Internal and Emergency Medicine
https://doi.org/10.1007/s11739-024-03823-0

IM - ORIGINAL

COmplexity of CARE and Discharge barriers: the 'modern internal medicine patient'. Results from the CO-CARED Study.

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Received: 14 June 2024 / Accepted: 14 November 2024
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Abstract
The ongoing demographic, epidemiological and social changes are dramatically raising the clinical and care complexity of patients admitted to internal medicine (IM) departments. Collecting evidence for a better characterization of patients is crucial to tailor future interventions based on patient's real needs. The aim of this prospective multicenter study was to describe the complexity of care of patients hospitalized in IM by calculating the complexity of care (ICC) score, through the combination of clinical instability (NEWS score) and care dependency scales (mICD). Furthermore, social frailty was assessed according to potential difficulty in discharge planning. 3912 patients were enrolled (median age 78 years); 71% had a Charlson Comorbidity Index ≥ 5. The ICC score was high in 14.7% of patients, while 15% exhibited a NEWS score at least moderate. One in four patients presented moderate to critical social frailty. The length of stay was correlated with social frailty, mICD and ICC scores, but not with NEWS. In-hospital mortality was correlated with the severity of all the considered scores. A relevant proportion of IM patients exhibited a high complexity of care. Our data support a model in which approximately 15% of IM beds are designated for clinically unstable patients managed in intermediate care sub-units. The substantial burden of social frailty highlights the urgency of national plans allowing at the same time to cover the needs of not self-sufficient and socially disadvantaged patients, and to efficiently address the issue of emergency department boarding.

Keywords Complexity of care · Discharge barriers · Clinical instability · NEWS score

Background

In recent years, the role of internal medicine has been reevaluated due to the growing prevalence of multimorbidity and an aging population, which demand its specific competencies. Patients with multiple diseases and varying degrees of clinical and social frailty require personalized care that integrates their pathology within their individual context, often necessitating tailored decision-making [1]. Currently, internal medicine (IM) wards admit from emergency departments (ED) a wide range of patients with different clinical and healthcare needs [2], encompassing very critical patients not suited for traditional intensive care units due to a "therapeutic ceiling" considerations, to those with acute but not critical conditions, or even patients who are not acutely ill. Additionally, most patients, who appear relatively stable upon admission to a medical ward, are indeed complex and frail, burdened with multiple chronic conditions, influencing treatment outcomes.

Health systems are challenged to adapt to the growing influx of these complex and/or frail patients by modifying clinical and management pathways [1]. In this regard, previous studies have demonstrated the cost-effectiveness of the "intensity of care model" for hospital organization and patient's allocation [3, 4]. Significant demands in terms of primary assistance, monitoring and therapeutic complexity, are often required not only for the initial condition, but also for complications that arise during hospitalization. Notably, in Italy the "minimum" standards of care in the IM units are still regulated by a legislative decree dating back to 1988, which classify IM wards as a "low-intensity hospital care

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settings", and thus quantifying the needs for medical and nursing staffing according to a low-intensity level. However, during the last 35 years, aging and multimorbidity have completely changed the "intensity level" of the IM patients.

On the other hand, discharge planning is further complicated by social issues and functional and cognitive decline of frail patients, which often deteriorate during hospitalization partially as a consequence of bedridden deconditioning [5]. This prolongation of hospital stays not only heightens health risk for patients, but also contributes to an increased risk of dysfunction within the hospital system, exacerbating the issue of ED boarding [6].

Therefore, assessing the needs of internal medicine units calls for a multidimensional approach that includes evaluation of patients' clinical conditions and care dependency [7], as well as their social frailty.

Given the current evolution of patient needs and the lack of recent studies on the topic, gaining a thorough understanding of the hospitalized IM population is essential for evidence-based improvement in care through changes in clinical and organizational practices.

