The impact of acute hospitalization on older persons

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Chapter 11

Determinants of post-acute care costs in acutely hospitalized older persons: the Hospital-ADL study

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Abstract

Objectives After hospitalization many older persons need post-acute care, including rehabilitation or home care. In fact, post-acute care expenses can be as high as the costs for the initial hospitalization. However, detailed information on monthly post-acute healthcare expenditures and the characteristics of patients that make up for a large share of these expenditures is scarce. We aimed to calculate costs in acutely hospitalized older patients and identify patient characteristics that are associated with high post-acute care costs.

Design Prospective multicenter cohort study (between October 2015 and June 2017).

Setting and participants 401 acutely hospitalized older persons from internal, cardiology, and geriatric wards.

Measurements Our primary outcome was mean post-acute care costs within 90 days postdischarge. Post-acute care costs included costs for unplanned readmissions, home care, nursing home care, general practice and rehabilitation care. Three costs categories were defined: low (p0-50, p=percentile); moderate (p50-75); and high (p75-100). Multinomial regression analyses were conducted to assess the associations between costs and frailty, functional impairment, health-related quality of life, cognitive impairment and depressive symptoms.

Results Costs were distributed unevenly in the population, with the top 10.0% (n=40) accounting for 52.1% of total post-acute care costs. Mean post-acute care costs were 4 035 euro (Standard Deviation (SD) 4 346 euro). At admission, frailty (Odds ratio (OR) 3.44, 95% Confidence Interval (CI) 1.78-6.63), functional impairment (OR 1.80, 95% CI 1.03-3.16) and poor health-related quality of life (OR 1.89, 95% CI 1.09- 3.28) were associated with increased risk of classification in the high cost group, compared to the low cost group.

Conclusion and implications Post-acute care costs are substantial in a small portion of hospitalized older adults. Frailty, functional impairment and poor health-related quality of life place patients at risk of high post-acute care costs and may be used as an indicator of such costs in practice.

Introduction

In many western countries, including the Netherlands, overall demand for healthcare is increasing due to aging populations. Acute hospitalizations in older persons are an important driver of increasing healthcare expenditures. Particularly, post-acute care expenses can be high in these patients; readmissions together with postdischarge care, e.g., rehabilitation care and nursing care can make up as much as the cost of initial index admission.[1] The high demand for post-acute care in older persons is often caused by the presence of multiple medical and functional problems.[2] Older patients develop impairments in performing activities of daily living (ADLs) and after hospitalization often do not regain their previous level of functioning.[3-5] Moreover, such functional loss is associated with the need for home care or rehabilitation, which might result in long-term stay in a nursing care facility.[6-8] Furthermore, over 20% of older patients require a re-hospitalization within 30-days postdischarge.[2]

Insights into post-acute care spending and characteristics of high cost patients are of interest to policy-makers and care managers alike, as such information may reveal opportunities for care improvement or cost reduction.[1,9-11] When studying overall healthcare costs it is often found that a small population of patients with multiple chronic conditions consume most of the costs.[12]

Previous studies have identified frailty as a risk factor associated with increased health-care utilization.[13] Although the association between frailty and costs might overlap with the association between costs and functional status or co-morbidity, frailty has been described as a distinct entity.[14,15] Most preventable costs, such as for preventable admissions, can be attributed to frail patients.[16] Other determinants, such as depressive symptoms and cognitive impairment are associated with poorer outcomes, and can also be related to increased healthcare utilization.[17,18] While high health care costs are thus often caused by multiple underlying factors, the problems that are associated with high care costs in older patients are often studied individually, describing only one determinant of increased overall health-care or hospital care utilization.[13,19]

Furthermore, previous research in this field has focused on large cohorts of patients, often derived from insurance or, in the United States, Medicare databases.[1,11,20] These studies have shed light on the uneven distribution of costs in various populations, indicating that healthcare utilization and associated costs are never evenly spread in a population and high cost groups, top 10% or even 1% often make up for 20% to 50% of the total healthcare budget.[10,11,20] Targeting particular high-cost patient groups, who have high inpatient and post-acute care costs may help to reduce costs more effectively.[9,21,22]

Currently there are few studies that provide a detailed description of post-acute healthcare expenditures in older patients and the characteristics of patients that make up for a large share of these expenditures. Insight into the characteristics of these patients can help to identify targets for cost-reduction strategies and care improvement.[21] Therefore, the objectives of this study were to 1) calculate costs that are associated with post-acute care in acutely hospitalized older patients, and 2) identify and analyze patient characteristics and clinical measurements (i.e. determinants) that are associated with high post-acute care costs in the 90 days following hospitalization.

