Rate and risk factors of in-hospital and early post-discharge mortality in patients admitted to an internal medicine ward

Authors: Marco Vincenzo Lenti,[A*] Gabriele Croce,[B*] Alice Silvia Brera,[C] Alessia Ballesio,[B] Lucia Padovini,[B] Giampiera Bertolino,[B] Antonio Di Sabatino,[D] Catherine Klersy[E] and Gino Roberto Corazza[F]

ABSTRACT

Background

We sought to quantify in-hospital and early post-discharge mortality rates in hospitalised patients.

Methods

Consecutive adult patients admitted to an internal medicine ward were prospectively enrolled. The rates of in-hospital and 4-month post-discharge mortality and their possible associated sociodemographic and clinical factors (eg Cumulative Illness Rating Scale [CIRS], body mass index [BMI], polypharmacy, Barthel Index) were assessed.

Results

1,451 patients (median age 80 years, IQR 69–86; 53% female) were included. Of these, 93 (6.4%) died in hospital, while 4-month post-discharge mortality was 15.9% (191/1,200). Age and high dependency were associated ($p<0.01$) with a higher risk of in-hospital (OR 1.04 and 2.15) and 4-month (HR 1.04 and 1.65) mortality, while malnutrition and length of stay were associated ($p<0.01$) with a higher risk of 4-month mortality (HR 2.13 and 1.59).

Conclusions

Several negative prognostic factors for early mortality were found. Interventions addressing dependency and malnutrition could potentially decrease early post-discharge mortality.

KEYWORDS: Ageing, healthcare assessment, mortality predictors, multimorbidity

Authors: [A]assistant professor of internal medicine, Fondazione IRCCS Policlinico San Matteo, University of Pavia, Pavia, Italy; [B]internal medicine physician, Fondazione IRCCS Policlinico San Matteo, University of Pavia, Pavia, Italy; [C]research nurse, Fondazione IRCCS Policlinico San Matteo, University of Pavia, Pavia, Italy; [D]full professor of internal medicine, Fondazione IRCCS Policlinico San Matteo, University of Pavia, Pavia, Italy; [E]statistician, Fondazione IRCCS Policlinico San Matteo, University of Pavia, Pavia, Italy; [F]emeritus professor of internal medicine, Fondazione IRCCS Policlinico San Matteo, University of Pavia, Pavia, Italy; *Joint co-first authors

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Introduction

According to previous studies, hospital mortality in internal medicine wards ranged between 3% and 13% (Table 1),[1–16] and this outcome is currently used as an indicator of quality of care and could play an important role in rethinking resource allocation and costs in healthcare systems.[17,18] However, some authors have raised concerns that this parameter alone may not fully reflect care performance,[19,20] and mortality in the early post-discharge period is also worth taking into consideration.[21–23] This may be particularly relevant for internal medicine patients, who are increasingly burdened by multimorbidity, polypharmacy, frailty and dependency[24] that may worsen over the course of the hospital stay and may be associated with both higher in-hospital and early post-discharge mortality.[25] In fact, hospital-related adverse events, such as bed confinement, worsening cognitive function, drug reactions and hospital-acquired infections, may persist – and even worsen – shortly after a hospital stay.[26,27] It is therefore crucial that all future studies consider post-discharge mortality and should not be based on retrospective analyses using electronic medical records, which may be biased by the intrinsic limitations of administrative data[28,29] and may leave some clinical and non-clinical factors unconsidered or poorly described as possible determinants of the outcomes.[24] Indeed, most of the available studies reported in Table 1 are rather heterogeneous, retrospective in nature, or lack a comprehensive description of potential factors associated with early mortality.

Starting from these premises, our aim was to determine early mortality rate, ie in-hospital and 4-month post-discharge mortality, in patients admitted to internal medicine wards. As secondary aims, we prospectively analysed possible factors affecting these outcomes.

Methods

For the purposes of this study, data from patients consecutively enrolled in the San MAtteo Complexity (SMAC) study, a large ongoing research project (NCT03439410) on clinical complexity conducted between November 2017 and November 2019 at our Institution (Fondazione IRCCS Policlinico San Matteo,

Table 1. Hospital mortality of patients admitted to internal medicine wards according to the available literature