The aim of this study was to describe the complexity of care and social frailty among patients hospitalized in IM wards in the Lombardy region, Italy, and to evaluate the impact of these factors on in-hospital mortality and length of stay. Furthermore, a survey of the technical equipment and staffing resources of the participating centers was conducted.

Methods

Study population and data collection

This was a prospective multicenter study enrolling hospitalized patients in internal medicine wards during prespecified days, once a month, from April 2022 to June 2023.

Fourteen IM wards from 12 metropolitan and extra-metropolitan hospitals in the region of Lombardy (Italy) participated in the study: ASST Fatebenefratelli Sacco (Milano, Coordinating Center), ASST Pavia (Voghera), ASST Ovest Milanese (Legnano), IRCCS Ospedale San Raffaele (Milano), Ospedale di Circolo e Fondazione Macchi (Varese), Ospedale Maggiore Ca' Granda Policlinico (Milano), ASST Grande Ospedale Metropolitano Niguarda (Milano), ASST Ospedale Papa Giovanni XXIII (Bergamo), ASST Santi Paolo e Carlo (Milano), Ospedale Sant'Anna, ASST Lariana (San Fermo della Battaglia, Como), ASST degli Spedali Civili di Brescia (Brescia), ASST Rhodense (Garbagnate).

The study protocol was approved by each local ethic committee (Coordinating Center protocol number: 2022/ST/094).

All adult inpatients present in the IM wards on the prespecified index days were enrolled, regardless of admission date. The data collection schedule was planned in advance, foreseeing an index day per month, which fell on different workdays each month.

Written informed consent was obtained for all study participants; in case of impossibility to sign the informed consent, such as in severely ill patients or patients with dementia, informed consent was signed by patient's legal guardian.

On the index day, local investigators registered the following data for each patient: age; gender; admission date; the National Early Warning Score (NEWS) [8]; the care dependency level (mICD) [7]; the index of caring complexity (ICC), which is derived by combination of the NEWS and mICD scores [7]; the Charlson Comorbidity Index [9]; and the body mass index. The above-mentioned scores are summarized in Appendix A. The presence of patient's disabilities and/or social frailty that might have been associated with difficulties in planning discharge was estimated according to the following scale: *level 1*: self-sufficient patient; *level 2*: patient not self-sufficient but with adequate social support; *level 3*: patient not self-sufficient and with inadequate social support; *level 4*: not self-sufficient, with no social support at all. Moreover, the attending physician registered in the daily clinical diary of the electronic record the date on which the patient was ready to be discharged from a clinical point of view.

Patients' data collection was completed at discharge with the following information: hospitalization outcome (death, transfer to another department, discharge home, discharge home with healthcare nursing service; transfer to a rehabilitation facility; transfer to a residential nursing home; transfer to a palliative care center); hospitalization length; primary diagnosis at discharge; date when the patient was judged 'clinically ready to be discharged'. If the patient remained in the hospital longer, waiting for a post-acute destination, the number of days of non-clinically justified hospital stay was collected as well as the reason for discharge delay. For patients hospitalized more than 1 month, data were recollected in the successive index day, thus generating two or more 'records' for the same patient.

Finally, data about the characteristics of participating IM Wards were collected: ward bed capacity, type of hospital (academic/teaching hospital or not), technical equipment (availability type and number of monitoring systems, ventilators, ultrasound equipment, the eventual possibility to perform hemodialysis or ultrafiltration in the department, volumetric infusion pumps, electrical outlet per bed) and healthcare staffing expressed as physician/patient ratio, nurse/patient ratio during the morning, afternoon and night shifts.

The overall number of physicians referring to each single IM unit as well as the number of outpatients visits per year was also registered.

Outcomes

The primary outcome was to assess the complexity of care in the enrolled hospitalized population as indicated by the ICC score, which is derived from the combination of the NEWS and mICD scores.

