

BMJ Open Factors associated with 30-day readmission after hospitalisation for community-acquired pneumonia in older patients: a cross-sectional study in seven Spanish regions

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ABSTRACT

Objective Hospital readmission in patients admitted for community-acquired pneumonia (CAP) is frequent in the elderly and patients with multiple comorbidities, resulting in a clinical and economic burden. The aim of this study was to determine factors associated with 30-day readmission in patients with CAP.

Design A cross-sectional study.

Setting The study was conducted in patients admitted to 20 hospitals in seven Spanish regions during two influenza seasons (2013–2014 and 2014–2015).

Participants We included patients aged ≥65 years admitted through the emergency department with a diagnosis compatible with CAP. Patients who died during the initial hospitalisation and those hospitalised more than 30 days were excluded. Finally, 1756 CAP cases were included and of these, 200 (11.39%) were readmitted.

Main outcome measures 30-day readmission.

Results Factors associated with 30-day readmission were living with a person aged <15 years (adjusted OR (aOR) 2.10, 95% CI 1.01 to 4.41), >3 hospital visits during the 90 previous days (aOR 1.53, 95% CI 1.01 to 2.34), chronic respiratory failure (aOR 1.74, 95% CI 1.24 to 2.45), heart failure (aOR 1.69, 95% CI 1.21 to 2.35), chronic liver disease (aOR 2.27, 95% CI 1.20 to 4.31) and discharge to home with home healthcare (aOR 5.61, 95% CI 1.70 to 18.50). No associations were found with pneumococcal or seasonal influenza vaccination in any of the three previous seasons.

Conclusions This study shows that 11.39% of patients aged ≥65 years initially hospitalised for CAP were readmitted within 30 days after discharge. Rehospitalisation was associated with preventable and non-preventable factors.

INTRODUCTION

Community-acquired pneumonia (CAP) is a frequent, potentially serious disease in people aged ≥65 years and one of the leading causes of hospitalisation and mortality worldwide in this age group,^{1–4} in whom recovery from

Strengths and limitations of this study

- All the information on readmission was obtained from medical records.
- The study is part of a multicentre study carried out in seven autonomous communities representing 70% of the Spanish population.
- It was not possible to collect detailed information on the readmission episode.

an episode of CAP is predictive of increased mortality in subsequent years.⁵

The incidence of CAP differs between European countries due to variations in age distribution, the introduction of vaccination programmes and the clinical guidelines used. However, the incidence of cases and hospitalisations increases with age in all countries.^{6,7} In Spain, CAP is not a reportable disease and therefore the incidence in the population is unknown, although 2013 data also show an increase in hospitalisation (394.04 per 100,000 in the 65–74 years age group and 2584.95 per 100,000 in the >85 years age group).⁸

In people aged ≥65 years, full recovery after hospitalisation due to CAP is usually slow and the probability of readmission during a period of time after discharge is greater.⁹ Thirty-day readmission postdischarge is usually used as an indicator of vulnerability.^{2,10–12}

Readmission in patients initially hospitalised due to CAP is relatively frequent (especially in the elderly and patients with multiple comorbidities), and is often associated with a worsening of a baseline disease or the appearance of a new pathology,¹³ and this results in a significant clinical and economic burden for health systems.^{2,14} Studies have explored



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the factors associated with readmission following hospitalisation due to CAP, and have identified factors that improve the prognosis at discharge and are considered preventable, such as influenza and pneumococcal vaccination, the use of hospital care protocols, discharge planning and postdischarge follow-up. Adequate discharge planning, including patient stability and destination, has been associated with reduced readmission.^{15–17} However, the effect of seasonal influenza and pneumococcal vaccination and the adequacy of hospital care (use of clinical guidelines and antibiotic plans) may be more controversial.^{18–21} The initial severity of CAP, worsening of comorbidities and some individual patient characteristics have been described as non-preventable factors,^{15 21–25} and factors such as age, sex, socioeconomic status, education and some comorbidities have been independently associated with a greater likelihood of readmission.^{25 26}

The objective of this study was to determine the risk factors associated with 30-day readmission in people aged ≥ 65 years initially hospitalised due to CAP.