Methods

Study Design and Setting

The Hospital-Associated Disability and impact on daily life (Hospital-ADL-study) is a multi-center prospective cohort study. The study was conducted between October 2015 and June 2017, including a three-month follow-up period. Further details of the study can be found in the study protocol, which was published elsewhere.[23] Participants were recruited from Internal Medicine, Cardiology, or Geriatric wards at six hospitals in the Netherlands, of which one university teaching hospital in Amsterdam, and five regional teaching hospitals.

Study population

Patients aged 70 and over requiring an acute admission to the hospital were eligible for inclusion. Following inclusion criteria were applied: 1) approval of the attending medical doctor 2) sufficient Dutch language proficiency to complete questionnaires and 3) Mini-Mental State Examination (MMSE)[24] score $\geq$ 15. We were not able to include patients diagnosed with delirium, due to the short time frame of inclusion, i.e. 48h after admission. Patients were excluded if they: had a life expectancy of less than three months or were disabled in all basic ADLs.[25] Two researchers (RS and LR) visited the participating wards on Mondays, Wednesdays and Fridays and contacted eligible patients within 48h after hospital admission. After informed consent was obtained, patients were enrolled in the study.

Definition of healthcare utilization and costs

Data on healthcare utilization were collected through reviewing patient files and questionnaires; either interviewing patients over telephone (at two months) or during home visits (at one month and three months). Costs were determined according to the Dutch Manual for Cost studies, and standard costs were obtained and set for the year 2017.[26] We assessed the following units of care during the 90 days after discharge: 1) number and duration of acute (unplanned) readmissions within the last month; 2) number of general practice visits, during office hours and outside of office hours; 3) number and duration of admissions and returns to a home for the elderly, nursing home or rehabilitation facility; 4) number of hours of home care per week: both medical as nonmedical home care; 5) rehabilitation care, namely the number of physiotherapist consultations and occupational therapy sessions. Note, we did not include costs on elective readmissions, such as admissions for cataract surgery, pacemaker insertion, chemotherapy or other procedures, since describing these types of (curative) care costs lies beyond the scope of this study.[27]

Primary outcome measure

We first calculated the mean and median costs which was the sum of post-acute care costs over three months. For the primary outcome in the multinomial regression model, we made a categorical variable based on the sum of three month post-acute care costs. Patients who had below median costs (p0- p50) were labeled as the *low cost group*. The third quartile of costs (p50-p75) was labeled as *moderate cost group* and above that (p75 >) was labeled as *high cost group*.

Measurements and determinants in relation to costs

All measurements, including baseline demographic characteristics, length of hospital stay (LOS), hospitalization in the past six months and score on the Charlson Comorbidity Index (CCI) were assessed at admission. CCI is a common parameter that can be used to correct for any overlap between comorbidity, disability and frailty.[14] Baseline characteristics included age, sex, living arrangements before admission, marital status, whether participants were born in the Netherlands, level of education (primary, elementary/domestic, secondary, higher level education) and admission diagnosis. (See table 1 for a complete overview).