Secondary outcomes included:

1. assessing the NEWS score for clinical instability and the mICD score for the caring dependence;
2. estimating the burden of hospitalization days related to non-clinical condition (determined by the discrepancy between the actual discharge date and the theoretical discharge date, as clinically assessed by the attending physician);
3. investigating any association between the length of stay and the NEWS score, mICD, ICC score, and social frailty;
4. determining any associations between in-hospital mortality and the NEWS score, mICD, ICC score, and social frailty;
5. evaluating the current healthcare equipment and staffing of the IM wards;
6. analyzing any difference in the NEWS score, mICD score, social frailty, and length of stay between hospitals in the Milano metropolitan area and those located outside it.

Statistical analysis

Data were expressed as mean ± standard deviation (normally distributed data), as median and interquartile range (non-normally distributed data) or as absolute frequency and percentage (categorical data), as appropriate.

For the primary outcome, the prevalence of patients characterized by high complexity of care was calculated on the total number of hospitalized patients, which was expressed as a proportion with its 95% confidence interval (CI).

For the secondary outcomes, all the comparisons between the predefined groups, as defined above, were performed using the non-parametric Kruskal–Wallis test for quantitative variables and the Chi-square test for categorical variables.

To assess the effect of staffing on the outcomes, we divided centers, based on the median doctor to patient ratio, as "understaffed" (where each physician managed more than 7 patients during the morning round) and "adequately staffed" (where each physician managed less or equal to 7 patients during the morning round). We performed univariate and multivariate logistic regression analyses to assess the association between staffing and clinical outcomes, i.e., length of stay (dichotomized as ≤ 16 or > 16 days, which represented the median value) and mortality.

P values < 0.05, two sided, were considered statistically significant. All the statistical analyses were performed with SAS statistical software (release 9.4).

The sample size was calculated based on the percentage of patients with high clinical care complexity, according to the aforementioned score [12]. From previous studies in the medical area, the prevalence of patients with high clinical care complexity is around 16% [12]. An enrollment of at least 2000 patients in 12 months was calculated to obtain a prevalence of 16% of highly complex patients with a 95% CI ranging from 14.4 to 17.7%.

Results

During the enrollment period, records for 4051 events involving 3912 patients were collected. The median age was 78 years (IQR 68–85), with 61% of them being > 75 years old. The burden of comorbidities was substantial, as 71% of patients presented with a Charlson Index ≥ 5. The characteristics of the patient population are detailed in Table 1. Most enrolled patients were admitted from the emergency department (87%), while 12% were transferred from other departments (3% from intensive care units, 9% from other wards), and only 1% were planned admissions. Data about IM wards in terms of staffing and equipment are reported in Table 2.

The analysis of the primary outcome indicated that the ICC score was high in 14.7% (95% CI 13.7–15.9%). Results regarding NEWS, mICD, and ICC distributions are displayed in Fig. 1. It should be noted that the ICC score was medium or high in the majority of records (57%). The social frailty assessment revealed potential difficulties in hospital discharge for more than a quarter of patients: in particular, only 33% of patients were self-sufficient; 40% were not self-sufficient but with adequate social support; 21% patient were not self-sufficient with inadequate social support; and 6% were not self-sufficient with no social support whatsoever.

The median length of stay was 16 days [IQR 10–25]. Twenty-one percent of patients experienced a delay in discharge due to non-clinical reasons. For this group, the median delay in hospital discharge was 7 days [IQR 4–12]. Reasons for discharge delay are depicted in Table 3.

Hospitalization outcomes are outlined in Table 4. Notably, less than half of the patients were discharged home without any need for post-acute care facilities. In-hospital mortality was 8.7%.