MATERIALS AND METHODS

Study design

This cross-sectional study was carried out as part of a multi-centre study in 20 hospitals from seven Spanish regions (Andalusia, the Basque Country, Castile and Leon, Catalonia, Madrid, Navarre and Valencian Community). Patients aged ≥ 65 years hospitalised due to CAP in the participating hospitals during the 2013–2014 and 2014–2015 influenza seasons were recruited.

Study population

The Spanish health system assigns each citizen a primary healthcare centre and a referral hospital to be attended. The assignment of the population to each hospital is made according to geography. Consequently, if there is a readmission, it would be in the same hospital. However, in an emergency, the patient may be treated in any hospital.

Patients included were aged ≥ 65 years admitted through the emergency department to any of the participating hospitals for ≥ 24 hours with a chest X-ray showing pulmonary infiltrate compatible with pneumonia and ≥ 1 of the following symptoms or signs of acute lower respiratory tract infection: cough, pleural chest pain, dyspnoea, fever $>38^{\circ}\text{C}$, hypothermia $<35^{\circ}\text{C}$ and abnormal auscultator respiratory sounds unexplained by other causes.

Patients who died during the initial hospitalisation and patients hospitalised for more than 30 days were not included. Institutionalised patients, patients with nosocomial pneumonia (onset ≥ 48 hours after hospital admission), patients whose main residence was not in any of the seven participating regions and those who did not provide signed informed consent were excluded.

Outcomes

The dependent variable was 30-day readmission, defined as 'hospitalisation for any reason within 30 days of

discharge'. Information on readmission was collected by re-review of index hospital medical records up to 30 days after initial discharge.

All participating hospitals had a specifically trained team of health professionals who used a structured questionnaire to obtain sociodemographic information and lifestyle factors by patient interview and the review of patient's medical record to collect immunisation history, risk medical conditions and the CAP hospital care process.

Information collected included sociodemographic variables: age, sex, marital status, educational level, cohabitation; lifestyle factors: smoking status (current smoker, ex-smoker, non-smoker) and high alcohol consumption (>40 g/day in men, >20 g/day in women). The Barthel Index²⁷ was used to assess the functional capacity at hospital admission (ranging from 0 — complete dependence to 100 — complete independence). Patients were considered vaccinated against pneumococcal disease if they had received a dose of pneumococcal vaccine in the last 5 years and against seasonal influenza if they had received a dose of the influenza vaccination at least 14 days before symptom onset. Comorbidities considered at high or moderate risk (chronic respiratory failure, history of pneumonia during the last 2 years, solid or haematological neoplasm, diabetes mellitus, renal failure, chronic obstructive pulmonary disease (COPD), heart failure, disabling neurological disease, chronic liver disease and haemoglobinopathy or anaemia) were collected from the patient's medical record through chart review and were assessed using the Charlson Comorbidity Index,²⁸ which assigns a weight to each comorbid condition (0, no comorbidity; 1, low comorbidity and 2, high comorbidity). Number of primary care nurse visits, number of hospital visits in the last 90 days. Severity of illness quantified in five risk classes using the Pneumonia Severity Index (PSI) at admission,²⁹ length of stay (LOS) <8 and ≥ 8 days,⁸ intensive care unit (ICU) admission, mechanical ventilation, adequacy of antibiotic treatment plan according to clinical guidelines (yes/no) and discharge disposition (home without services, home with home healthcare or social health centre) 6 were also collected.

Statistical analysis

The Barthel Index, a continuous variable, was dichotomised into 0–89 (moderate-to-high degree of dependency) and ≥ 90 (little or no dependency).

A bivariate analysis was conducted to compare 30-day readmission and no readmission according to sociodemographic variables, lifestyle factors, the Barthel Index, immunisation history, risk medical conditions, prior medical utilisation and hospital care process. Independent variables were checked for collinearity using the variance inflation factor.³⁰

As Spanish regions have varying degrees of autonomy in organising health services, persons living in the same region tend to have similar access to healthcare. Therefore, to estimate the crude OR and adjusted OR (aOR), we used multilevel regression models that considered