Functional impairment was defined as a score of 1 or higher on the Katz-6 ADL index.[25] Depressive symptoms were classified as a score of six or higher on the Geriatric Depression Scale (GDS).[28] Cognitive impairment at any time point was defined as a MMSE of 23 points or lower.[24] Health- Related Quality of Life (HRQOL) was measured using the EQ-5D questionnaire. Based on the answers to the EQ-5D utility scores were calculated using the Dutch EQ-5D tariff.[29] The EQ-5D is widely used to measure HRQOL and is validated in many countries. The questions concern mobility, self-care, usual activities, pain and discomfort, anxiety and depression.[30] HRQOL is expressed as a utility score between 0-1, where 0 equals death and 1 perfect health. Poor HRQOL was defined as utility score below the median score.[31]

Frailty was assessed according to the criteria described by Fried et al.[32], including weight loss, fatigue, low physical activity, slowness and muscle weakness. A person was considered frail when 3 or more criteria were present. Weight loss was dichotomized as determined by the SNAQ-score: having lost 6 kg or more in the last 6 months, or 3 kg or more in the past month.[33] Fatigue was defined by a Numerical Rating Scale (NRS) score of 4 or more on the question: 'On a scale of 0-10 how would you score your sense of fatigue at this time?'[34] Low physical activity was scored as present when patients reported that they did not do any physical exercise, walking, cycling or swimming for 30 minute at least monthly, in the past 6 months. Slowness was defined with a cut-off point of walking slower than 6,42 seconds on a 4 meter walking test.[32] We measured muscle weakness using maximum handgrip strength (JAMAR). Cut-off points were $<$18 kg for women and $<$30 kg for men.[32]

Statistical analysis

Missing values for cost and effect data were imputed using multiple imputation by chained equations with predictive mean matching.[35] Individual sub costs per category were imputed instead of total costs to maximize the accuracy of the imputation.[36] We created 25 datasets where the analysis results were pooled using Rubin's rules.[37] Cost groups (low, moderate and high) were calculated per imputed dataset and pooled in further analysis.

We used multinomial logistic regression models to calculate Odds Ratio's (OR) to estimate the association between variables and the three cost-groups.[38] The low cost group was the reference group in all analyses. Besides crude analysis, we adjusted for demographic characteristics: age (continuous), sex, educational level, marital status and/or living situation in all adjusted multivariable multinomial logistic regression analyses. Secondly, we ran a further adjusted analysis including

adjustment for length of stay (LOS), hospitalization in the past six months and score on the CCI.[39] For sensitivity analyses, we performed additional complete case analysis, including only complete cases and patients who died within three months postdischarge. Data was analyzed using SPSS version 24.0.

Results

Participants and study sample

In total, 1024 consecutive patients were determined eligible for participation, of whom 505 did not meet inclusion criteria, could not be approached or were too ill to participate. Of the 519 remaining patients, 401 were enrolled in the study. Forty patients (10.0%) died within the first three months postdischarge, of whom 28 died during admission or within the first month postdischarge. For these 28 patients post-acute care costs were hence 0. If participants died in the postdischarge period, we did include their cost data using the complete cost measurements until death. Overall we had 296 complete (including those who died) and 105 incomplete cases.

Mean care costs and distribution of costs

In the imputed dataset we found that mean costs for index-admission were 4 121 euro SD (Standard Deviation) 7 597 euro. Mean costs for post-acute care were 4 035 euro, SD 4 346 euro. Post-acute care costs were distributed unevenly in the population, with the top 10.0% (n=40) of participants accounting for 52.1% of total post-acute care costs. Mean healthcare costs (in euro) were highest in the first month postdischarge: 1 689 euro and were 1 161 and 1 186 euro in the second and third month respectively. Of total costs, 40.9% were attributed to unplanned readmissions. (Figure 1)