Length of stay was associated with the level of social frailty, mICD, and ICC score (Fig. 2, panel A). Specifically,

Table 1 Characteristics of the study population

Number of patients	3912
Median age (IQR)	78 years (IQR 68–85)
Age < 75 years, *n* (%)	1517 (39%)
Age 75–84 years, *n* (%)	1469 (37%)
Age > 85 years, *n* (%)	926 (24%)
Male, *n* (%)	2073 (53%)
Charlson Comorbidity Index ≥ 5	2769 (71%)
Mean BMI kg/m^2 (SD)	24.9 (± 5.5)
BMI ≥ 30 (%)	515 (13.5%)
BMI 25–30 (%)	1086 (28.4%)
BMI 18.5–25 (%)	1912 (50.1%)
BMI < 18.5 (%)	306 (8.0%)
Missing	93
Admission from	
Emergency department	3411 (87%)
Intensive care unit	116 (3%)
Other departments	342 (9%)
Planned, non-urgent hospitalization	43 (1%)
Primary diagnosis at discharge	
Pneumonia	461 (11.8%)
Sepsis	415 (10.6%)
Cancer	340 (8.7%)
Heart failure	280 (7.1%)
Respiratory failure	257 (6.6%)
Urinary trait infection	151 (3.9%)
Anemia/hemorrhage	133 (3.4%)
Hepato-biliary/pancreatic disease	119 (3%)
COPD exacerbation/bronchitis	117 (3%)
Renal failure	112 (2.9%)
SARS-CoV-2 infection	106 (2.7%)
Fractures	97 (2.5%)
Pulmonary embolism	96 (2.5%)
Other	1228 (31.3%)

SD standard deviation, *BMI* body mass index, *COPD* chronic obstructive pulmonary disease

the median length of stay was 13, 16, 20, and 23 days for social frailty level 1, 2, 3, and 4 ($p < 0.0001$);13, 18, and 19 days for low, medium, and high mICD scores ($p < 0.0001$); and 13, 18, and 19 days for low, medium, and high ICC scores ($p < 0.0001$). No significant association was found between length of stay and NEWS score.

Mortality was positively associated with the different levels of severity for all considered scores (Fig. 2, panel B). Specifically, mortality was 6, 16, and 44% for low, medium, and high NEWS scores ($p < 0.0001$); 3, 9, and 31% for low, medium, and high mICD scores ($p < 0.0001$); 2, 8, and 29% for low, medium, and high ICC scores ($p < 0.0001$); 3, 9, 13, and 25% for social frailty levels 1, 2, 3, and 4 ($p < 0.0001$).

Concerning differences between metropolitan and extra-metropolitan hospitals, there was a higher prevalence of patients with moderate or high social frailty (29.2% vs 23.3%, $p < 0.01$) and high mICD score in the extra-metropolitan hospitals compared to metropolitan ones (14.3% vs 10.1%, $p < 0.01$). No significant difference was observed in relation to NEWS score levels. Nurses and doctors in non-metropolitan hospitals care for one and two more patients, respectively, compared to their colleagues in metropolitan hospitals (median nurse-to-patient ratio of 1:10.3 in metropolitan hospitals vs nurse-to-patient ratio of 1:11.3 in extra-metropolitan hospitals; median doctor-to-patient ratio in morning shift of 1:7 in metropolitan hospitals vs doctor-to-patient ratio in morning shift of 1:9 in extra-metropolitan hospitals).

In wards where each physician managed more than seven patients during the morning round (7 centers), the median hospital stay was 17 days. Conversely, in wards where each physician managed seven or fewer patients (5 centers), the median hospital stay was 15 days.

At univariate analysis, wards with better staffing demonstrated an odds ratio (OR) of 1.2 for a hospital stay of ≤ 16 days ($p < 0.05$) compared to those with lower staffing levels. Considering also potential confounding factors in multivariate analysis (NEWS, mICD, ICC, and social frailty), the OR remained significant (OR 1.39, $p < 0.001$).

Moreover, departments with better staffing presented an OR for mortality of 1.25 (p 0.066) at univariate analysis. Considering confounding factors at multivariate analysis, the OR was 0.93 (p 0.58). Thus, staffing did not play a role in influencing mortality risk.

