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Profiling the hospital-dependent patient in a large academic hospital: Observational study

Andrea Ticinesi[a,b,*], Antonio Nouvenne[a], Beatrice Prati[a], Fulvio Lauretani[a], Ilaria Morelli[a], Claudio Tana[a], Massimo Fabi[c], Tiziana Meschi[a,b]

[a] Geriatric-Rehabilitation Department, Azienda Ospedaliero-Universitaria di Parma, Via Antonio Gramsci 14, 43126 Parma, Italy
[b] Department of Medicine and Surgery, University of Parma, Via Antonio Gramsci 14, 43126 Parma, Italy
[c] General Management, Azienda Ospedaliero-Universitaria di Parma, Via Antonio Gramsci 14, 43126 Parma, Italy

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ABSTRACT

Background: In older patients with acute illness, a condition of "hospital-dependence" may arise: patients get adapted to the hospital care and, once discharged, may experience health status decline, requiring repeated readmissions despite appropriate treatments.
Aims: The objective of this case-series study was to describe the characteristics of 118 patients (72 F) aged ≥75 (mean 83.7 ± 4.9) who were urgently admitted to our institution at least 4 times in 2015.
Methods: For each patient and admission, data on multimorbidity (Cumulative Illness Rating Scale Comorbidity Score and Severity Index), frailty (Rockwood Clinical Frailty Scale), functional dependence, functional status, polypharmacy, length of stay and interval between admissions were extrapolated from clinical records. Mortality during the years 2015 and 2016 was assessed on the institutional database.
Results: At the first admission, patients had a high burden of polypharmacy (median number of drugs 8.5, IQR 6–11) and multimorbidity (Comorbidity Score 15.8 ± 4.1, Severity Index 2.9 ± 1.1). However, most (55.5%) were fit or pre-frail according to Clinical Frailty Scale (score 1–4). At multivariate models, Severity Index was significantly correlated with the length of stay (β ± SE 2.23 ± 0.89, p = .01) and readmission interval (β ± SE -22.49 ± 9.27, p = .02). Significantly increasing trends of multimorbidity and disability occurred across admissions. By the end of 2016, 66% of patients had died. Frailty (RR 2.005, 95%CI 1.054–3.814, p = .007) and cancer were the only predictors of mortality.
Conclusions: Hospital-dependent patients had severe multimorbidity, but exhibited an unexpectedly low prevalence of frailty/disability at baseline, though increasing across admissions. Trends of frailty and multimorbidity are paramount for profiling the hospital-dependence risk.

1. Introduction

In the last decade, the improvement in standards of care has led to significant prolongation of life expectancy in developed countries. However, this progress has also been accompanied by a massive increase in multiple chronic condition burden for older people [1]. Multimorbidity represents a big challenge for healthcare systems, and particularly for the hospital care, which has been traditionally organized for managing acute conditions [2]. Older frail multimorbid patients have in fact rapidly become the "core business" of acute-care hospitals.

Hospital care may give immediate and effective responses to these patients, relieving acute symptoms. However, in some cases older patients can get adapted to the high standard of care, making the discharge into a community setting difficult. Once returned home, where the responses to their needs may be less timely and intense than in the hospital, these patients may face rapid deterioration of their health status, even when the best medical practice and assistance is delivered [3]. This results into high numbers of Emergency department visits, early readmissions, and even multiple readmissions, contributing to hospital overcrowding in a significant way [4,5].

A few years ago, the term "hospital-dependent patient" has been coined to indicate this particular category of patients [6]. Hospital-dependence is conditioned by both physical and psychological factors.

* Corresponding author at: Geriatric-Rehabilitation Department, Azienda Ospedaliero-Universitaria di Parma and Department of Medicine and Surgery, University of Parma, Via Antonio Gramsci 14, 43126 Parma, Italy.
E-mail address: aticinesi@ao.pr.it (A. Ticinesi).

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Physical factors are related to the clinical complexity of these patients, who unexpectedly experience a high number of complications, decompensation of chronic diseases, pharmacotherapy-related adverse events both in the hospital and the community [7]. Psychological factors are associated with the feeling of safety and support these patients and their caregivers experience in the hospital [8,9].

Although not limited to older patients, this concept mainly applies to subjects aged ≥75 years old, who, according to nation-wide studies performed in the United States, account for more than two thirds of unplanned hospital readmissions [10].