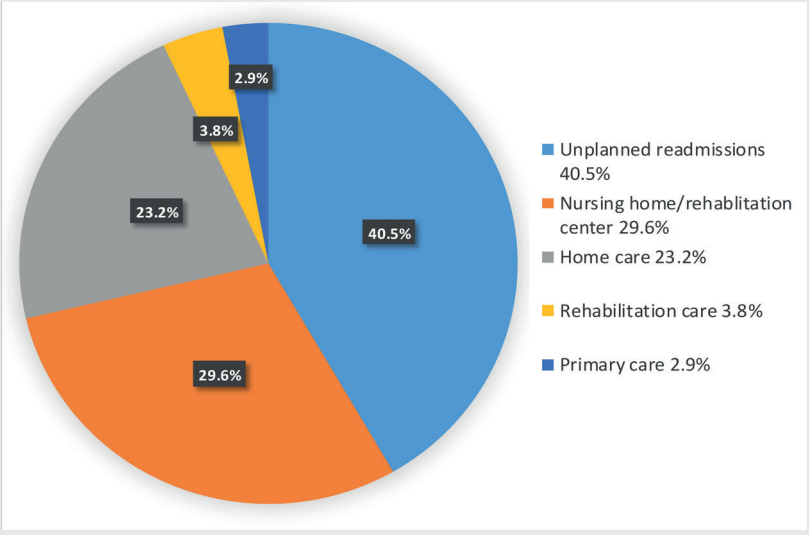

Figure 1. Distribution of post-acute care costs, by type of care

Costs groups and patient characteristics by cost group

Total post-acute care costs for the 401 cases were 1 618 226 euro. The low, moderate and high cost groups accounted for 4.3%, 16.3% and 79.4% of total post-acute care costs, respectively. In figure 2 we present the mean costs for index admission and the mean associated post-acute care costs per cost group based on index admission. Table 1 presents the baseline table per cost group based on post- acute care costs: participants in the high cost group tended to be older, had a longer length of stay (LOS), were often previously hospitalized and tended to be nursing home residents more often than patients in the low and moderate cost groups.

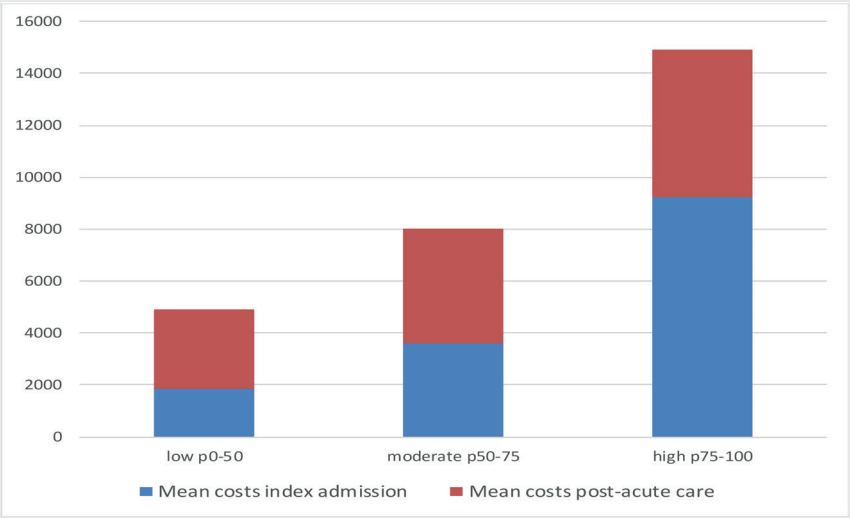

Figure 2. Displaying the mean costs of the index admission and associated post-acute care costs, in euro, per cost group defined as low (p=percentile, p0-50), moderate (p50-75) and high (p75-100). In the lowest cost group (p0-p50) mean index admission cost and associated mean post-acute care costs were 1 852 (SD 2 746) and 3062 (SD 7 797). In the group p50-75, these costs were 3 581 (SD 2 181) and 4 416 (SD 6 948) and for the highest quartile (p75-p100) this was 9 146 (SD 6 289) and 5 556 (SD 10 114).

Multinomial regression analyses

In table 2 we show that participants who had functional impairment, poor HRQOL or were frail at admission, had higher odds of being categorized in the high cost group compared to the lowest cost group. These associations were still present in the analysis adjusted for demographic characteristics and the fully adjusted model, in which we controlled for all demographic characteristics, LOS, previous hospitalization in the past 6 months and CCI. Cognitive impairment and depressive symptoms at admission were not associated with higher odds of categorization in the moderate or high cost group compared to the low cost group in any of our models (Table 2). These results differed slightly from the complete case analysis (n=296): whereas poor HRQOL was not associated with a risk of being placed in the moderate or high cost group, the associations between frailty and a risk of