Discussion

The primary finding from this study indicates that more than half of the patients hospitalized in IM departments present moderate or high complexity of care. Fifteen percent of inpatients had a NEWS score at least moderate, indicating the need for prompt evaluation by a team adept in managing acutely ill patients and potential escalation to critical care units. More than half of the patients required intravenous therapy and frequent monitoring and demonstrated a lack of self-sufficiency.

Overall, these findings led to the consequential conclusion that IM wards can no longer be regarded as 'low-intensity care' settings.

Furthermore, our data reveal a diverse IM patient population with a broad range of care intensity and dependency scores. Among frail patients, clinical instability and care requirements not only vary between individuals, but also evolve significantly during hospitalization. This varies from initially stabilizing the acute illness post-admission to managing potential complications that may revert patients from clinical stability to instability [10].

Table 2 Characteristic of Internal medicine wards in terms of staffing and equipment

Unit characteristics	
Hospital with medical residents, *N* (%)	14 (100%)
University department, *N* (%)	9 (64.3%)
Ward bed capacity	48.4 (range 23–100)
Outpatients visits per year	4040 (range 300–15,138)
Overall number of physicians per ward	12 (range 4–26)
Technical equipment	
Bed-monitoring systems, *N* (%)[a]	6 (42.9%)
If yes, mean unit-to-patient ratio	1:6.2 (range 3.2–12.5)
Telemetry monitoring, *N* (%)[a]	9 (64.3%)
If yes, mean unit-to-patient ratio	1:5.8 (range 3–12.5)
Non-invasive ventilation, *N* (%)[a]	7 (50%)
If yes, mean unit-to-patient ratio	1:17.9 (range 3.2–33.3)
Volumetric infusion pumps, *N* (%)[a]	14 (100%)
If yes, mean unit-to-patient ratio	1:4.4 (range 1.3–8.5)
Syringe pumps, *N* (%)[a]	9 (64.3%)
If yes, mean unit-to-patient ratio	1:7.9 (range 2.3–14.7)
Portable ultrasound equipment, *N* (%)[a]	14 (100%)
If yes, mean unit-to-patient ratio	1:26.4 (range 11.5–58)
Central venous pressure measuring device, *N* (%)[a]	5 (35.7%)
If yes, mean unit-to-patient ratio	1:37.75 (range 22–58)
Electrical outlet per bed	4.4 (range 2–8)
Invasive arterial pressure monitoring, *N* (%)[a]	1 (7.1%)
In-ward hemodialysis system, *N* (%)[a]	4 (28.6%)
In-ward ultrafiltration system, *N* (%)[a]	2 (14.3%)
Healthcare staffing	
Nurse-to-patient ratio in morning shift, mean	1:8.9 (range 6–14)
Nurse-to-patient ratio in afternoon shift, mean	1:9.9 (range 6–14)
Nurse-to-patient ratio in night shift, mean	1:15.1 (range 8–30)
Doctor-to-patient ratio in morning shift	1:8.6 (range 7–14)
Doctor-to-patient ratio in afternoon shift	1:39.6 (range 7–88)
Doctor-to-patient ratio in night shift	1:105.1 (range 45–150)