Despite the topicality of this theme and the need for implementing novel models of care to address the needs of these patients [11], no studies have focused on hospital-dependent patients to date. Thus, besides a careful conceptualization [6], quantitative data describing the profile of older hospital-dependent patients are still lacking. Several predictors of rehospitalization have been identified in older patients [12], but their generalizability is limited by different care settings and methodology of assessment [13]. Moreover, none of them has been focused on early identification of older patients at risk for multiple readmissions and health trajectory towards hospital dependence.

The objective of this case-series study was to describe the characteristics of patients aged ≥75 years old experiencing repeated unplanned readmissions to a large academic hospital during an index year, and factors associated with length of stay, early readmissions and survival.

2. Materials and methods

2.1. Study design, setting and population

This observational study was performed at Parma-University hospital, a 1200-bed teaching hospital located in Northern Italy representing the only healthcare facility performing urgent admissions in a district of over 300,000 inhabitants, with an Emergency Department visit volume of > 100,000 per year.

The study was designed as a case-series with sampling of participants based on the outcome (repeated hospital admissions over one-year time) [14], due to the relatively low prevalence of hospital-dependence in the hospitalized older population and the lack of clinical characterization of this condition in the scientific literature.

Hospital-dependent patients were operatively defined as those experiencing at least 4 unplanned urgent Emergency department visits followed by admission in medical, surgical, rehabilitation, or intensive care wards over one year. A number of 4 unplanned admissions in one-year time is in fact associated with the highest risk of future readmissions [15]. Thus, included in the study were all those patients aged ≥75 who fulfilled this criterion for the calendar year 2015.

Patients not residing in the Parma district, those with evidence of admission to other hospitals outside the Parma district in the year 2015, those admitted in outpatient units or short-stay observation units were excluded from the study.

2.2. Data collection

Two physicians of the team consulted the clinical records relating to all the hospital admissions of the calendar year 2015 of patients fulfilling inclusion criteria. For each admission, the following information was retrieved:

- Administrative data: day of the week of admission and discharge, length of stay, time interval from the previous admission, type of hospital ward, outcome, type and number of diagnostic procedures performed during stay;
- Personal data: age, place of residence, family composition, presence of one or more caregivers;
- Clinical data referred to both admission and discharge time: main diagnosis, number and type of chronic conditions, functional capacity in activities of daily living (ADL) and instrumental activities of daily living (IADL), presence of medical devices, way of feeding, number and type of drugs, vital signs;
- Laboratory data at admission time: hemoglobin, blood count, serum creatinine, sodium, potassium, albumin, cholesterol, triglyceride, bilirubin.

The information of each medical record was used to calculate the Cumulative Illness Rating Scale Comorbidity Score (CIRS-CM) and Severity Illness (CIRS-SI), as a measure of chronic illness burden [16], and the Rockwood Clinical Frailty Scale (RCFS), as a measure of frailty and disability [17], at the moment of admission. The calculation of CIRS-CM, CIRS-SI, RCFS, ADL and IADL, when not directly present on clinical records, was determined retrospectively by carefully reviewing medical history and patient diaries filled by managing physicians and nurses on daily basis during hospital stay. Categories of frailty and functional status were determined by analogy with a retrospective methodology proposed for scientific studies [18].

For all patients who were discharged alive from the last admission of the index year 2015, the incident mortality during the following year (until 12/31/2016) were extrapolated from the hospital institutional database.

2.3. Critical review of clinical cases

The clinical records were also independently evaluated by other five board-certified expert clinicians with similar experience in management of multimorbid elderly patients but different specialty background (one geriatrician, one nutritionist, one gastroenterologist and two internists). Blind to each other, they gave a synthetic judgement about the factors that, according to their personal experience, conditioned the admission cascade in each patient. They were asked to indicate which figure was the main contributor to repeated hospital admissions among hospital physicians, general practitioner, patient himself, caregivers, and severity of diseases (i.e. unpreventable admissions). They were also asked to list, for each clinical case, the factors that could have contributed to the admission cascade, either related to the patient (for example, lack of compliance to drug prescriptions), caregivers (insufficient home supervision), family (lack of understanding of healthcare needs), general practitioner (insufficient monitoring), or hospital management of the case (malpractice, insufficient provision by specialists, lack of prognostic evaluation). No preordained list of possible contributing factors was given, in order to let each reviewer identify the most relevant elements according to his/her clinical experience. This procedure was planned since the complexity of hospital-dependent patients and the pitfalls of their clinical management may not be fully captured by quantitative measures, requiring also a qualitative research approach [19].