Table 1. Patient characteristics and cost groups n=401

Patient characteristics	Low cost group N= 201	Moderate cost group N=100	High cost group N= 100
Age in years, mean (S*)	78.91 (6.66)	80.63 (8.10)	80.23 (7.24)
Male, N (%)	114 (56.7)	48 (48.0)	45 (45.0)
Living arrangements before admission, N (%)			
Independent	181 (90)	83 (83.0)	73 (73.0)
Nursing home	1 (0.5)	-	7 (7.0)
Senior residence/Assisted living	19 (9.5)	17 (17.0)	20 (20.0)
Marital status, N (%)			
Married or living together	118 (58.7)	51 (51.0)	40 (40.0)
Single or divorced	26 (12.9)	12 (12.0)	26 (26.0)
Widow/widower	57 (28.4)	37 (37.0)	34 (34.0)
Born in the Netherlands, N (%)	179 (89.1)	90 (90.0)	90 (90.0)
Education, N (%)			
Primary school	46 (22.9)	24 (16.0)	31 (31.0)
Elementary technical/domestic science school	43 (21.4)	28 (28.0)	18 (18.0)
Secondary vocational education	62 (30.8)	31 (31.0)	27 (27.0)
Higher level high school/third-level education	50 (24.9)	17 (17.0)	24 (24.0)
Charlson Comorbidity Index† (mean, SD)	2.04 (2.00)	2.21 (2.08)	2.27 (2.11)
Polypharmacy‡, N(%)	120 (59.7)	71 (71.0)	71 (71.0)
Mean MMSE§ score (mean, SD)	26.20 (3.15)	25.48 (4.16)	25.19 (3.82)
Hospitalization in past 6 months, N(%)	61 (30.3)	46 (46.0)	27 (27.0)
Primary admission diagnosis, N(%)			
Infection	24 (11.9)	18 (18.0)	16 (16.0)
Gastrointestinal	23 (11.4)	11 (11.0)	11 (11.0)
Cardiac	74 (36.8)	18 (18.0)	30 (30.0)
Respiratory	37 (18.4)	21 (21.0)	18 (18.0)
Cancer (including hematology)	8 (4)	4 (4.0)	1 (1.0)
Electrolyte disturbance	5 (2.5)	4 (4.0)	1 (1.0)
Renal	7 (3.5)	4 (4.0)	4 (4.0)
Other	23 (11.4)	20 (20.0)	19 (19.0)
Length of hospital stay, Mean, SD	6.96 (6.15)	7.47 (7.94)	10.48 (10.75)
Discharge destination, N(%)			
Home	168 (83.6)	83 (83.0)	66 (66.0)
Nursing home	2 (1)	-	4 (4.0)
Rehabilitation center	3 (1.5)	4 (4.0)	13 (13.0)
Assisted living	1 (0.5)	-	5 (4.0)
Other (e.g. other hospital)	7 (3.5)	4 (4.0)	6 (6.0)
Unknown	20 (10)	9 (9.0)	6 (6.0)
Functional impairment	104 (51.7)	72 (72.0)	73 (73.0)
Depressive symptoms	38 (18.9)	25 (25.0)	28 (28.0)
Cognitive impairment	36 (17.9)	28 (28.0)	23 (23.0)
Poor health related quality of life	90 (44.8)	57 (57.0)	65 (65.0)
Frailty ≥ 3 factors	85 (42.3)	58 (58.0)	74 (74.0)

*Standard Deviation, † Range of 0 to 31, with a higher score indicating more or more severe comorbidity[39], ‡ Use of 5 or more different medications, § Range 0-30, ≤23 is cognitive impairment[24]

Table 2. Multinomial regression on cost groups with the low cost group as reference group at admission and discharge n=401

