ORIGINAL RESEARCH

Results of a Retrospective Observational Study of Intermediate Care Staffed by Hospitalists: Impact on Mortality, Co-Management, and Teaching

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BACKGROUND: Hospitalized patients are complex and institutions have to face the high cost of critical care and the limited resources of the ward. Intermediate care appears as an attractive strategy to provide rational care according to patient needs. It is an interesting scenario to expand co-management and teaching.

STUDY DESIGN: Retrospective observational study.

SETTING: Intermediate care unit (ImCU) of a single academic hospital.

PATIENTS AND METHODS: 456 patients admitted from April 2006 to April 2010 were included in the study. Demographics, admission physiologic parameters and in-hospital mortality were recorded. We used the Simplified Acute Physiology Score II (SAPS II) as prognostic score system. Co-management with medical and surgical teams, and the number of training residents were evaluated.

RESULTS: In-hospital mortality was 20.6%, whereas the expected mortality was 23.2% based on SAPS II score. The correlation between SAPS II predicted and observed death rates was accurate and statistically significant (Rho = 1.0, p < 0.001). Co-management was performed with several medical and surgical teams, with an increase in perioperative comanagement of 22.7% (p = 0.014). The number of training residents in ImCU increased from 4.3% to 30.4% (p = 0.002)

CONCLUSIONS: An ImCU led by hospitalists showed encouraging results regarding patient survival and SAPS II is an useful tool for prognostic evaluation in this population. Intermediate care serves as an expansion of role for hospitalists; and clinicians, trainees and patients may benefit from co-management and teaching opportunities at this unique level of care. *Journal of Hospital Medicine* 2012;7:411–415 © 2012 Society of Hospital Medicine

Hospitalized patients are becoming increasingly complex. The care of such patients may be impacted by the limited resources of the general ward and might benefit from more intensive monitoring in an intensive care unit (ICU)-like setting. In light of this problem, the intermediate care units (ImCU) may provide a cost-effective alternative by providing higher levels of staffing tailored to patient needs, without incurring the cost of an ICU admission. The ImCU can reduce costs and improves ICU utilization for sicker patients, decrease ICU readmissions, promote greater flexibility in patient triage, and decrease mortality rates in hospital wards.[1–8]

The characteristics of ImCUs depend on resource availability, institutional infrastructure, and the organization and funding of the parent healthcare system. The ImCU may function as a step-up or step-down unit, or may provide specialty care for cardiac, neurologic, respiratory, or surgical conditions.[8–11] These units can expand opportunities for co-management and, at the same time, offer the occasion for training residents to follow up patients through different levels of care (from the general ward to ImCU). In the same way, the multidisciplinary approach of the ImCU can improve the center's teaching potential.

Characterizing the ImCU population requires the assessment of their severity of illness, which is crucial for the evaluation of risk-adjusted outcomes. The present study evaluated the impact of a hospitalist-led ImCU on observed-to-expected mortality ratios, as well as its role in co-management and teaching.

PATIENTS AND METHODS

We performed a retrospective observational study, with data collected from April 2006 to April 2010 in a single academic medical center in Pamplona, Spain. The ImCU is a 9-bed unit adjacent to, but independent from, the mixed ICU. Each bed is equipped with continuous telemetry, pulse oximetry, noninvasive arterial blood pressure, central venous pressure monitoring, and noninvasive pressure support ventilation. The

TABLE 1. Physiologic Parameters Evaluated at ImCU Admission

Vital signs
Glasgow Coma Scale
Serum bilirubin
Serum creatinine
Urea nitrogen
Leucocyte count
Serum sodium
Serum potassium
Bicarbonate levels
Urinary output in the first 24 hr
Oxygenation and ventilatory support

Abbreviations: ImCU, intermediate care unit.