Authors	Country	Year	Design	Main aim	No. of patients	In-hospital mortality, n (%)	Follow-up mortality, n (%) [follow-up]
Sanclemente *et al*[1]	Spain	2004	Retrospective	Patients' characteristics and mortality	16,059	819 (5.1)	N/A
Kettaneh *et al*[2]	France	2007	Retrospective	Prediction of mortality by biochemical markers	1,054	59 (5.6)	N/A
Francia *et al*[3]	Spain	2009	Prospective	Physiological parameters vs clinical categories to predict mortality	500	65 (13.0)	N/A
Marco *et al*[4]	Spain	2010	Retrospective	Weekend admission and mortality	460,423	47,569 (10.3)	N/A
Subbe *et al*[5]	Ireland	2010	Prospective	A clinical score and mortality	1,098	82 (7.5)	N/A
Mannucci *et al*[6]	Italy	2014	Prospective	Multimorbidity, polypharmacy and mortality	3,999	158 (4.0)	140 (8.1) [3-month]
Aljishi *et al*[7]	New Zealand	2014	Retrospective	Readmissions and mortality	394	N/A	91 (23.1) [1-year]
Smolin *et al*[8]	Israel	2015	Retrospective	A prediction model of 6-month mortality	19,257	N/A (9.5)	N/A (20) [3-month]
Perysinaki *et al*[9]	Greece	2015	Prospective	Mortality predictors	101	16 (15.8)	30 (29.7) [6-month]
Fabbian *et al*[10]	Italy	2017	Retrospective	A predictive model of mortality	75,586	6,007 (7.9)	N/A
Schwartz *et al*[11]	Israel	2017	Retrospective	A predictive model of mortality	10,788	874 (8.1)	N/A
Sakhnini *et al*[12]	Israel	2017	Retrospective	A predictive model of mortality	12,499	882 (7.1)	N/A
Lenti *et al*[13]	Italy	2019	Retrospective	Gastrointestinal bleeding in elderly patients	120	4 (3.3)	8 (9.4)
Sanson *et al*[14]	Italy	2019	Retrospective	A predictive model of mortality	5,698	452 (7.9)	1,303 (22.9) [3-month]
Han *et al*[15]	South Korea	2020	Retrospective	Fulltime hospitalist service and mortality	513	46 (9.0)	N/A
Soffer *et al*[16]	Israel	2020	Retrospective	Prediction of mortality by machine learning	118,262	6311 (5.3)	N/A

University of Pavia), were used.[30,31] The final aim of the study is the validation of a clinical complexity index that should be able to predict the length of stay and possibly other relevant clinical outcomes.

The San Matteo Hospital Foundation is a tertiary referral academic hospital in Northern Italy that serves a population of roughly 550,000 people, and most adult patients (>90%) are admitted to the internal medicine ward after being brought to the emergency department. Internal medicine is a medical specialty that is dedicated to the 'diagnosis, treatment, and compassionate care of adults across the spectrum from health to complex illness'.[32] In practice, adult patients who need to be admitted to hospital in order to receive a definitive diagnosis in the context of a complex clinical picture, or those who suffer from multiple diseases requiring coordinated care across multiple disciplines, are usually admitted to an internal medicine ward. Instead, patients with a single, acute, specialistic disease (eg ischemic heart disease, acute kidney failure, stroke) are usually admitted to a specialty ward (eg cardiology, nephrology, neurology). At our hospital, after initial assessment performed in the emergency department, patients are allocated to the appropriate ward by the emergency physician according to the overall clinical picture and after discussion of the case with the admitting physician.

In accordance with the protocol design, adult patients (aged 18 years or older) admitted to our internal medicine unit have been included regardless of the cause of admission, the only exclusion criteria being denial of informed consent or a prognosis $<$24 hours. All patients were enrolled by physicians and healthcare professionals who received specific training before the start of the study.[33] In instances of severe cognitive impairment or severe dementia with incapacity to consent, consent to participate in the study and relevant information were obtained from the caregiver, a close relative or next of kin. Patients were considered as incapable of consenting for themselves in the case of a previous formal assessment proving incapability, or in the case of severe dementia or acute/chronic cognitive impairment as assessed by an expert physician, by using internationally recognised scales for these purposes (eg Short Blessed test, Glasgow Coma Scale). Demographic data (age, sex) and clinical data (polypharmacy, body mass index [BMI], multimorbidity, length of stay) were collected. Several scales were also assessed, including the Cumulative Illness Rating Scale (CIRS),[34] the Barthel Index,[35] the Edmonton Frail Scale[36] and the Short Blessed test,[37] which are all internationally recognised and evaluate the overall disease burden, performance in daily life activities, frailty, and cognitive disfunction, respectively. Several sociodemographic factors were also included (living alone, monthly income, need for a caregiver, inadequate adherence to medications, previous institutionalisation, and education level). Patient follow-up visits were scheduled every 4 months during the first year after discharge, and then once a year during the next 4 years; long-term follow-up is therefore still ongoing. Data for analysis were retrieved from the dedicated REDCap database, in which all data have been stored in a semi-anonymised format.

For the purposes of this study, we looked at early mortality rates after index hospitalisation, ie in-hospital mortality (occurring during the hospital stay) and 4-month mortality (occurring within 4 months after discharge; last follow up 6 March 2020). In-hospital mortality was recorded by the attending physicians on the day of death, while the 4-month mortality was assessed by means of a phone call interview with the patient's caregiver, spouse, partner or next of kin. If no phone number was available, the date of death of the patient was retrieved, when possible, during a specific recapture session, by either contacting the general practitioner, the public obituary, or the local registry office. Some patients were lost to follow-up, as detailed in the Results section.