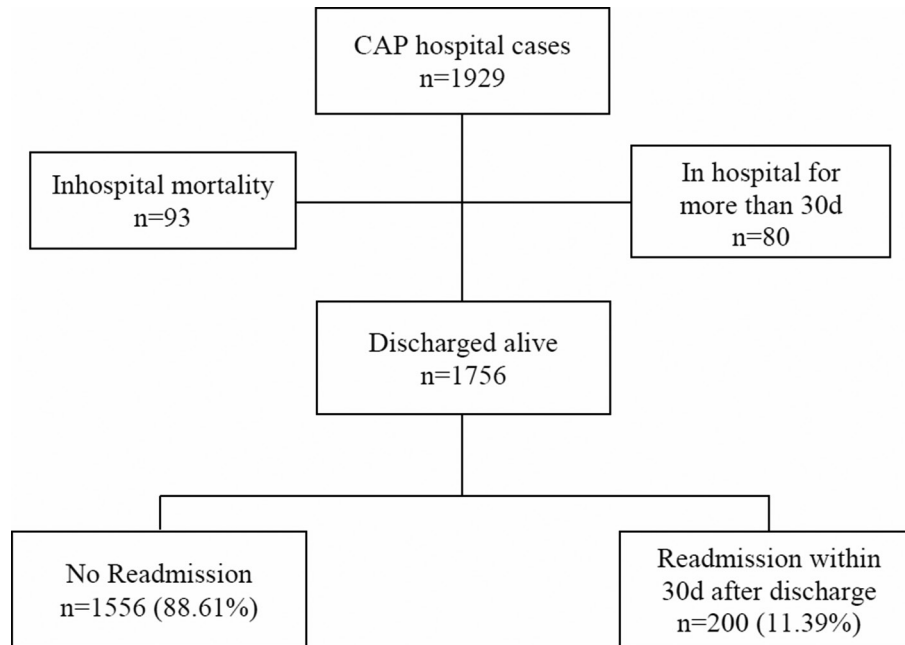


Figure 1 Flow chart of hospital readmissions. CAP, community-acquired pneumonia.

the outcome variable in people from the same region to obtain accurate statistical estimates of predictors of 30-day readmission.³⁰ Covariates were introduced into the model using a backward stepwise procedure, with a cut-off point of $p < 0.2$.

The analysis was performed using the SPSS V.24 statistical package and R V.3.3.0 statistical software.

RESULTS

Overall, 1929 inpatients met all study eligibility criteria for CAP: 93 patients died during the initial hospitalisation and 80 were hospitalised for >30 days. Therefore, 1756 CAP cases were discharged within 30 days after the initial hospitalisation: of these, 200 (11.39%) were readmitted within 30 days after hospital discharge (figure 1).

The reasons for 30-day readmission were unrelated to pneumonia in 49.5% (99 cases), pneumonia-related in 44.5% (89 cases) and unknown diagnosis in 6% (12 cases).

The descriptive analysis and unadjusted associations of factors related to 30-day readmission are shown in table 1. No differences were observed according to lifestyle factors and immunisation history.

Factors independently associated with 30-day readmission in the multilevel analysis (table 2) were living with a person aged <15 years (aOR 2.10, 95% CI 1.01 to 4.41; $p=0.04$), more than three hospital visits during the 90 previous days (aOR 1.53, 95% CI 1.01 to 2.34; $p=0.04$) chronic respiratory failure (aOR 1.74, 95% CI 1.24 to 2.45; $p=0.001$), heart failure (aOR 1.69, 95% CI 1.21 to 2.35; $p=0.002$), chronic liver disease (aOR 2.27, 95% CI 1.21 to 4.31; $p=0.01$) and discharge to home with home healthcare (aOR 5.61, 95% CI 1.70 to 18.50; $p=0.005$).

A moderate-to-high degree of dependency was tentatively associated with readmission (aOR 1.39, 95% CI 0.99 to 1.95; $p=0.05$).

No associations were observed with age, sex, pneumococcal vaccination or seasonal influenza vaccination in any of the three previous seasons, the PSI or any variable related to the hospital care process.

DISCUSSION

The overall 30-day readmission rate in our study was 11.39%. Although all participating hospitals were referral centres, readmission rates ranged between regions from 2.5% to 14%. This might be due to the differences in the hospital healthcare burden of participating hospitals and in the protocols used.