2.4. Statistical analysis

Data were expressed as mean ± standard deviation, median and interquartile range (IQR) or percentage, according to their type and distribution. The prevalence of multimorbidity (number of chronic conditions ≥2), frailty (Rockwood Clinical Frailty Scale ≥5), functional dependence (activities of daily living score < 5) and polypharmacy (chronic drug treatments ≥5) was calculated in the studied population. Multivariate linear regression models, accounting for possible confounding factors, were applied to verify which factors were correlated with length of stay of each admission, cumulative length of stay, hospitalization-free interval after discharge and number of readmissions. Multivariate logistic regression models and Kaplan-Meier survival analysis were also applied to identify factors associated with mortality and readmission at 10 and 30 days after discharge. A prevalence analysis was performed for the identification of factors

involved in the readmission cascade, according to independent reviewers. Inter-reviewer agreement was calculated (k coefficient). P values were considered significant when < 0.05. All statistical analyses were performed with the SAS v. 9.2 (SAS Institute, Cary, NC, USA) software.

2.5. Ethical statement

The study protocol was approved by the local Ethics Committee (Comitato Etico per Parma approval ID 1550). Due to the retrospective study design and high expected mortality of the studied population, the ethics committee waived the obtainment of written informed consent, in compliance with the Italian law. All procedures were performed following the principles of the 1963 Declaration of Helsinki and its later amendments.

3. Results

3.1. Baseline characteristics of participants at the index admission

The number of older (age ≥ 75) patients urgently admitted at least four times in Parma University-Hospital during the year 2015, and thus eligible for study inclusion, was 118 (72 F, 46 M, mean age 83.7 ± 5.0). Fifty-eight subjects (49%) were admitted four times, 37 (31%) five times, 14 (12%) six times, 8 (7%) seven times and one patient experienced eight unplanned admissions. Thus, clinical records from 565 urgent admissions were examined, 87.2% from medical wards and 12.8% from surgical wards. The cumulative length of stay was in average 50 ± 28 days per patient.

The main characteristics of the study population at the moment of the first admission are summarized in Table 1 and Supplementary material (Table S1). The baseline prevalence of multimorbidity (≥2 chronic diseases), frailty (Rockwood Clinical Frailty Scale ≥5), functional dependence (activities of daily living score < 5) and polypharmacy (≥5 chronic drug treatments) were 100%, 45%, 50%, and 83%, respectively.

From a functional point of view, at the first admission most patients were able to walk alone (44%) or with the aid of a cane (28.8%); fewer required a walker (13.6%) or a wheelchair (11%), and only three (2.5%) were completely bedridden. Only two patients (1.7%) lived alone, without a reliable caregiver. In 59.3% of cases, the caregiver was an offspring, while in 20.6% of cases a professional caretaker lived with the patient. Invasive devices (bladder catheters, central venous lines, feeding tubes) were present in only 7 participants (5.9%). Artificial nutrition was being performed at baseline in only 3 patients (2.5%).

3.2. Factors associated with length of stay and early readmission

In a multivariate linear regression model (Table 2), the only factors significantly associated with length of stay during the index admission were CIRS-SI (β ± SE 2.23 ± 0.89, p = .01), reduced functional status (β ± SE 3.41 ± 1.29, p = .009) and admission for acute infection (β ± SE 7.83 ± 2.01, p < .001).

The second unexpected readmission occurred in average 54 ± 53 days after the first discharge. The only factor significantly and negatively associated with the length of readmission interval at multivariate linear regression (Table 2) was illness severity measured with CIRS-SI (β ± SE -22.49 ± 9.27, p = .02).

CIRS-SI was also independently associated with very early readmission interval (< 10 days), but not with readmission within 30 days and number of total readmissions (Supplementary Material, Tables S2, S3 and S4). No clinical parameter was associated with the cumulative length of stay during the index year (Supplementary Material, Table S5).

Table 1
Baseline characteristics of the 118 elderly patients experiencing multiple unexpected readmissions included in the study.