Statistical analysis

Since this is a sub-study of the larger SMAC protocol, the sample size was based on the primary aim of the SMAC study.[30] Continuous data were described with mean, standard deviation and interquartile range (IQR), and categorical data were described as counts and percent. Patients lost to follow-up were excluded for percentage calculation. Mortality was analysed with generalised linear models and competitive risk models were applied, in which the choice of covariates was decided *a priori*, based on clinical considerations. A Kaplan Maier curve depicting the mortality trend up to 4 months was calculated. Odds ratios for in-hospital mortality and hazard ratios for 4-month mortality were calculated in a multivariable model, after excluding collinear variables. The study was approved by the local ethics committee (San Matteo Hospital Foundation, 3 July 2017, Protocol number 2017/0019414) and complies with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to study enrolment. All analyses were performed using Stata (StataCorp, College Station, TX, USA). The full dataset of the SMAC study cannot be shared publicly at this stage because the research project is still ongoing and follow-up data are being collected. Additional data and information can be requested from the corresponding author.

Results

Overall, 1,451 consecutive patients (median age 80 years, IQR 69–86; female sex 53%) enrolled in the SMAC study were included. Of these, 93 patients died during the hospital stay, with an in-hospital mortality rate of 6.4%. As 158 patients were lost to follow-up, further analyses included 1,200 patients. At follow-up, 191/1,200 patients (15.9%) died within 4 months after discharge. The demographic and baseline clinical characteristics of patients who died during the hospital stay vs patients alive at discharge, vs patients who died within 4 months, are reported in Table 2. According to the CIRS comorbidity and/or severity index, the majority of patients in all groups had a high disease burden, although this was even higher in those who died in hospital. As expected, patients who died in hospital were older, were more vulnerable/ frail as measured with the Edmonton Frail Scale, had greater cognitive disfunction as measured with the Short Blessed Test, and had a higher dependency score as measured using the Barthel Index with a greater need for a caregiver. With regard to these variables, there were no substantial differences between the entire patient cohort and that of patients who survived until discharge, while patients who died within 4 months had similar characteristics to those who died during hospitalisation, except for a higher prevalence of malnutrition (BMI $<$18.5). The length of stay was longer for patients who died at any stage, compared to those who survived. No other substantial differences emerged with regard to the other sociodemographic variables.

The multivariable analysis for in-hospital mortality and 4-month mortality outcomes are reported in Table 3. Age (as a continuous variable) and a Barthel Index score $<$60 were significantly associated with a greater odds ratio of in-hospital mortality (1.04 and 2.15, respectively) and with a greater hazard ratio of 4-month mortality (1.04 and 1.65, respectively). However, CIRS$>$3 and polypharmacy at admission and discharge were not significantly correlated with any of the outcomes. Malnutrition (BMI $<$18.5), compared to normal or increased BMI, turned out to be significantly associated with a greater hazard ratio of 4-month mortality (2.13, $p=0.001$). Notably, in this multivariable model, the Edmonton Frail Scale and the presence of comorbidity or multimorbidity were not included as they were collinear with age.

Finally, the Kaplan Meier 4-month survival estimate, starting from the date of admission, after excluding the patients who died in hospital, showed a linear trend over time (Fig 1).

Table 2. Demographic and clinical characteristics of all patients who died (in-hospital and at 4 months) and who survived at discharge

	All patients	Died in hospital	Discharged patients	Discharged and died within 4 months
No. of patients, n (%)	1,451 (100.0)	93 (6.4)	*1,200 (82.7)	191 (15.9)
Female sex, n (%)	773 (53.3)	48 (51.6)	645 (53.8)	99 (51.8)
Age, median (years; IQR)	80 (69–86)	83 (78–88)	75 (69–86)	82 (77–88)
Age groups, n (years; %)				
18–64	267 (18.8)	4 (4.3)	229 (19.1)	8 (4.2)
65–74	210 (14.8)	8 (8.6)	183 (15.2)	29 (15.2)
75–84	494 (34.7)	41 (44.1)	416 (34.7)	66 (34.6)
≥85	451 (31.7)	40 (43.1)	372 (31.0)	88 (46.1)
CIRS comorbidity index and/or CIRS severity index >3, n (%)	773 (54.5)	61 (65.6)	646 (54.0)	113 (59.2)
Edmonton Frail Scale >5, n (%)	987 (69.5)	83 (89.2)	818 (68.2)	163 (85.3)
Short Blessed Test >9, n (%)	748 (52.8)	64 (68.8)	625 (52.2)	127 (66.5)
Barthel Index <60, n (%)	317 (22.3)	39 (41.9)	252 (21.0)	65 (34.0)
Need for a caregiver, n (%)	859 (60.4)	76 (81.7)	711 (59.3)	152 (79.6)
BMI <18.5	106 (7.4)	3 (3.2)	96 (8.0)	29 (15.2)
Intake ≥5 medications at admission, n (%)	994 (70.0)	74 (80.4)	840 (70.0)	148 (77.5)
Intake ≥5 medications at discharge, n (%)	1,172 (82.6)	1 (1.12)	1,055 (87.9)	175 (91.6)
Living alone, n (%)	326 (23.0)	19 (20.4)	268 (22.3)	39 (20.4)
Income <1,000 €, n (%)	678 (47.8)	42 (45.6)	573 (47.9)	92 (48.4)
Inadequate adherence to medications, n (%)	198 (14.0)	14 (15.2)	161 (13.4)	20 (10.5)
Previous institutionalisation, n (%)	94 (6.6)	8 (8.6)	78 (6.5)	18 (9.5)
Schooling <8 years, n (%)	755 (53.2)	55 (59.1)	632 (52.7)	121 (63.7)
Length of stay, days (IQR)	18.7 (10–23)	22.2 (8–31)	17.9 (10–21)	21 (12–27)