TABLE 2. Patient Characteristics and Mortality (n = 456)

Age (yr)	65.6 ± 14.3
Gender	
Male	283 (62.1%)
Female	173 (37.9%)
Location prior to admission	
General ward	252 (55.3%)
Emergency room	96 (21.1%)
ICU	63 (13.8%)
Operating room	28 (6.1%)
Other hospital	17 (3.7%)
Probability of in-hospital mortality based on SAPS II	
<10%	128 (28.1%)
11%-25%	176 (38.6%)
26%-50%	107 (23.4%)
>50%	45 (9.9%)
Global expected mortality (in-hospital)	23.2%
Global observed mortality (in-hospital)	20.6% (94/456)
O/E mortality ratio	0.89
Discharge location	
General ward	352/456 (77.2%)
ICU	65/456 (14.3%)
Home	1/456 (0.2%)
Other hospital	11/456 (2.4%)
Death location	
ImCU	27/456 (5.9%)
ICU (transferred patients)	32/65* (49.2%)
General ward	35/352* (9.9%)

Abbreviations: ICU, intensive care unit; ImCU, intermediate care unit; O/E, observed-to-expected mortality ratio; SAPS II, Simplified Acute Physiology Score II.
* Denominator data represents the total population of transferred patients.

signals are relayed to a central monitoring station and the nurse-to-patient ratio is 1:3.

The ImCU rounding team is multidisciplinary, and involves the hospital pharmacist, a nurse, the ImCU resident, the specialist or surgeon, and the attending hospitalist. After the triage process, ImCU patients were admitted to the attending hospitalist, who was responsible for admission and discharge of all ImCU patients. The hospitalist ordered diagnostic or therapeutic interventions as needed, with the exception of orders for procedures or consultations related with specialist/surgeon's specific needs.

Admission and discharge criteria for the ImCU were set according to guidelines defined by The American College of Critical Care Medicine,[10] and also served as inclusion criteria for the present study. Exclusion criteria included: age less than 18 years old, severe respiratory failure, status epilepticus, and catastrophic brain illness. Patients admitted for drug administration and desensitization, and also ImCU readmissions, were excluded from data analysis. Patients came from medical and surgical wards, ICU, the operating room, and the emergency room.

A total of 756 patients were admitted to our ImCU during the study period. Patient demographics, past medical history, physiologic parameters at the time of admission, and survival to hospital discharge were recorded for all patients. Patient demographics include: age, gender, location before ImCU admission, length of stay before ImCU admission, reason for ImCU admission, anatomic site of surgery (if applicable), planned or unplanned admission, and infection status (nosocomial). Past medical history includes: the presence of arterial hypertension, diabetes, cirrhosis, chronic renal failure, chronic heart failure, cancer, hematological malignancy, chronic obstructive pulmonary disease (COPD), human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), immunosuppression, radiotherapy, chemotherapy, steroid treatment, and alcoholism. Physiologic parameters abstracted are described in Table 1. We used the Simplified Acute Physiology Score II (SAPS II),[12] as a

prognostic and severity score. SAPS II is the only previously validated score in intermediate care.[13] In-hospital mortality was the clinical outcome measured.

Data were entered into a computer database by the authors. Statistical analysis was not blinded, and was performed using SPSS for Windows, version 15.0 (SPSS Inc, Chicago, IL). Continuous variables were reported as mean ± standard deviation or median (25%-75% interquartile range). For nonparametric measure of statistical dependence of quantitative variables, we used Spearman's correlation coefficient. Discrimination was evaluated by calculating the area under receiver operating characteristic curve (AUROC).

The study protocol was approved by the institutional review board at the Clínica Universidad de Navarra in Pamplona, Spain.

RESULTS

Four hundred fifty-six patients were included in data analysis. Three hundred patients were excluded: 61 low-risk patients (drug administration and desensitization), 147 readmissions, and 92 patients for missing variables. Patient characteristics, including probability of death following ImCU admission and discharge location, are summarized in Table 2. The mean age was 65.6 years, and about 35% of patients had a

TABLE 3. Reasons for ImCU Admission and Severity Score Index

Condition	Patients	SAPS II	Expected Mortality	Observed Mortality	O/E Ratio
Respiratory failure	153 (33.6%)	36.1 ± 9.7	21.5 ± 15.3%	25.5% (39)	1.19
Sepsis	88 (19.3%)	45.7 ± 15.1	37.5 ± 25.1%	22.7% (20)	0.61
Cardiovascular	72 (15.8%)	35.7 ± 11.0	21.3 ± 16.6%	23.6% (17)	1.11
Perioperative	59 (12.9%)	28.9 ± 9.9	12.9 ± 11.7%	5.1% (3)	0.40
Complex monitoring	34 (7.5%)	33.2 ± 12.1	19.1 ± 16.3%	14.7% (5)	0.77
GI complications	33 (7.2%)	32.1 ± 8.3	15.6 ± 10.7%	12.1% (4)	0.78
Neurologic	10 (2.2%)	40.9 ± 10.6	29.7 ± 20.0%	30.0% (3)	1.01
Liver failure	7 (1.5%)	42.1 ± 17.2	30.9 ± 29.4%	42.9% (3)	1.39