Baseline characteristics of included patients		Most frequent reasons for the index hospitalization	
		COPD, n (%)	23 (19.4%)
General		Congestive heart failure, n (%)	21 (17.8%)
Age, years	83.7 ± 5.0	Pneumonia, n (%)	16 (13.5%)
Females, n (%)	72 (61%)	Cancer, n (%)	10 (8.4%)
Length of stay, days	9 [5–15]	Syncope, n (%)	6 (5%)
Frailty		Acute pancreatitis, n (%)	6 (5%)
RCFS score	4.7 ± 1.4	Stroke, n (%)	6 (5%)
Pre-frail or healthy (RCFS < 5), n (%)	65 (56%)	Acute coronary syndrome, n (%)	3 (2.5%)
Frail (RCFS 5–6), n (%)	37 (32%)	Complicated UTIs, n (%)	3 (2.5%)
Disabled (RCFS > 6), n (%)	16 (12%)	Acute kidney injury, n (%)	3 (2.5%)
Functional performance		Acute bowel disease, n (%)	2 (1.6%)
Able to walk alone, n (%)	52 (44%)	Lower limb ischemia, n (%)	2 (1.6%)
Walking with cane, n (%)	34 (29%)	Septic shock, n (%)	2 (1.6%)
Walking with assistive devices, n (%)	21 (18%)	Fracture, n (%)	2 (1.6%)
On wheelchair, n (%)	15 (13%)	Tachyarrhythmia, n (%)	1 (0.8%)
Bedridden, n (%)	5 (2%)	Delirium/dementia, n (%)	1 (0.8%)
Multimorbidity and polypharmacy		Other diagnoses, n (%)	11 (9.3%)
CIRS-CS score	15.9 ± 4.1	**Main comorbidities**	
CIRS-SI score	2.9 ± 1.2	Hypertension, n (%)	107 (90.6%)
Drugs, n	8.5 [6–11]	Heart disease, n (%)	97 (82.2%)
Place of living		COPD or other lung diseases, n (%)	63 (53.3%)
Residing at home, n (%)	113 (96%)	Vascular encephalopathy, n (%)	51 (43.2%)
Residing in nursing home, n (%)	5 (4%)	Diabetes, n (%)	39 (33%)
Main caregiver		Cancer, n (%)	37 (31.3%)
Spouse, n (%)	20 (17%)	Chronic kidney disease, n (%)	30 (25.4%)
Offspring, n (%)	70 (59%)	Dementia, n (%)	29 (24.5%)
Private assistance, n (%)	8 (7%)	Chronic intestinal diseases, n (%)	21 (18.8%)
Public assistance, n (%)	2 (2%)	Previous stroke, n (%)	20 (16.9%)
Offspring plus assistance, n (%)	16 (13%)	Cirrhosis, n (%)	13 (11%)
Living alone, n (%)	2 (2%)		

Data expressed as percentages (qualitative variables), mean ± standard deviation or median [interquartile range] according to the normality od distribution (quantitative variables). RCFS = Rockwood Clinical Frailty Scale. CIRS-CS = Cumulative Illness Rating Scale Comorbidity Score. CIRS-SI = Cumulative Illness Rating Scale Severity Index. COPD = Chronic Obstructive Pulmonary Disease.

Table 2
Multivariate linear regression models showing the association between baseline characteristics of patients experiencing repeated unexpected hospital admissions over one year and length of stay during the index admission (model 1) or interval before the second readmission (model 2).

	Model 1		Model 2	
	Association between baseline parameters and length of stay during the index admission		Association between baseline parameters and length of the interval between the first and the second admission	
	β ± SE	p*	β ± SE	p*
Age	−0.33 ± 0.21	0.11	0.29 ± 1.08	0.78
Sex (female vs male)	1.89 ± 2.07	0.36	−9.13 ± 10.8	0.40
Rockwood Clinical Frailty Scale	−1.38 ± 1.07	0.20	−3.36 ± 12.91	0.79
Reduced functional status	3.41 ± 1.29	**0.009**	−3.36 ± 6.77	0.62
CIRS- SI score	2.23 ± 0.89	**0.01**	−22.49 ± 9.27	**0.02**
Cognitive impairment or dementia	−2.57 ± 2.60	0.33	17.75 ± 13.67	0.20
Infection	7.83 ± 2.01	< **0.001**	4.39 ± 10.54	0.67
Cancer	0.36 ± 2.13	0.86	−4.03 ± 11.18	0.72
Number of drugs at admission	−0.24 ± 0.31	0.43	0.92 ± 1.63	0.57
Presence of a caregiver	0.27 ± 0.52	0.61	−4.69 ± 2.76	0.09

CIRS-SI = Cumulative Illness Rating Scale Severity Index.
P values < 0.05 are indicated in bold
* p fully adjusted.

