition.

with only 70% (95% CI, 64%-76%) of hospitalizations achieving a return to the pre-hospitalization total disability score within 6 months of hospitalization.

Table 3 shows the cumulative probability of incident NH admission after an ACSC-related hospitalization. Of the 251 ACSC-related hospitalizations, incident NH admission was experienced by 38% (95% CI, 32%-44%) within 1 month and 50% (95% CI, 43%-56%) within 6 months of discharge. Short-term NH stays accounted for 90 (75.6%) of the 119 incident NH admissions within the 6 months after ACSC-related hospitalizations. Sensitivity analyses yielded comparable disability scores, shown in Appendix Table 4.

DISCUSSION

In this longitudinal study of community-living older persons, we evaluated functional disability, recovery, and incident NH admission within 6 months of hospitalization for an ACSC. Our study has three major findings. First, disability scores for total, basic, instrumental, and mobility activities at months 1 to 6 of follow-up were greater on average than pre-hospitalization scores. Second, functional recovery was not achieved by 3 of 10 participants after an ACSC-related hospitalization. Third, half of them experienced an incident NH admission within 6 months of discharge from an ACSC-related hospitalization, although about three-quarters of these were short-term stays. Our findings provide evidence that older persons experience clinically meaningful adverse patient-reported outcomes after ACSC-related hospitalizations.

Prior research involving ACSCs has focused largely on rates of hospitalization as a measure of access to primary care and the associated factors predictive of ACSC-related hospitalizations,[23-26] and has not addressed subsequent patient-reported outcomes. The findings in this analysis highlight that older persons experience worsening disability immediately after an ACSC-related hospitalization, which persists for prolonged periods and often results in incomplete recovery. Prior research

TABLE 2. **Cumulative Monthly Probability of Recovery to Pre-ACSC-Related Hospitalization Functional Status[a,b,c]**

Months after ACSC-related hospitalization					
1	**2**	**3**	**4**	**5**	**6**
0.33 (0.27-0.39) [251]	0.48 (0.41-0.54) [240]	0.58 (0.51-0.64) [236]	0.64 (0.58-0.70) [230]	0.68 (0.62-0.74) [226]	0.70 (0.64-0.76) [223]

[a] Presented as probability (95% CI) [# at-risk ACSC-related hospitalizations].

[b] Across 13 basic, instrumental, and mobility activities

[c] Return to pre-ACSC-related hospitalization functional status was defined as a disability score that was the same or lower than the pre-ACSC-related hospitalization total disability score (across 13 basic, instrumental, and mobility activities)

Abbreviation: ACSC, ambulatory care sensitive condition.

TABLE 3. **Cumulative Monthly Probability of Incident Nursing Home Admission After an ACSC-Related Hospitalization[a,b]**

	Months after ACSC-related hospitalization					
Month before hospitalization	**1**	**2**	**3**	**4**	**5**	**6**
0 [251]	0.38 (0.32-0.44) [250]	0.43 (0.37-0.50) [245]	0.47 (0.41-0.54) [241]	0.48 (0.41-0.54) [241]	0.48 (0.42-0.55) [241]	0.50 (0.43-0.56) [240]

[a] Presented as probability (95% CI) [# at-risk ACSC-related hospitalizations].

[b] Short-term nursing home admission (≤100 days) accounted for 90 (75.6%) of the 119 incident NH admissions within the 6-month follow-up time frame.

Abbreviation: ACSC, ambulatory care sensitive condition.

has assessed pre-hospitalization functional status through retrospective recall approaches,[2] included only older adults discharged with incident disability,[3] and examined functional status after all-cause medical illness hospitalizations.[5] Our prospective analysis extends the literature by reliably capturing pre-hospital disability scores and uniquely assessing the cohort of older persons hospitalized with ACSCs.

Our work is relevant to the continued evaluation of ACSC-related hospitalizations in national quality measurement and payment initiatives among Medicare beneficiaries. In prior evaluations of ACSC-related quality measures, stakeholders have criticized the measures for limited validity due to a lack of evidence linking each utilization outcome to other patient-centered outcomes.[10,27] Our work addresses this gap by demonstrating that ACSC-related hospitalizations are linked to persistent disability, incomplete functional recovery, and incident NH admissions. Given the large body of evidence demonstrating the priority older persons place on these patient-reported outcomes,[28,29] our work should reassure policymakers seeking to transform quality measurement programs into a more patient-oriented enterprise.