Abbreviations: GI, gastrointestinal complications; ImCU, intermediate care unit; O/E ratio, observed-to-expected mortality ratios; SAPS II, Simplified Acute Physiology Score II.
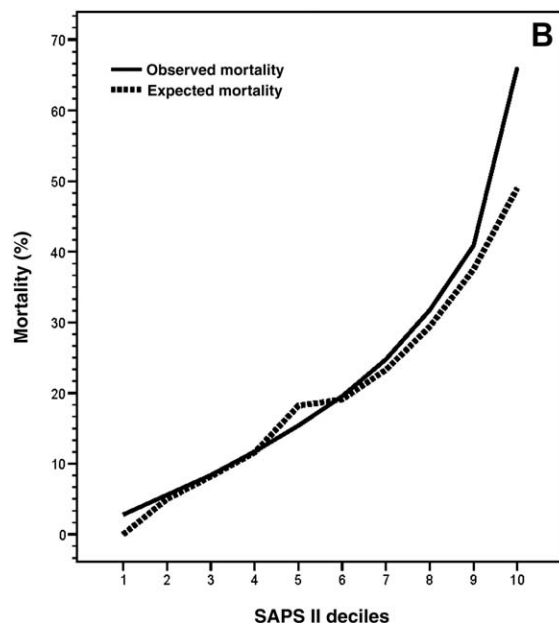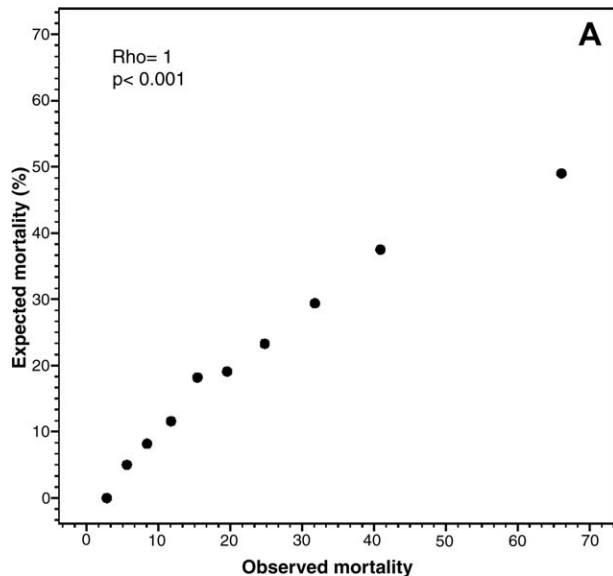

TABLE 4. Co-Management Areas and Patient Distribution

Medical			
Oncology	100 (21.9%)	Neurology	17 (3.7%)
Hepatology	43 (9.4%)	Cardiology	14 (3.1%)
Pulmonology	36 (7.9%)	Nephrology	14 (3.1%)
Hematology	20 (4.4%)	Others	13 (2.9%)
Gastroenterology	19 (4.2%)		
Total	276		
Surgical			
General	44 (9.6%)	Orthopedics	6 (1.3%)
Vascular	23 (5.0%)	Urology	5 (1.1%)
Thoracic	11 (2.4%)	Others	10 (2.2%)
Neurosurgery	7 (1.5%)		
Total	106		

NOTE: Data are number of patients and percentage of total co-managed patients (n = 382). Seventy-four patients from the Department of Internal Medicine/Hospitalists Unit were excluded from this analysis.

FIG. 1. Correlation between observed and expected mortality based on SAPS II. (A) Rho = 1.0, $P < 0.001$. (B) Simplified Acute Physiology Score II (SAPS II).

Outcomes

The mean SAPS II of the cohort was 37 ± 12 points, and the expected mortality derived from this score was 23.2%. The observed in-hospital mortality was 20.6% (94/456) resulting in an observed-to-expected mortality ratio of 0.89 (Table 2). Reasons for ImCU admission, as well as mortality ratios, are described in Table 3. The correlation between SAPS II predicted and observed death rates was accurate and statistically significant (Rho = 1.0, $P < 0.001$) (Figure 1). The AUROC for SAPS II predicting in-hospital mortality was 0.75 ($P < 0.001$).