*As 158 patients were lost to follow-up after discharge, these patients were excluded from further analyses; a total of 1,200 discharged patients were included. BMI = Body Mass Index; CIRS = Cumulative Illness Rating Scale; IQR = interquartile range; SD = standard deviation.

Discussion

This is the first prospective study conducted in an internal medicine setting to look at determinants and comparison of both in-hospital and early post-discharge mortality by including biological and non-biological variables that may affect these outcomes. Although previous studies have analysed this same issue (Table 1), only three of them were prospective, not based on administrative data, and extended the observation to the early post-discharge period.[5,6,9] Moreover, a comparison of factors affecting in-hospital vs early post-discharge mortality has never been reported before. For these reasons, our study fills some relevant knowledge gaps concerning early mortality in the internal medicine setting which deals with clinically complex patients.[32] We found some important factors associated with early mortality, such as older age, high dependency, and malnutrition that could be targeted for personalising *ad hoc* interventions, possibly improving patient outcomes and resource rationalisation.

Before performing any comparison of factors affecting mortality across the available studies, it is worth highlighting the wide heterogeneity of the different study populations. Our 1,451 patients had a median age of 80 years, and the in-hospital mortality rate (6.5%) was a little lower than the median mortality (7.9%) in the studies reported in Table 1. Notably, we excluded those patients with an expected prognosis of <24 hours, and this may have affected our overall in-hospital mortality rate. However, it should be noted that previous studies[1–16] are only partly comparable to ours, due to differences in methodology, patient age and enrolment criteria. For example, in the study by Sanclemente *et al*, in which no restriction based on prognosis was stipulated, roughly one-third of the deaths occurred within 48 hours after admission.[1] One study specifically focused on weekdays vs weekend hospital admissions.[4] Other studies focused on specific age ranges, including age ≥65 years[6] or ≥80 years.[9] Although our only age limit was adulthood (≥18 years), most of our patients were >60 years old. Regarding frailty, another key clinical variable, our results were similar to those reported by Joosten,[38] who, however, studied the prevalence of frailty in a geriatric population and using a different scale.

Table 3. Multivariable analysis of factors affecting in-hospital and 4-month post-discharge mortality

	In-hospital mortality			*4-month mortality*		
	Odds ratio	**95% CI**	**p-value**	**Hazard ratio**	**95% CI**	**p-value**
Sex						
Male	1.00 (base)					
Female	0.77	0.49–1.20	0.247	0.67	0.49–0.90	0.008
Age (continuous variable)	1.04	1.02–1.06	0.001	1.04	1.03–1.06	0.000
Body mass index						
18.5–24.9	1.00 (base)					
<18.5	0.39	0.12–1.30	0.126	2.13	1.39–3.26	0.001
≥25	0.87	0.56–1.36	0.541	0.78	0.57–1.08	0.135
Barthel Index						
≥60	1.00 (base)					
<60	2.15	1.35–3.41	0.001	1.65	1.20–2.28	0.002
CIRS						
≤3	1.00 (base)					
>3	1.13	0.70–1.81	0.617	0.80	0.58–1.09	0.150
Medication intake at admission						
<5	1.00 (base)					
≥5	1.24	0.71–2.17	0.441	1.25	0.87–1.81	0.228
Medication intake at discharge						
<5						
≥5				0.85	0.49–1.48	0.569
Length of stay (continuous variable)				1.59	1.28–1.97	0.000

CIRS = cumulative illness rating scale.