In the Pneumonia Patient Outcomes Research Team cohort study, carried out in the USA and Canada, the readmission rate in adults was 10.1%.³¹ Readmission rates at 30 days in people aged ≥ 65 years admitted for CAP vary between 8% and 27%, depending on the population and country studied.^{11 19 21 25 32} In Spain, national data show 30-day readmissions increased from 11.5% in 2004 to 13.5% in 2013 in adults admitted for CAP.⁸

Our results show that non-preventable factors, specifically patient characteristics (living with a person aged <15 years, more than three hospital visits during the 90 previous days and some comorbidities) and one preventable factor (discharge disposition) were significantly associated with 30-day readmission. Factors such as cohabitation and the discharge disposition have been little studied and their identification provides a new perspective on the risk factors involved in 30-day readmission of these patients.

Table 1 Distribution of 30-day readmission cases according to patient characteristics

	Readmission n=200	No readmission n=1556	Crude OR (95%CI)	P values
Sociodemographic				
Age median (range)	80 (65–101)	78 (64–100)	1.02 (0.99–1.04)	0.07
Age group				
65–74 years	56 (28.0%)	501 (32.2%)	1	
75–84 years	98 (49.0%)	729 (46.9%)	1.20 (0.85–1.70)	0.31
>84 years	46 (23.0%)	326 (20.5%)	1.26 (0.83–1.91)	0.27
Sex				
Female	64 (32.0%)	622 (40.0%)	1	
Male	136 (68.0%)	934 (60.0%)	1.44 (1.05–1.97)	0.02
Educational level				
No/primary education	153 (78.1%)	1118 (72.4%)	1	
Secondary or higher	43 (21.9%)	427 (27.6%)	0.75 (0.51–1.10)	0.14
Marital status				
Married/cohabiting	116 (58.0%)	912 (58.6%)	1	
Single	21 (10.5%)	107 (6.9%)	1.56 (0.94–2.59)	0.09
Widowed/divorced	63 (31.5%)	536 (34.4%)	0.93 (0.67–1.29)	0.66
Cohabitation				
Lives alone	31 (15.5%)	289 (18.6%)	1	
Lives with cohabitant aged >15 years	155 (77.5%)	1203 (77.4%)	1.20 (0.80–1.80)	0.39
Lives with cohabitant aged <15 years	14 (7.0%)	63 (4.1%)	2.03 (1.02–4.04)	0.04
Lifestyle factors				
Smoking status				
Non-smoker	79 (39.5%)	693 (44.5%)	1	
Smoker	16 (8.0%)	138 (8.9%)	1.04 (0.59–1.83)	0.90
Ex-smoker	105 (52.5%)	725 (46.6%)	1.28 (0.94–1.75)	0.11
High alcohol consumption				
No	197 (98.5%)	1524 (97.9%)	1	
Yes	3 (1.5%)	32 (2.1%)	1.38 (0.42–4.54)	0.60
Prior utilisation of resources				
No of nurse visits in last 90 days				
0–2	147 (73.5%)	1182 (76.4%)	1	
≥3	53 (26.5%)	365 (23.6%)	1.17 (0.82–1.65)	0.39
No of hospital visits in last 90 days				
0–2	164 (82.8%)	1355 (87.6%)	1	
≥3	34 (17.2%)	192 (12.4%)	1.53 (1.02–2.31)	0.04
Barthel Index				
Little or no dependency >90	108 (54.0%)	990 (63.6%)	1	
Moderate-to-high dependency ≤90	92 (46.0%)	566 (36.4%)	1.47 (1.08–2.01)	0.01
Immunisations				
Influenza vaccination in any of the three previous seasons				
No	54 (27.0%)	464 (29.8%)	1	
Yes	146 (73.0%)	1092 (70.2%)	1.16 (0.83–1.61)	0.39
Pneumococcal vaccination in five previous years				
No	161 (80.5%)	1281 (82.3%)	1	