Co-Management and Teaching

During the study period, 382/456 (83.8%) patients were co-managed with 9 medical and 7 surgical teams (Table 4). From the period of 2006-2008, a total of 37/106 (34.9%) patients were co-managed with surgeons, and just 5/37 (13.5%) were co-managed preoperatively before ImCU admission. In the next 2 years, the patient total increased to 69/106 (65.1%), and preoperative surgical co-management significantly increased to 25/69 (36.2%) ($P = 0.014$).

Our academic medical center enrolls 46 new residents every year. Since the creation of the ImCU in 2006, residents from different medical subspecialties and from general surgery received training in

SAPS II-based risk of death higher than 25% at the time of ImCU admission. The median length of stay was 4 (3-7) days.

intermediate care and hospital medicine. All residents rotated into the ImCU for 1-3 months working 8 hours a day. In 2006, when the unit was opened, 2 residents from internal medicine (4.3%) rotated in the ImCU. Thereafter, a significant increase in the number of training residents was observed, reaching 30.4% of the total resident pool (14/46) in 2010 ($P = 0.002$).

DISCUSSION

To the best of our knowledge, this is the first description of hospitalists in intermediate care. In Spain, where hospital medicine is early in development but expanding, critical and intermediate care units are usually staffed by intensivists or anesthesiologists. Staffing an ImCU with hospitalists, using a multidisciplinary co-management model, is a novel staffing solution for acutely ill patients.

Approximately 35% of ICU patients are low risk, admitted mainly for monitoring purposes.[9,14] In contrast, some patients are treated on general wards when they should receive more intensive care and monitoring.[15] Intermediate care units could improve cost containment and triage flexibility, while tailoring treatments according to patient needs. In general, ImCUs require lower nurse-to-patient ratios, and less expensive equipment and supplies than ICUs, while retaining the capability of responding appropriately to acute events.[16] Moreover, patient and family satisfaction may be increased as a result of more liberal visitation policies and a less noisy environment.[17]

This study was not designed to measure the cost-effectiveness of the ImCU. Surprisingly, there are few reports in the last 2 decades demonstrating the efficacy and cost containment of intermediate care. The majority of the studies were retrospective or uncontrolled observations.[2–7] To our knowledge, only 1 randomized controlled trial[1] and 1 multicenter prospective cost study exist.[8] Further research is needed in this area, with larger, prospective randomized controlled trials, before the benefits and limitations of intermediate care can be fully determined.

Description of the ImCU patients depends on accurate severity scoring. The efficacy and reliability of these scores has been described only for ICU patients and their role for predicting mortality in the ImCU is uncertain. There is only 1 report using SAPS II in intermediate care, showing good discriminant power and calibration in a cohort of 433 patients.[13] Auriant et al described, in that cohort, an observed mortality rate of 8.1% with an expected mortality rate of 8.7%.[13] In contrast, our expected mortality rate was considerably higher (23.2%). Although ImCUs are generally created for low-risk patients and monitoring purposes, our population was more similar to an ICU population, with very high risk for major complications and mortality.[18–23] The contribution of oncologic patients (22% of the total series; most of them with advanced disease, elevated SAPS II [42.2 ± 13.6]

and do-not-resuscitate orders), probably contributed to the higher acuity of our ImCU population. The correlation of our present data supports the value of SAPS II as a prognostic score in intermediate care, even for patients sicker than those reported by Auriant et al.[13] Intermediate care is also a valuable setting to expand a co-management model with different medical and surgical specialties.

Similarly, since the creation of the ImCU at our institution in 2006, there is a substantial increase in the number of residents rotating through our ImCU. Previous studies showed positive results of hospitalists as clinical educators in various settings.[24,25]

In conclusion, intermediate care serves as an expansion of role for hospitalists at our institution; and clinicians, trainees, and patients may benefit from co-management and teaching opportunities at this unique level of care. An ImCU led by hospitalists showed encouraging results in terms of observed-to-expected mortality ratios for acutely ill patients. SAPS II is a useful tool for prognostic evaluation of ImCU patients. However, results of this study should be confirmed with larger, prospective trials at multiple centers.

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