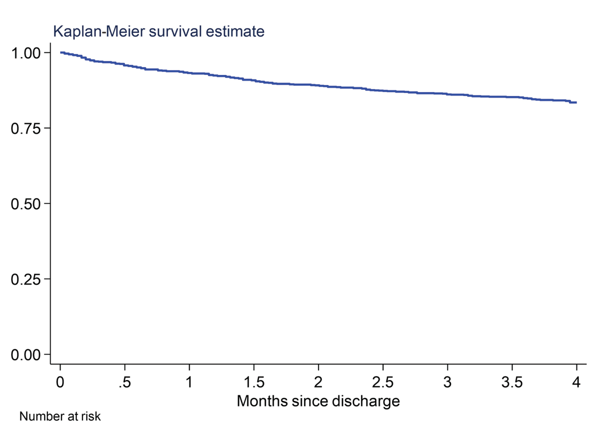

Fig 1. Kaplan-Meier 4-month survival estimate. The curve starts from the date of admission, after excluding patients who died in hospital. Notably, a linear, homogeneous, decreasing slope trend is noticeable over time.

Ageing is a well-established risk factor in both in-hospital and 4-month mortality,[3,4,6,13,15,16] and, as expected, we confirmed these figures in our study. The detrimental effect of ageing is still significant at the 4-month follow up, possibly reflecting the poor homeostatic resources of the elderly.

Data regarding multimorbidity as a determinant of early mortality are heterogeneous and partly conflicting. Indeed, multimorbidity is common in internal medicine, and is generally associated with worse outcomes, as shown in the previous studies.[1–16] Our population reported a CIRS comorbidity or severity index >3 in most cases, similar to the study by Mannucci, who also used CIRS to assess multimorbidity.[6] However, other studies reported multimorbidity using different tools. Multimorbidity was sometimes defined as the association of two or more diseases,[8,9,16] or else instances of specific disease clustering were taken into account,[3] with a particular focus on neoplastic diseases or major clinical syndromes, including anaemia, chronic obstructive pulmonary disease, chronic heart failure, liver cirrhosis and chronic kidney disease.[1,3,6,8,9,13,15,16] In our study, multimorbidity, as assessed by CIRS, was not correlated with either in-hospital or post-discharge mortality. This is probably because, as already shown in the SMAC study,[39] upon admission, the majority of patients had a CIRS comorbidity index >3, and hence this factor was far too common to highlight heterogeneity within the population. In other studies, multimorbidity had different impacts on early mortality, sometimes being significantly associated, as in Smolin *et al*, Han *et al* and Aljishi *et al* (according to the Charlson Comorbidity Index),[7,8,15] or had no significant effect, as in Perysinaki *et al* (according to the simple enumeration of diseases).[9] Altogether, these data highlight the need for harmonisation in the reporting of multimorbidity and for further prospective studies to assess the effect of multimorbidity on mortality.

Polypharmacy, defined as the use of >5 medications, was not found to be associated with mortality. A landmark study focusing on this issue in internal medicine instead found an opposite result,[6] attributing this finding to possible drug interactions. This apparent discrepancy may have different explanations. According to a recent meta-analysis, only excessive polypharmacy, defined as the use of 10 or more medications, was associated with death.[40] As the number of prescribed drugs increases with increasing number of chronic illnesses, in our study we preferred to use the internationally recognised definition of polypharmacy as a categorical variable, rather than a continuous one. Finally, as our hospital is an academic, tertiary referral centre, medication deprescription is part of the routine clinical practice,[41] and this may have lowered potentially threatening drug interactions. At our hospital, both at the time of admission and discharge, a medication reconciliation is performed, ie, a careful assessment of all the medications taken by the patient, also discussed with their relatives, spouse, or caregiver. Indeed, potential drug–drug interactions and the risk–benefit profile is always considered in this process.

Many of the previously published studies frequently reported physiological and laboratory parameters, but gave relatively poor consideration to dependency as a significant variable that could influence patient outcomes. In our study, the Barthel index was lower than 60 in roughly 20% of all patients, meaning that one in five patients had at least moderate dependency. This finding appears to be even more significant if we consider that a dependency status turned out to be a significant determinant of both in-hospital (OR 2.1) and 4-month post-discharge mortality (OR 1.6). While one might expect age to be a strong determinant of mortality, the impact of dependency on mortality is not that obvious. One possible reason for this is that highly dependent patients at admission to hospital could undergo a progressive change in their daily habits that could also affect the clinical outcome. Similarly, Mannucci *et al*,[6] who reported a Barthel index lower than 50 in about 16% of all patients enrolled in their registry, highlighted the importance of a routine assessment of the functional status of elderly patients using appropriate tools such as the Barthel index. The authors suggested that the traditional approach based on history and physical examination might be inadequate for identifying subtle impairments in daily life activities that we found had such a significant impact on the early mortality rate. Notably, in the prospective study by Perysinaki *et al*,[9] although this was restricted to octogenarians and nonagenarians in the multivariate analysis, functional dependence was the strongest significantly independent predictor of mortality (HR 7.40), up to the 6-month follow-up. In addition, functionally independent individuals and those living at home with no need for caregivers lived longer. This points to the need to prevent disability[42] and ensure the correct allocation of resources for frailer patients, especially outside of the hospital.