	OR (CI) P-value Moderate cost group Unadjusted		**OR (CI) P-value Moderate cost group Adjusted***		**OR (CI) P-value Moderate cost group Adjusted****		**OR (CI) P-value High cost group Unadjusted**		**OR (CI) P-value High cost group Adjusted***		**OR (CI) P-value High cost group Adjusted****	
Outcome variables at admission												
Functional impairment	2.36 (1.34-4.16)	0.003	2.03 (1.11-3.73)	0.22	1.84 (0.98-3.46)	0.06	2.58 (1.45-4.61)	0.001	2.19 (1.17-4.10)	0.015	1.80 (1.03-3.16)	0.04
Depressive symptoms	1.44 (0.74-2.81)	0.28	1.38 (0.70-2.73)	0.35	1.43 (0.71-2.86)	0.32	1.68 (0.89-3.19)	0.11	1.52 (0.79-2.94)	0.21	1.49 (0.75-2.95)	0.25
Cognitive impairment	1.75 (0.86-3.52)	0.12	1.50 (0.71-3.15)	0.29	1.68 (0.78-3.61)	0.18	1.38 (0.71-2.69)	0.34	1.20 (0.59-2.45)	0.62	1.17 (0.57-2.44)	0.66
Poor health-related quality of life	1.62 (0.96-2.74)	0.07	1.49 (0.87-2.53)	0.15	1.50 (0.87-2.58)	0.14	2.29 (1.36-3.88)	0.002	2.10 (1.23-3.59)	0.007	1.89 (1.09-3.28)	0.02
Frailty	1.86 (1.03-3.35)	0.04	1.70 (0.91-3.15)	0.10	1.60 (0.83-3.06)	0.16	3.93 (2.15-7.18)	<0.001	3.69 (1.98-6.88)	<0.001	3.44 (1.78-6.63)	<0.001

* Multivariable regression with the low cost group as reference group, correction for demographic characteristics: age, marital status, education level, sex, and living arrangements at admission

** Multivariable regression with the low cost group as reference group, correction for demographic characteristics, length of stay, previous hospitalization in the past 6 months and Charlson Comorbidity index.

being placed in the highest cost group were much stronger. (Data of the complete case analysis is presented in supplement table Appendix 1.)

Discussion

This study is one of the first to describe post-acute care costs in older hospitalized persons and to provide a detailed description of clinically relevant patient characteristics and determinants that are associated with high costs. Our results demonstrated that for the total study population, the mean costs of post-acute care were as high as the costs of the index admission. As mean costs of index admission increased, post-acute care costs increased as well. The top 10.0% (n=40) of patients with highest post-acute care cost accounted for 52.1% of total post-acute care costs. Hence, whereas most patients had no or very little costs, costs were substantial in a small part of the population. Costs were highest in the first month postdischarge and the costliest types of care were unplanned readmissions, nursing home/rehabilitation care and home care. Frailty, functional impairment and poor HRQOL at admission were strongly associated with post-acute care costs above the median.

Our findings on the ratio between post-acute care costs and the costs of index admission are in concordance with a report by Mechanic et al. This study stated that the average post-acute care payments by Medicare were almost as high as the costs for the initial index admission.[1] Our findings on the pattern of spending, with highest costs occurring in the first month postdischarge coincide with the postdischarge literature that describes that most readmissions occur within 30 days after discharge.[40,41] General practice care contributed only to a small share of overall costs, which is in a accordance with the small percentage (3.9%) of total healthcare budget that is allocated to general practice in the Netherlands.[42]

Although frailty can be measured using various scales,[32,43-45] the finding that frailty is associated with increased post-acute care costs, corresponds with previous literature that has described frailty as an independent determinant of high healthcare costs in both the in- as outpatient setting.[13,15,46]

Building on these findings, our study indicates that frailty measured during the hospitalization period, is also associated with increased postdischarge costs. Moreover, our findings are concordant with Murray et al. who studied mean costs in the inpatient setting and found hospital expenses were higher in older patients with functional impairment.[19] Finally, our analysis suggests there is a relationship between poor EQ-5D utility scores and costs, suggesting that the EQ-5D could be used as an indicator of costs.