[a]Number and percentage of hospitals where the item is available

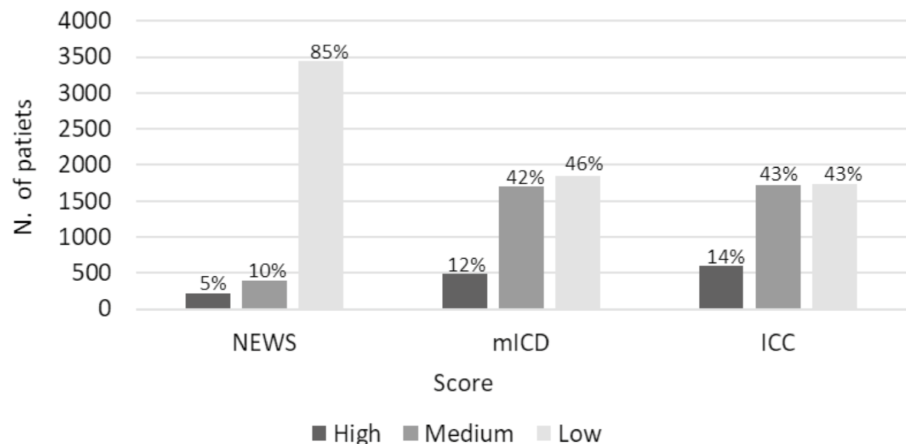

Fig. 1 Score distribution. The evaluation of clinical instability through NEWS showed that 15% of the patients had at least a moderate score. More than half of the patients had a medium–high level in both mICD and ICC scores. *NEWS* National Early Warning Score, *ICC* index of caring complexity, *mICD* care dependency level

Table 3 Reasons for delayed discharge (bed blockers)

Number of patients with discharge delay (835 patients)	*N* (%)
Wait for home healthcare nursing service activation	98 (11.7%)
Wait for home sanitary devices delivery	47 (5.6%)
Wait for rehabilitation facility transfer	251 (30.1%)
Wait for residential nursing home transfer	130 (15.6%)
Wait for hospice transfer	120 (14.4%)
Wait for other wards transfer	27 (3.2%)
Other reasons	147 (17.6%)
Missing data	15 (1.8%)

Table 4 Hospitalization outcome and modality of discharge

Hospitalization outcome (3912 patients)	*N* (%)
In-hospital death	341 (8.7%)
Home discharge without any support	1800 (46%)
Home discharge with healthcare nursing service	390 (9.9%)
Home discharge with palliative care support	114 (2.9%)
Transfer to other wards	224 (5.8%)
Transfer to intensive care unit	41 (1%)
Transfer to rehabilitation facilities	393 (10%)
Transfer to residential nursing home	274 (7%)
Transfer to hospice	169 (4.3%)
Other	157 (4.2%)
Missing data	9 (0.2%)

This evidence emphasizes the need to structure IM wards as clinical units that encompass areas for high intensity of care, as advocated in existing literature and supporting the concept of intermediate care units [3, 4]. It is crucial to recognize the presence of unstable patients and allocate congruous medical and nursing staff accordingly to ensure appropriate care. A recent study illustrated that basic scores of clinical instability and degree of non-self-sufficiency could independently predict nursing demand based on the time needed for patient care [11].

Moreover, managing different care intensity levels within the same ward helps to minimize hospital-related health risks to patients and ensures care continuity, crucial for clinical appropriateness and efficiency. Hence, we advocate for a patient-centered approach for individuals with an acute disease within the complex setting of multiple chronic comorbidities [12, 13].

Multiple comorbidities, as highlighted by a Charlson Score ≥ 5 in most of our population, represents only one main determinant of the complexity of IM inpatients. Socioeconomical status, mental and behavioral conditions, polypharmacy, and individual frailty and resilience are all significant contributors to patients' complexity [1, 14, 15]. Notably, increased complexity correlates with poorer prognoses [16] and escalates healthcare and psychosocial costs [17].