3.3. Trends of multimorbidity, frailty and polypharmacy during the admission cascade

In average, participants experienced a significant increasing trend of multimorbidity (CIRS-CS and number of chronic diseases p for trend < 0.001) and frailty (Rockwood Clinical Frailty Scale p for trend < 0.001) throughout the admissions (Fig. 1). Conversely, ADL and IADL showed a significant decreasing trend. The number of drugs increased after the first admission, and then remained stable (Fig. 1). No trend of length of hospital stay could be identified throughout the admissions (first admission: 12.6 ± 11.5 days; second admission: 10.5 ± 8.7 days; third admission: 10.2 ± 8.9 days; fourth admission 11.8 ± 10.9 days).

An increase of Rockwood Clinical Frailty Scale score between the first and the second admission was independently associated with the duration of stay during the second admission, and the total number of hospitalization days at multivariate linear regression models (Supplementary Material, Tables S6, S7 and S8).

3.4. Patient outcomes

After 1-year follow-up period, 78 out of 118 patients (66%) had died. A comparison of the baseline characteristics of survivors vs non-survivors is depicted in Supplementary Material, Table S9. Kaplan-Meier analysis (Fig. 2) showed that the presence of frailty (Rockwood Clinical Frailty Scale score 5–6) or disability (Rockwood Clinical Frailty Scale score ≥ 7) at baseline was associated with a significantly lower survival at follow-up (age- and sex-adjusted p < .001). A multivariate Cox proportional hazard model confirmed that the presence of frailty/disability at baseline (Rockwood Clinical Frailty Scale RR 2.005, 95% CI 1.054–3.814, p = .03) was significantly associated with reduced survival, together with a diagnosis of cancer (RR 2.405, 95% CI 1.427–4.054, p = .001) (Table 3.

3.5. Factors conditioning admission cascade

Once asked which was the single main contributor to hospital admission cascade in each patient, five independent reviewers, in average, indicated hospital physicians (53.3% of cases), general practitioners (18.9%), severity of disease (18.9%), caregivers (6.5%) and patient themselves (2.4%) (Supplementary material, Table S10). A low inter-rater agreement was found (k = 0.22).

The factors influencing the admission cascade, according to their judgement, are listed in Table 4, together with the prevalence in the studied population.

4. Discussion

The elderly hospital-dependent patients included in our study suffered from a high burden of multimorbidity and disease severity. At baseline, they had, in average, a relatively good functional performance and most of them had a reliable caregiver at home. However, during the admission cascade, they experienced a rapid deterioration of functional performance, increased frailty and multimorbidity, eventually leading to adverse outcomes. Frailty at baseline was a significant predictor of mortality, while illness severity was associated with the length of hospitalization.

To our knowledge, this is the first study attempting to profile the clinical characteristics of elderly hospital-dependent patients, since previous works have mainly concentrated on the psychosocial aspects of this condition [6–8]. Several studies have tried to identify predictors of hospital readmission after a single discharge [12,13,20] rather than patterns of multiple readmissions. The models of readmission risk prediction were mainly focused on specific elements, such as medication exposure [21,22], cognitive status [23] and medical errors [24], and did not consider the trajectory of multimorbidity and functional performance of patients. However, in some cases, the presence of a high number of admissions was considered itself as a relevant risk factor for further readmissions [15].

Only one study investigated these topics, without a specific focus on older subjects. It showed that patients experiencing repeated readmissions had a higher level of multimorbidity and functional dependence, and worse prognosis [25]. These characteristics were also present in our cases, although the functional status at baseline was in many cases fairly good, and the rapid decline in physical and health status could not be predicted with sufficient accuracy at the moment of the first discharge, as suggested in the first conceptualization of the hospital-dependent patient [6].