The fact that post-acute care costs are substantial, underlines the importance of adequate follow-up care to prevent unnecessary post-acute care expenditures. Our findings show that several measures that are often included in Comprehensive Geriatric Assessment (CGA), such as screening on frailty, are associated with increased healthcare expenditure. Although there is no definitive evidence that CGA has a cost-reducing effect on overall post-acute care costs,[47,48] using recommendations provided in the CGA treatment for discharge planning and initiation of appropriate follow-up care may reduce costs.[47,48] However, frailty may also be a sign that an older patient is entering the final phase of life, which may not warrant a sole focus on early treatment of recurrent illness but also on advanced care planning.[32,49] This could improve patient care, and may also have

an effect on post-acute care spending by preventing unnecessary readmissions. However, there is no decisive evidence on the effects of advanced care planning on post-acute care costs, which thus warrants further research on this topic.[50]

Limitations

Our study has several limitations. Firstly, how post-acute care should be defined is contentious. For instance, because it is difficult to distinguish between post-acute care and 'care as usual' in participants who were already nursing home residents, we decided to account all costs for home care and nursing home/rehabilitation care as post-acute care.[27] Subsequently, we could not distinguish between expenditures from participants who were already living in nursing homes before hospitalization and participants who moved to a nursing home after hospitalization. We did however correct for previous living arrangements in our statistical analyses. Furthermore, we did not include costs for emergency department visits that did not result in a hospitalization, which in other research has been studied as a source of preventable costs.[11,16] Secondly, patients with an MMSE lower than 15 were excluded from this study, which fundamentally alters our study population from the populations that have been studied with respect to the relation between dementia and costs.[18] This could explain why we did not find an association between cognitive impairment and costs. Moreover, missing data may have decreased the certainness of the absolute cost data per participant. After performing multiple imputation we found similar results in our multinomial regression analysis, so this missingness may not have changed our results and conclusions. However, it is possible that we were underpowered for drawing conclusions on some of the relations between determinants and costs, since the number of participants in the study was set in order to draw conclusions on differences in ADL-functioning.

Conclusion and implications

Post-acute care costs are substantial, but only in a small portion of acutely hospitalized older adults. The presence of frailty, functional impairment and poor health-related quality of life at time of admission are associated with an increased risk of high post-acute care costs. These measures may provide means to be studied as a predictor of post-acute costs in future research. Moreover, our study has important clinical implications because it underlines the importance of adequate follow-up care planning in effective cost-reduction strategies.

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Appendix 1. Complete Case analysis (n=296)
Multinomial regression on cost groups with the low cost group as reference group at admission and discharge n=296

	OR (CI) P-value Moderate cost group Unadjusted		**OR (CI) P-value Moderate cost group Adjusted***		**OR (CI) P-value Moderate cost group Adjusted****		**OR (CI) P-value High cost group Unadjusted**		**OR (CI) P-value High cost group Adjusted***		**OR (CI) P-value High cost group Adjusted****	
Outcome variables at admission												
Functional impairment	2.10 (1.16-3.78)	0.01	1.62 (0.85-3.07)	0.14	1.58 (0.81-3.08)	0.18	2.69 (1.46- 4.98)	0.002	2.19 (1.14-4.21)	0.02	2.16 (1.10-4.20)	0.02
Depressive symptoms	1.44 (0.72-2.88)	0.3	1.36 (0.66-2.80)	0.4	1.62 (0.76-3.43)	0.2	1.91 (0.99-3.73)	0.06	1.75 (0.89-3.45)	0.1	1.69 (0.85-3.41)	0.14
Cognitive impairment	2.83 (1.40-5.76)	0.004	1.90 (0.87-4.12)	0.11	2.28 (1.03-5.10)	0.043	1.69 (0.77-3.69)	0.19	1.57 (0.68-3.61)	0.29	1.64 (0.70-3.86)	0.25
Poor health-related quality of life	1.46 (0.83-2.56)	0.19	1.32 (0.74-2.35)	0.35	1.39 (0.77-2.53)	0.28	1.93 (1.09-3.41)	0.02	1.80 (1.01-3.21)	0.47	1.72 (0.96-3.10)	0.07
Frailty	1.41 (0.77-2.59)	0.27	1.07 (0.55-2.10)	0.84	1.04 (0.51-2.15)	0.91	6.93 (3.03-14.54)	<0.001	6.87 (3.16-14.92)	<0.001	6.93 (3.09-15.54)	<0.001

* Multivariable regression with the low cost group as reference group, correction for demographic characteristics: age, marital status, education level, sex, and living arrangements at admission
** Multivariable regression with the low cost group as reference group, correction for demographic characteristics, length of stay, previous hospitalization in the past 6 months and Charlson Comorbidity index