A low BMI was another key factor associated with 4-month mortality, but not with in-hospital mortality. BMI is frequently used as screening parameter of the nutritional status of hospitalised patients, and a low BMI underlies malnutrition. In this regard, our results are in line with those of another study[43] that already reported the association between higher early mortality rates and malnutrition, as measured with using either BMI or nutritional assessment scores. However, what is novel here is the lack of association between malnutrition and in-hospital mortality, while malnutrition affected the likelihood of death after discharge. In our hospital, all malnourished patients are assessed and treated by a physician nutrition specialist (ie a board-certified physician with clinical experience in nutrition therapy), and this might have influenced the in-hospital mortality outcome, as already demonstrated in a recent, large study assessing nutritional support in hospitalised patients.[44] Hence, our results seem to point to malnutrition as a main determinant of death when the patient is re-allocated at home early after a major health event (ie recent hospitalisation). Early after discharge, patients may be particularly frail and could have poor nutritional support, hence malnutrition should be prevented starting from the first day of hospitalisation and should be continued thereafter in order to avoid future detrimental effects, such as hospital readmission and death.[45]

The last factor found to be associated with 4-month mortality was the length of stay. Indeed, a longer length of stay reflects the severity of the illness and more significant resource requirements,[46] and this may affect the subsequent risk of death. Notably, a previous study showed an opposite result, with a positive association between the in-hospital standardised mortality ratio and the length of hospital stay, and an inverse correlation between the in-hospital standardised mortality ratio and early post-discharge mortality (defined as 30-day mortality).[21] This phenomenon was explained by the so called 'discharge bias', in which early discharge may be associated with worse outcomes within a short timeframe. It is less likely that such a bias occurred in our study, as we excluded *a priori* patients with a very poor prognosis.

Finally, as shown in Fig 1, the slope of the Kaplan–Meier survival curve is relatively constant, and no abrupt changes were noticed, especially within the first month after discharge. This certainly is the most important finding, as it confutes the assumption that factors attributable to the hospitalisation *per se* are preponderant in determining early post-discharge mortality, which instead may be linked to a cumulative effect of dependency and malnutrition, both of which could be minimised with tailored interventions. A study with a prolonged follow-up may be useful for a more in-depth dissection of the slope trend – and its determinants – over time.

Indeed, our study has some limitations. Since the follow-up was conducted with phone interviews, it is possible that certain information was missed. Moreover, our results are limited to an academic, internal medicine setting, and cannot be applied to the primary care setting or a population with a specific medical condition. Also, we did not explore the effects of specific diseases or conditions, as was done in some previous studies. On the other hand, our study also has many strengths, including the wide range of data, that include clinical and performance status parameters, and its monocentric nature. All data were prospectively collected without using administrative data.

Conclusion

To conclude, we conducted the first study in an internal medicine setting to evaluate the possible correlation between an early mortality rate and its multiple determinants. We found that 6.5% of patients died during their stay in hospital and almost 16% within 4 months after discharge. Age, dependency, malnutrition and length of stay were found to be important determinants of early mortality. In future studies, an evaluation of specific determinants of early mortality, including both in-hospital and early post-discharge mortality, may be useful for both taking appropriate clinical decisions and for rethinking the organisation of healthcare systems, in order to provide better quality of care. Interventions aiming at preventing dependency and malnutrition could potentially improve various patient outcomes. For example, a number of studies have shown that physical exercise can improve mobility and daily life activities in older individuals.[47,48] Additionally, interventions aiming at improving social and family support for dependent patients may be helpful, at least in terms of improving quality of life.[49] Malnutrition is known to be associated with increased overall mortality and healthcare expenditure,[50,51] and specific guidelines for the management of clinical nutrition in the elderly[52] and, more generally, in hospitalised patients[53] should be applied. However, studies focusing on nutritional interventions after discharge from hospital are warranted. ■

Summary

What is known?

In-hospital and early post-discharge mortality have been poorly addressed in the internal medicine setting.

What is the question?

What are the rates and determinants of in-hospital and early post-discharge (4 months) mortality in internal medicine patients?

What was found?

In this prospective cohort study of 1,451 consecutive patients, 93 (6.4%) died in hospital, while 191/1,200 (15.9%) died within 4 months after discharge. Age and dependency were significantly associated with increased risk of both in-hospital and 4-month mortality, while malnutrition and length of stay were significantly associated with increased risk of 4-month mortality.

What is the implication for practice now?

Interventions targeting dependency and malnutrition during the hospital stay and early after discharge could potentially decrease early mortality rates.