Continued

Table 1 Continued

	Readmission n=200	No readmission n=1556	Crude OR (95%CI)	P values
Yes	39 (19.5%)	275 (17.7%)	1.11 (0.76–1.62)	0.58
Risk medical conditions				
Chronic respiratory failure				
No	136 (68.0%)	1269 (81.6%)	1	
Yes	64 (32.0%)	287 (18.4%)	2.08 (1.50–2.88)	<0.001
Pneumonia during the last 2 years				
No	146 (73.0%)	1267 (81.4%)	1	
Yes	54 (27.0%)	289 (18.6%)	1.65 (1.18–2.32)	0.004
Any malignancy				
No	161 (80.5%)	1271 (81.7%)	1	
Yes	39 (19.5%)	285 (18.3%)	1.08 (0.74–1.58)	0.67
Diabetes				
No	139 (69.5%)	1023 (65.7%)	1	
Yes	61 (30.5%)	533 (34.3%)	0.83 (0.60–1.14)	0.26
Renal failure				
No	151 (75.5%)	1263 (81.2%)	1	
Yes	49 (24.5%)	293 (18.8%)	1.38 (0.97–1.96)	0.07
Chronic obstructive pulmonary disease				
No	128 (64.0%)	1074 (69.0%)	1	
Yes	72 (36.0%)	482 (31.0%)	1.25 (0.92–1.70)	0.16
Heart failure				
No	128 (64.0%)	1168 (75.1%)	1	
Yes	72 (36.0%)	388 (24.9%)	1.69 (1.24–2.31)	0.001
Chronic liver disease				
No	186 (93.0%)	1504 (96.7%)	1	
Yes	14 (7.0%)	52 (3.3%)	2.13 (1.15–3.94)	0.01
Haemoglobinopathy or anaemia				
No	160 (80.0%)	1324 (85.1%)	1	
Yes	40 (20.0%)	232 (14.9%)	1.40 (0.96–2.04)	0.08
Disabling neurological disease				
No	179 (89.5%)	1416 (91.0%)	1	
Yes	21 (10.5%)	140 (9.0%)	1.17 (0.72–1.90)	0.52
Charlson Index				
No comorbidity (0)	18 (9.0%)	233 (15.0%)	1	
Low comorbidity (1)	54 (27.0%)	378 (24.3%)	1.83 (1.05–3.20)	0.03
High comorbidity (≥2)	128 (64.0%)	945 (60.7%)	1.71 (1.02–2.86)	0.04
Hospital care process				
Intensive care unit				
No	188 (94.5%)	1499 (96.9%)	1	
Yes	11 (5.5%)	48 (3.1%)	1.93 (0.97–3.81)	0.06
Mechanical ventilation				
No	157 (78.5%)	1317 (84.9%)	1	
Yes	43 (21.5%)	235 (15.1%)	1.50 (1.03–2.18)	0.03
Pneumonia Severity Index				

Continued

Table 1 Continued

	Readmission n=200	No readmission n=1556	Crude OR (95%CI)	P values
I-III	69 (34.7%)	645 (41.7%)	1	
IV-V	130 (65.3%)	902 (58.3%)	1.40 (1.02–1.92)	0.04
Length of hospital stay				
<8 days	80 (40.0%)	766 (49.2%)	1	
≥8 days	120 (60.0%)	790 (50.8%)	1.45 (1.05–2.02)	0.02
Antibiotic treatment				
No	97 (50.3%)	700 (46.6%)	1	
Yes	96 (49.7%)	802 (53.4%)	1.07 (0.76–1.50)	0.70
Discharge disposition				
Home without services	185 (92.5%)	1477 (94.9%)	1	
Home with home healthcare	9 (4.5%)	19 (1.2%)	5.05 (1.58–16.15)	0.01
Social health centre	6 (3.0%)	60 (3.9%)	1.23 (0.41–2.92)	0.63

Table 2 Multilevel regression analysis of factors associated with 30-day readmission

	Adjusted OR (95%CI)	P values
Age	1.02 (0.99–1.04)	0.13
Sex—male	1.39 (0.99–3.12)	0.06
Cohabitation		
Lives alone	1	
Lives with cohabitant aged >15 years	1.17 (0.71–1.95)	0.54
Lives with cohabitant aged <15 years	2.10 (1.01–4.41)	0.04
Marital status		
Married/cohabiting	1	
Single	1.73 (0.96–3.11)	0.07
Widowed/divorced	0.94 (0.61–1.44)	0.77
No of hospital visits ≥3	1.53 (1.01–2.34)	0.04
Barthel Index		
Moderate-to-high dependency ≤90	1.39 (0.99–1.95)	0.05
Pneumonia during the last 2 years	1.31 (0.91–1.88)	0.14
Chronic respiratory failure	1.74 (1.24–2.45)	0.001
Diabetes	0.74 (0.53–1.04)	0.08
Heart failure	1.69 (1.21–2.35)	0.002
Chronic liver disease	2.27 (1.20–4.31)	0.01
Mechanical ventilation	1.33 (0.90–1.97)	0.15
Discharge disposition		
Home without services	1	
Home with home healthcare	5.61 (1.70–18.50)	0.005
Social health centre	1.27 (0.53–3.05)	0.59