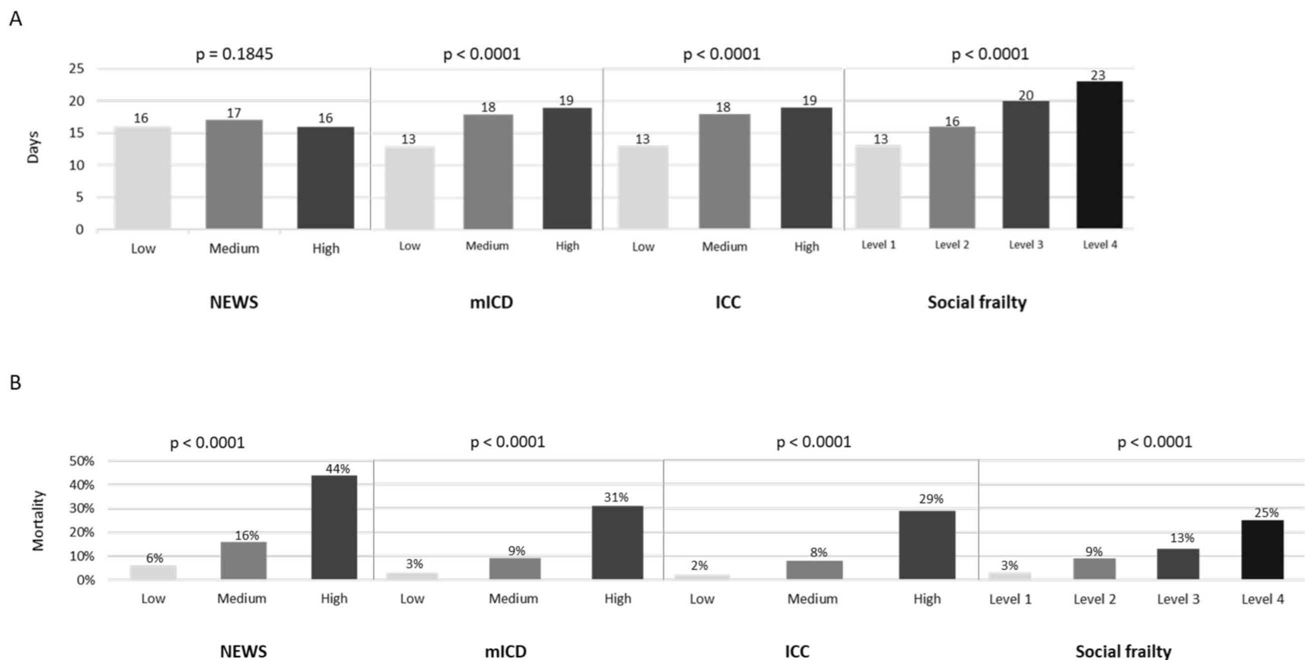

Fig. 2 Median length of stay (panel **A**) and in-hospital mortality (panel **B**) in different scores' classes. Panel **A** significant differences in length of stay were retrieved in different classes of social frailty, mICD, and ICC scores, but not in NEWS score. Panel **B** significant differences in mortality were retrieved in different classes of all considered scores

Significantly, an association with mortality was observed for acute clinical conditions, as expected, care dependency, and social status in our cohort, supporting the notion that all these three dimensions of patient complexity are integral to clinical outcomes. Therefore, internists are tasked with a 'three-dimensional' competency: (1) ensuing acute patients care needs through proper clinical management and monitoring, (2) possessing comprehensive knowledge of chronic diseases and associated polypharmacy, and (3) understanding socioeconomic factors to facilitate proper post-discharge patient management.

Another critical insight emerging from our data was that more than a quarter of inpatients of our cohort had insufficient social support post-discharge. The need for post-discharge facilities is a primary factor that delayed discharge, extending the hospital stay by an average of 7 days for this subgroup. This complex social problem needs a multimodal approach to be addressed. Past research has pointed out potential discharge barriers, including the absence of standardized discharge planning, coordination challenges among healthcare providers and patients, staff shortages, and the unavailability of home-care services [18–20]. Early identification of patients at risk of complicated discharges is crucial, and several scoring systems have been proposed for this purpose [19, 20]. Our data indicates the need for a more efficient and structured support by nurses and hospital social workers units. The efficiency of these units cannot disregard the fact that the bed capacity of post-discharge facilities needs to be increased.