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References

1 Sanclemente C, Barcons M, Moleiro MA *et al*. Hospital mortality in an Internal Medicine service. *An Med Interna* 2004;21:317–21.
2 Kettaneh A, Mario N, Fardet L *et al*. In-hospital mortality and stay duration of internal medicine patients: prognosis value of biochemical markers commonly performed on admission. *Rev Med Interne* 2007;28:443–49.
3 Francia E, Torres O, Laiz A, Ruiz D, Gich I, Casademont J. Ability of physiological parameters versus clinical categories to predict mortality on admission to an internal medicine ward. *Eur J Intern Med* 2009;20:636–9.
4 Marco J, Barba R, Plaza S, Losa JE, Canora J, Zapatero A. Analysis of the mortality of patients admitted to internal medicine wards over the weekend. *Am J Med Qual* 2010;25:312–8.
5 Subbe CP, Jishi F, Hibbs RA. The simple clinical score: a tool for benchmarking of emergency admissions in acute internal medicine. *Clin Med (Lond)* 2010;10:352–7.
6 Mannucci PM, Nobili A; REPOSI Investigators. Multimorbidity and polypharmacy in the elderly: lessons from REPOSI. *Intern Emerg Med* 2014;9:723–34.
7 Aljishi M, Parekh K. Risk factors for general medicine readmissions and association with mortality. *N Z Med J* 2014;127:42–50.
8 Smolin B, Levy Y, Sabbach-Cohen E, Levi L, Mashiach T. Predicting mortality of elderly patients acutely admitted to the Department of Internal Medicine. *Int J Clin Pract* 2015;69:501–08.
9 Perysinaki GS, Theodorakopoulou V, Bertsias A *et al*. Almost half of octogenarians and nonagenarians admitted acutely to internal medicine ward die during admission or within 6 months after discharge: time to redefine treatment goals? *J Am Geriatr Soc* 2015;63:380–3.
10 Fabbian F, De Giorgi A, Maietti E *et al*. A modified Elixhauser score for predicting in-hospital mortality in internal medicine admissions. *Eur J Intern Med* 2017;40:37–42.
11 Schwartz N, Sakhnini A, Bisharat N. Predictive modeling of inpatient mortality in departments of internal medicine. *Intern Emerg Med* 2018;13:205–11.
12 Sakhnini A, Saliba W, Schwartz N, Bisharat N. The derivation and validation of a simple model for predicting in-hospital mortality of acutely admitted patients to internal medicine wards. *Medicine (Baltimore)* 2017;96:e7284.
13 Lenti MV, Pasina L, Cococcia S *et al*. Mortality rate and risk factors for gastrointestinal bleeding in elderly patients. *Eur J Intern Med* 2019;61:54–61.
14 Sanson G, Sadiraj M, Barbin I *et al*. Prediction of early- and long-term mortality in adult patients acutely admitted to internal medicine: NRS-2002 and beyond. *Clin Nutr*. 2020;39:1092–100.
15 Han SJ, Jung HW, Oh DY *et al*. Comparisons of clinical outcomes between weekday-only and full-time, 24-hour/7-day coverage hospitalist systems. *J Korean Med Sci* 2020;35:e117.
16 Soffer S, Klang E, Barash Y, Grossman E, Zimlichman E. Predicting in-hospital mortality at admission to the medical ward: a big-data machine learning model. *Am J Med* 2021;134:227–34.
17 Jarman B, Gault S, Alves B *et al*. Explaining differences in English hospital death rates using routinely collected data. *BMJ* 1999;318:1515–20.
18 Jarman B, Pieter D, van der Veen AA *et al*. The hospital standardised mortality ratio: a powerful tool for Dutch hospitals to assess their quality of care? *Qual Saf Health Care* 2010;19:9–13.
19 Pitches DW, Mohammed MA, Lilford RJ. What is the empirical evidence that hospitals with higher-risk adjusted mortality rates provide poorer quality care? A systematic review of the literature. *BMC Health Serv Res* 2007;7:91.
20 Shahian DM, Wolf RE, Iezzoni LI, Kirle L, Normand SLT. Variability in the measurement of hospital-wide mortality rates. *N Engl J Med* 2010;363:2530–9.