Calvillo-King *et al* in a thorough review of studies on readmission, underlined the importance of considering social factors (sociodemographic, socioeconomic and the social environment) as elements that could influence readmission after an episode of CAP.²² Our study evaluated sociodemographic and socioeconomic factors and the social environment. Although the influence of sex varies between studies and may be closely related to other factors such as age, risk habits and some comorbidities, the association with male sex disappeared in the final model, in contrast to the results found by Neupane *et al*, and Bohannon and Maljanian.^{19 33}

Patients living with children aged <15 years had a twofold higher probability of readmission than those living alone or with a partner. Although it is known that school children may be a source of infection of the elderly in some infectious diseases, we found no studies that investigated the type of cohabitation in this context, possibly because one factor usually associated with readmission in people aged ≥65 years is living in geriatric residences.¹¹ In Spain, the recommendation of vaccination of persons in contact with high-risk persons, including persons aged ≥65 years with risk factors has been maintained.³⁴ We also found no association with factors identified by other authors, such as the educational level or the history of smoking or alcohol use.^{25 35}

In the studies by Neupane *et al* in two Canadian cities and Adamuz *et al* in a tertiary hospital in Barcelona, seasonal influenza and pneumococcal vaccination were included in the adjusted analysis of readmission due to CAP, but no association was found.^{19 23} We investigated seasonal influenza and pneumococcal vaccination in the previous 5 years but found no association in the crude or adjusted models.

In our study, 49.5% of 30-day readmissions were due to causes unrelated to CAP and 91% of readmitted patients presented comorbidities. Patients with chronic liver disease, heart failure and respiratory failure had higher

30-day readmission rates, findings consistent with other studies showing that some cardiovascular and respiratory diseases play an important role in the risk of readmission in patients with CAP,^{12 23–25 36} and that the reason for readmission generally differs from the initial diagnosis of CAP due, in most cases, to destabilisation of comorbidities^{10 23–26 37 38}. Fine *et al*, in a cohort study, found that pneumonia often occurs in patients with underlying comorbidities and often results in a worsening of such underlying conditions.³¹

We found an association with prior hospital utilisation in the 90 days before admission for CAP, but no association with general practitioner and primary care nurse visits. Healthcare in Spain is free, which encourages patients to make multiple visits to primary care centres and/or hospitals, ensuring patient care and follow-up. Adamuz *et al* and Tang *et al* found an association between readmission and hospitalisation in the 90 days before admission for CAP.^{11 23}

One preventable factor that influences CAP episodes in people aged ≥ 65 years is the quality of care received during hospitalisation, while discharge planning and follow-up until recovery influence patient recovery and, therefore, readmission.^{16 21 23 24} We found, as did Dong *et al*,¹⁶ an association with discharge to home with home healthcare. A possible explanation might be an inadequate evaluation of the patient's stability at discharge. Various authors have suggested the importance of the discharge disposition in patients admitted due to other causes such as COPD or some specific interventions.^{39–41} However, with respect to patients with CAP, only Dong *et al* and the present study have found an association between the discharge disposition and readmission. Other variables related to the quality of care were studied to assess these aspects but no association with readmission was found.

Strengths and limitations

The main strength of the study is that all clinical information was obtained from patient medical records and, therefore, was unlikely to be biased. Another strength is the cross-sectional design, as it is part of a multicentre study carried out in seven regions representing 70% of the Spanish population.

A limitation is that it was not possible to collect patient characteristics at discharge, and therefore we cannot say whether there was instability at discharge that may have caused the readmission. Therefore, the variable 'discharge disposition' was considered as a proxy to define instability.

CONCLUSIONS

In conclusion, this study shows that 11.39% of patients aged ≥ 65 years hospitalised due to CAP are readmitted within 30 days after an episode of CAP and that this was associated with living with a cohabitant aged < 15 years, more than three hospital visits during the 90 previous

days, chronic respiratory failure, heart failure, chronic liver disease and discharge to home with home health-care services.

Because social factors, in addition to postdischarge and preadmission clinical information, may influence the prognosis, it is important that these factors continue to be considered in future research.

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