However, those who had frailty or disability at baseline had a huge mortality rate after one-year follow-up. Frailty is a known predictor of adverse outcomes independently of the presence of multimorbidity [26], but the coexistence of both conditions identifies subjects with a particularly high risk profile [27]. In fact, frailty acts as an effect modifier for medical treatments [28] and prevents complete recovery after hospitalization for acute illness [29]. The absence of an association between baseline frailty and repeated readmissions, detected in out

Fig. 1. Trends of multimorbidity, functional performance, frailty and polypharmacy in the earlier four admissions of 118 elderly patients experiencing multiple unexpected readmissions during the year 2015. Multimorbidity was measured with Cumulative Illness Rating Scale, functional performance with Activities of Daily Living and Instrumental Activities of Daily Living, frailty with Rockwood Clinical Frailty Scale, and polypharmacy with the number of chronic drug prescriptions at the moment of admission.

study, may be the consequence of a limited access to hospital care for those who are completely bedridden or disabled, and will need confirmation in future studies.

Our case-series of hospital-dependent patients was characterized by trajectories of functional decline and accelerated accumulation of chronic diseases. The two elements are strictly inter-related. In fact, in population-based studies accelerated multimorbidity represents a strong risk factor for disability [30], particularly when dementia or cognitive impairment are present [31]. Interestingly, accelerated multimorbidity might also be associated with cognitive decline even in those subjects without dementia [32]. This may, at least in part, depend on the massive burden of polypharmacy of multimorbid patients, conditioning worsening cognitive status and functional performance [33]. Moreover, the disease patterns associated with the worst trajectory of functional decline are cardiovascular and neuropsychiatric conditions [34]. Interestingly, those were among the main chronic conditions detected in our case-series.

The severity of acute illnesses or symptoms justifying hospital admissions is another important issue. In our study, illness severity was independently associated with length of stay and with a reduced interval before the following readmission. These results match those by Fimognari et al., who identified illness severity as an independent predictor of hospitalization-associated disability [29]. Illness severity may also increase the risk of some common acute infections associated with hospitalization, such as pneumonia or *Clostridium difficile* colitis [35,36].

In the context of hospital-dependent patients, multimorbidity may

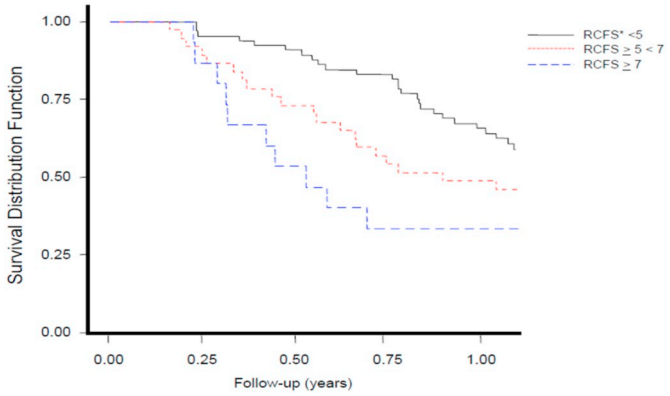

Fig. 2. Kaplan-Meier survival analysis showing one-year follow-up survival of 118 patients experiencing multiple unexpected readmissions during the year 2015, stratified by frailty (not frail: Rockwood Clinical Frailty Scale, RCFS, < 5; frail: RCFS ≥5 and < 7; disabled: RCFS ≥7).

Table 3
Cox proportional hazards model showing baseline factors associated with one-year follow-up mortality in older patients experiencing multiple unexpected readmissions (n = 118).

	RR [95% CI]	p*
Age	1.028 [0.976–1.083]	0.29
Sex (female vs male)	0.786 [0.473–1.307]	0.35
Rockwood Clinical Frailty Scale stratified (< 5, 5–6, > 6)	2.005 [1.054–3.814]	**0.03**
Reduced functional status	0.900 [0.606–1.337]	0.60
CIRS- SI score	0.869 [0.704–1.073]	0.19
Cognitive impairment or dementia	0.804 [0.419–1.541]	0.51
Infection	0.902 [0.545–1.493]	0.68
Cancer	2.405 [1.427–4.054]	**0.001**
Number of drugs at admission	0.948 [0.875–1.017]	0.19
Presence of a caregiver	1.004 [0.889–1.134]	0.94

CIRS-SI = Cumulative Illness Rating Scale Severity Index.
* p fully adjusted.

Table 4
Overview of the main factors contributing to unexpected admission cascade in a population of 118 elderly patients, according to five independent reviewers. A single factor was considered as present in a patient if at least one of the reviewers identified it as a possible contributor to the admission cascade.