21 Pouw ME, Peelen LM, Moons KG, Kalkman CJ, Lingsma HF. Including post-discharge mortality in calculation of hospital standardised mortality ratios: retrospective analysis of hospital episode statistics. *BMJ* 2013;347:5913.
22 Yu P, Chang DC, Osen HB, Talamani MA. NSQIP reveals significant incidence of death following discharge. *J Surg Res* 2011;170:e217–24.
23 Metersky ML, Waterer G, Nsa W, Bratzler DW. Predictors of in-hospital vs postdischarge mortality in pneumonia. *Chest* 2012;142:476–81.
24 Corazza GR, Formagnana P, Lenti MV. Bringing complexity into clinical practice: an internistic approach. *Eur J Intern Med* 2019;61:9–14.
25 Gill TM, Allore HG, Gahbauer EA, Murphy TE. Change in disability after hospitalization or restricted activity in older persons. *JAMA* 2010;304:1919–28.
26 Bradshaw LE, Goldberg SE, Lewis SA *et al*. Six-month outcomes following an emergency hospital admission for older adults with comorbid mental health problems indicate complexity of care needs. *Age Ageing* 2013;42:582–8.
27 Forster AJ, Clark HD, Menard A *et al*. Adverse events among medical patients after discharge from hospital. *CMAJ* 2004;170:345–9.
28 Lieberman D. Pitfalls of using administrative data for research. *Dig Dis Sci* 2010;55:1506–08.
29 Lenti MV, Corazza GR. Administrative data for exploring multimorbidity in hospitalised patients. *Intern Emerg Med* 2020;15:1161–3.
30 Corazza GR, Klersy C, Formagnana P, Lenti MV, Padula D; Consensus Panel. A consensus for the development of a vector model to assess clinical complexity. *Intern Emerg Med* 2017;12:1313–8.
31 Lenti MV, Klersy C, Brera AS *et al*. Clinical complexity and hospital admissions in the December holiday period. *PLoS One* 2020;15:e0234112.
32 Weinberger SE. Challenges for internal medicine as the American College of Physicians celebrates its 100th anniversary. *Ann Intern Med* 2015;162:585–6.
33 Lenti MV, Klersy C, Brera AS *et al*. Reproducibility in the assessment of the components of a clinical complexity index. *J Gen Intern Med* 2019;34:2316–8.
34 Linn BS, Linn MW, Gurel L. Cumulative illness rating scale. *J Am Geriatr Soc* 1968;16:622–6.
35 Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. *J Clin Epidemiol* 1989;42:703–09.
36 Rolfson DB, Majumdar SR, Tsuyuki RT, Tahir A, Rockwood K. Validity and reliability of the Edmonton Frail Scale. *Age Ageing* 2006;35:526–9.
37 Katzman R, Brown T, Fuld P, Peck A, Schechter R, Schimmel H. Validation of a short Orientation-Memory-Concentration Test of cognitive impairment. *Am J Psychiatry* 1983;140:734–9.
38 Joosten E, Demuynck M, Detroyer E, Milisen K. Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients. *BMC Geriatr* 2014;14:1.
39 Lenti MV, Klersy C, Brera AS *et al*. Aging underlies heterogeneity between comorbidity and multimorbidity frameworks. *Intern Emerg Med* 2022;7:1033–41.
40 Leelakanok N, Holcombe AL, Lund BC, Gu X, Schweizer ML. Association between polypharmacy and death: A systematic review and meta-analysis. *J Am Pharm Assoc* 2017;57:729–38.
41 Jansen J, Naganathan V, Carter SM *et al*. Too much medicine in older people? Deprescribing through shared decision making. *BMJ* 2016;353:i2893.
42 Stuck AE, Beck JC, Egger M. Preventing disability in elderly people. *Lancet* 2004;364:1641–2.
43 Cereda E, Klersy C, Hiesmayr M *et al*. NutritionDay Survey Collaborators. Body mass index, age and in-hospital mortality: The NutritionDay multinational survey. *Clin Nutr* 2017;36:839–47.
44 Kaegi-Braun N, Mueller M, Schuetz P, Mueller B, Kutz A. Evaluation of nutritional support and in-hospital mortality in patients with malnutrition. *JAMA Netw Open* 2021;4:e2033433.
45 Lindegaard Pedersen J, Pedersen PU, Damsgaard EM. Nutritional follow-up after discharge prevents readmission to hospital – a randomized clinical trial. *J Nutr Health Aging* 2017;21:75–82.
46 Awad A, Bader-El-Den M, McNicholas J. Patient length of stay and mortality prediction: A survey. *Health Serv Manage Res* 2017;30:105–20.
47 Venturelli M, Lanza M, Muti E, Schena F. Positive effects of physical training in activity of daily living-dependent older adults. *Exp Aging Res* 2010;36:190–205.
48 Burge E, Kuhne N, Berchtold A, Maupetit C, von Gunten A. Impact of physical activity on activity of daily living in moderate to severe dementia: a critical review. *Eur Rev Aging Phys Act* 2012;9:27–39.
49 Rosell-Murphy M, Bonet-Simó JM, Baena E *et al*; ICIAS research group. Intervention to improve social and family support for caregivers of dependent patients: ICIAS study protocol. *BMC Fam Pract* 2014;15:53.
50 Söderström L, Rosenblad A, Thors Adolfsson E, Bergkvist L. Malnutrition is associated with increased mortality in older adults regardless of the cause of death. *Br J Nutr* 2017;117:532–40.
51 Saunders J, Smith T. Malnutrition: causes and consequences. *Clin Med (Lond)* 2010;10:624–7.
52 Volkert D, Beck AM, Cederholm T *et al*. ESPEN guideline on clinical nutrition and hydration in geriatrics. *Clin Nutr* 2019;38:10–47.
53 Thibault R, Abbasoglu O, Ioannou E *et al*. ESPEN guideline on hospital nutrition. *Clin Nutr* 2021;40:5684–09.

Address for correspondence: Gino Roberto Corazza, Emeritus Professor of Internal Medicine, Clinica Medica I, Fondazione IRCCS Policlinico San Matteo, Viale Golgi 19, 27100 Pavia, Italy. Email: gr.corazza@smatteo.pv.it