Overall, while hospital inpatient complexity is increasing [1], and a comprehensive approach is generally recommended [14], pragmatic strategies and resources allocation addressing these challenges are often inadequate. A paradigm shift from a health system that allocates resources based solely on acute organ disease toward one that takes account of patients' complexity is pivotal to improve patients' care, optimize healthcare costs, and avoid actual hospital physicians' and nurses' overload and burnout [14].

Finally, it is noteworthy to underline that an association between improved staffing levels and shorter hospital stays was observed in our cohort, although staffing did not influence mortality rates. We can infer that, in cases of staffing shortages, critical measures to manage life-threatening conditions are always ensured, while the length of hospital stay is adversely affected. However, longer hospital stays may indirectly impact healthcare costs and eventually patient's functional status deterioration.

Limitations

The main limitation of this study may be the population sampling method, using a 1-day per month approach. This sampling strategy was designed to extend enrollment over a 1-year period: on the one hand, selecting a single day each month may have underestimated individual patients' clinical instability, since the NEWS score was assessed on the index day rather that considering the patients' worse score throughout their hospitalization. On the other hand, patients with longer hospital stay and potentially higher care complexity were more likely to be included in the index days than those with shorter stays, potentially resulting in an overestimation of the average length of stay and the prevalence of patients with non-clinically justified delayed discharges.

However, the objective of the study was not to identify the number of patients unstable at any time during their hospitalization, but to approximate the burden imposed by unstable patients present in the IM unit in a single day, as would occur under real-world conditions.

Furthermore, we did not utilize a validated score for assessing social frailty. Instead, we employed a scale commonly used in clinical practice in Lombardy hospitals to determine the eventual inadequacy of patient support and the necessity for referrals to social services. Lastly, as the study was geographically confined to Lombardy, our findings may not be generalizable to other regions or healthcare systems with different patient demographics or healthcare infrastructure.

Conclusions

The aim of our cohort study was to provide a detailed description of the actual needs of patients hospitalized in IM wards by assessing the proportion of patients with clinically significant instability. Our findings endorse an organization model where approximately 15% of IM beds are designated for unstable patients, providing for intermediate care sub-units equipped with the necessary technical resources and staff. Furthermore, the significant care dependency of most inpatients highlights the need for allocating sufficient resources for primary care assistance to ensure patient comfort and safety. Finally, the presence of one-over-five patients with non-clinically driven delayed discharge demonstrates the crucial requiring of health system's plans that should cover the needs of not self-sufficient and socially deprived patients and, at the same time, efficiently address the burden of emergency department boarding [21].

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11739-024-03823-0.

Acknowledgements The authors affiliated to Vita e Salute University acknowledge co-funding from Next Generation EU, in the context of the National Recovery and Resilience Plan, Investment PE8–Project Age-It: "Ageing Well in an Ageing Society" [DM 1557 11.10.2022]. The views and opinions expressed are only those of the authors and do not necessarily reflect those of the European Union or the European

Commission. Neither the European Union nor the European Commission can be held responsible for them.

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Declarations

Informed consent Writteninformed consent was obtained for all study participants; in case of impossibility to sign the informed consent, such as in severely ill patients or patients with dementia, informed consent was signed by patient's legal guardian.

Human and animal rights statement The study complied with the ethical standards of the Helsinki Declaration.

Conflict of interest The authors declare that they have no conflict of interest.

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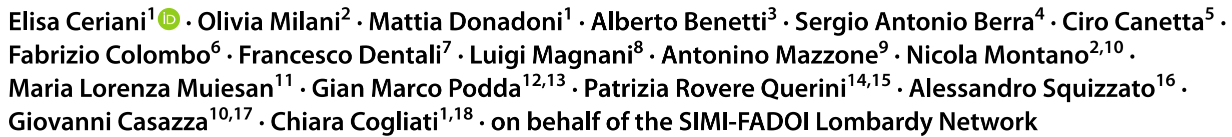
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