Contributing factors	Prevalence
Patient-related factors	
Clinical complexity of the patient	83.0%
Insufficient patient compliance to prescriptions	17.7%
Family- or caregiver-related factors	
Insufficient comprehension of the patient prognosis and needs by the family or excessive expectations from medical treatments	11.0%
Caregiver negligence	16.1%
Social hardship or poverty	5.0%
Lack of experience by caregivers	2.5%
Lack of adequate home assistance	30.5%
Nursing home- or general practitioner-related factors	
Weaknesses in the care management of nursing homes	9.3%
General practitioner not completely taking charge of the patient	21.2%
Defective management of follow-up timing and therapy by general practitioner	23.7%
Lack of activation of nursing services at home	21.2%
Hospital physician-related factors	
Lack of clinical pathways for specialist referral after discharge	33.9%
Lack of programming a specialist follow-up schedule after discharge	38.9%
Improper timing of follow-up schedule	20.3%
Lack of a prognostic evaluation during hospital stay	50.8%
Failure to recognize a terminal stage of illness	29.6%
Insufficient taking charge by specialists	68.6%
Care fragmentation	17.7%
Absence of a comprehensive geriatric assessment evaluation	32.2%
Failure to identify cognitive impairment	7.6%
Fallacious management of drug treatments or failure to deprescribe	9.3%
Inappropriate medical or surgical prescriptions	27.1%
Wrong surgical timing	10.1%
Diagnostic delay or failure to recognize a disease	18.6%
Incoherence of clinical decisions or reduced patient involvement in decision making	9.3%
Lack of communication between physicians and patients, proxies or general practitioners	17.7%

thus influence length of hospital stay and patterns of readmissions, while frailty may have an impact on survival, together with cancer. These different aspects of clinical complexity of older patients may thus influence different outcomes. However, our results are limited to a small sample and cannot be generalized to the general population of elderly patients, due to the particular study design. They anyway suggest that comprehensive evaluation of multimorbidity, early identification of frailty and management of geriatric patients with cancer are the main areas deserving attention through development of dedicated interventions targeted at the prevention of hospital-dependence.

We also identified several critical issues in the management of study participants, involving particularly, but not exclusively, hospital care. The absence of prognostic evaluation, the lack of a formal comprehensive geriatric assessment, insufficient specialistic management and follow-up, inappropriate prescriptions and ineffective communication with patients and proxies were the main issues. Clinical management and therapeutical choices seemed in many cases independent of the functional status of patients, even when this parameter was collected on clinical records. An accurate management of these issues could have theoretically interrupted the admission cascade or prevented at least some of the hospital admissions. Previous studies have emphasized the role of adequate preparation of hospital discharge process by hospital physicians for preventing readmissions [37]. Interventions by hospital physicians at home or in nursing homes after discharge may also represent another effective strategy, although trials have given inconclusive results [38,39]. At the current state of art, multi-component and multi-level interventions, considering most of all the organization of care, seem the best way to deal with complex multimorbid patients [40].

Our study has several limitations. The single-center retrospective design may limit generalizability of findings. The absence of a control group did not allow to identify the risk factors for the condition of hospital-dependence, but only to describe the characteristics of patients. Data were extrapolated from clinical records without a direct evaluation of patients. In many non-geriatric ward admissions, data on cognitive performance of patients were unavailable, representing a possible source of bias and highlighting the importance of disseminating the concepts of geriatric care also to other specialists. Finally, the used definition of hospital-dependent patient was based on pragmatic considerations and not on epidemiologic studies.

However, this was the first comprehensive attempt to define the characteristics of older hospital-dependent patients from a clinical perspective. Future studies should better define the role of multimorbidity, frailty and disability for an early identification of subjects at risk of becoming hospital-dependent.

5. Conclusions

Older patients experiencing multiple hospital readmissions had a high baseline burden of multimorbidity and a relatively lower presence of frailty and disability. However, the admission cascade was associated with rapidly increasing trends of chronic disease accumulation and

disability. These characteristics should be taken into great consideration for an early identification of patients at risk of becoming hospital-dependent and for designing targeted health policies and future studies.

Conflict of interest

The authors have nothing to disclose.

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Author contributions

AT, MF and TM conceived and designed the study. AT, AN, BP, IM, FL, CT and TM collected and interpreted the data. FL performed the statistical analyses. AT drafted the manuscript. MF and TM revised the manuscript critically for intellectual content. All authors read and approved the final manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejim.2019.02.013.

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