Our findings have several clinical practice, research, and policy implications. First, more-effective clinical strategies to minimize the level of care required for acute exacerbations of ACSC-related illnesses may include: (1) substituting home-based care[30] and telehealth interventions[31] for traditional inpatient hospitalization, (2) making in-ED resources (ie, case management services, geriatric-focused advanced practice providers) more accessible for older persons with ACSC-related illnesses, thereby enhancing care transitions and follow-up to avoid potential current and subsequent hospitalizations, and (3) ensuring adequate ambulatory care access to all older persons, as prior work has shown variation in ACSC hospital admission rates dependent on population factors such as high-poverty neighborhoods,[16] insurance status,[16,32] and race/ethnicity.[33]

Clinical strategies have been narrow and not holistic for ACSCs; for example, many institutions have focused on pneumonia vaccinations to reduce hospitalizations, but our work supports the need to further evaluate the impact of preventing ACSC-related hospitalizations and their associated disabling consequences. For patients admitted to the hospital, clinical strategies, such as in-hospital or post-hospital mobility and activity programs, have been shown to be protective against hospital-associated disability.[34,35] Furthermore, hospital discharge planning could include preparing older persons for anticipated functional disabilities, associated recoveries, and NH admission after ACSC-related hospitalizations. Risk factors contributing to post-hospitalization functional disability and recovery have been identified,[19,20,36] but future work is needed to: (1) identify target populations (including those most likely to worsen) so that interventions can be offered earlier in the course of care to those who would benefit most, and (2) identify and learn from those who are resilient and have recovered, to better understand factors contributing to their success.

Our study has several strengths. First, the study is unique due to its longitudinal design, with monthly assessments of

functional status. Since functional status was assessed prospectively before the ACSC-related hospitalization, we also have avoided any potential concern for recall bias that may be present if assessed after the hospitalization. Additionally, through the use of Medicare claims and the Minimum Data Set, the ascertainment of hospitalizations and NH admissions was likely complete for the studied population.

However, the study has limitations. First, functional measures were based on self-reports rather than objective measurements. Nevertheless, the self-report function is often used to guide coverage determinations in the Medicare program, as it has been shown to be associated with poor health outcomes.[37] Second, we are unable to comment on the rate of functional decline or NH admission when an older person was not hospitalized in relation to an ACSC. Future analyses may benefit from using a control group (eg, older adults without an ACSC hospitalization or older adults with a non-ACSC hospitalization). Third, we used strict exclusion criteria to identify a population of older adults without recent hospitalizations to determine the isolated impact of ACSC hospitalization on disability, incident NH admission, and functional recovery. Considering this potential selection bias, our findings are likely conservative estimates of the patient-centered outcomes evaluated. Fourth, participants were not asked about feeding and toileting. However, the incidence of disability in these ADLs is low among nondisabled, community-living older persons, and it is highly uncommon for disability to develop in these ADLs without concurrent disability in the ADLs within this analysis.[14,38]

Finally, because our study participants were members of a single health plan in a small urban area and included nondisabled older persons living in the community, our findings may not be generalizable to geriatric patients in other settings. Nonetheless, the demographics of our cohort reflect those of older persons in New Haven County, Connecticut, which are similar to the demographics of the US population, with the exception of race and ethnicity. In addition, the generalizability of our results are strengthened by the study's high participation rate and minimal attrition.

CONCLUSION

Within 6 months of ACSC-related hospitalizations, community-living older persons exhibited greater total disability scores than those immediately preceding hospitalization. In the same time frame, 3 of 10 older persons did not achieve functional recovery, and half experienced incident NH admission. These results provide evidence regarding the continued recognition of ACSC-related hospitalizations in federal quality measurement and payment programs and suggests the need for preventive and comprehensive interventions to meaningfully improve longitudinal outcomes.

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