

# Inpatient Placement: Associations With Mortality, Cost, and Length of Stay

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As healthcare becomes increasingly complex, patients admitted to the hospital require specialized services from both a physician and nursing perspective. Many hospitals have developed specific inpatient units to meet the needs of unique patient populations. However, with inpatient occupancy rates up in many tertiary referral centers,<sup>1</sup> hospitals may not be able to place patients on the primary specialty unit to meet the specific needs of their medical condition. This must be balanced with the fact that increasing inpatient occupancy rates have been shown to lead to adverse outcomes.<sup>2-6</sup> Therefore, patients may need to be placed on secondary specialty units to optimize capacity demands to compensate for resource constraints of the inpatient setting.

When no inpatient beds are available, patients may be delayed in the emergency department (ED), leading to the boarding of patients, which occurs when a patient has been accepted to an inpatient service but remains located in a noninpatient setting, usually in the ED. Boarding has been found to increase the length of stay (LOS) for both patients awaiting admission and those eventually discharged from the ED.<sup>7</sup> Increased ED occupancy rates have also been found to lead to increased morbidity and mortality rates. One study found that the highest quartile of ED occupancy ratios—the total number of patient beds divided by the number of licensed ED beds—compared with the lowest quartile was associated with significantly increased odds of 1-day (odds ratio [OR], 1.42), 2-day (OR, 1.31), and 3-day (OR, 1.27) mortality.<sup>8</sup> Another study's findings demonstrated a 3% increase in mortality with a 10% increase in ED bed occupancy, along with a 3% increase in hospital admission during a return visit to the ED.<sup>9</sup>

Another patient population affected by high inpatient occupancy rates is those awaiting transfers from lower-acuity medical/surgical units to the intensive care unit (ICU) or from outside facilities. Delays in transfer to an ICU setting when clinically indicated due to a lack of inpatient capacity have been found to increase mortality.<sup>10</sup> Conversely, a lack of medical/surgical beds may result in patients boarding in the ICU setting.

To date, no study has looked at the impact of admitting a patient based on the primary disease focus of a particular unit. There is

## ABSTRACT

**OBJECTIVES:** Tertiary referral centers have created inpatient units to meet the needs of specific patient populations but sometimes are forced to place patients on other units that, although having the basic necessary skillsets for treating the patient, are not focused on that diagnosis area. The objective of this study was to look at outcomes of patients admitted to these different inpatient settings.

**STUDY DESIGN:** Retrospective review of patient data from a single tertiary academic medical center from August 1, 2014, to June 30, 2015, comparing patients admitted to primary versus secondary inpatient services. Patients admitted to the inpatient children's hospital, psychiatric hospital, labor and delivery unit, or subacute transitional care unit were excluded.

**METHODS:** Demographics of patients in the primary versus secondary units were compared to look for systematic differences between the 2 patient populations. To control for confounding variables, a gamma regression analysis was conducted for length of stay (LOS) and total cost, whereas a logistic regression was conducted for mortality.

**RESULTS:** Admitting to the primary unit resulted in 5.5% lower observed LOS, controlling for other patient variables, but it came at a 17.8% higher total cost of care provided compared with secondary units. Mortality was also found to be lower on primary units (odds ratio, 0.864) but did not cross the threshold of statistical significance ( $P = .101$ ).

**CONCLUSIONS:** Patients admitted to the primary unit had a lower LOS with higher costs of care. There was a trend toward improved mortality, although it was not statistically significant.

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existing evidence that trauma patients do best when cared for on a trauma unit.<sup>11</sup> One study from a French hospital found longer LOS and higher readmission rates for patients not admitted to the primary specialty unit.<sup>12</sup> However, no existing study has explored LOS and readmissions across all specialties in an American inpatient population. This study looked at the impact on patient outcomes based on the initial placement of a patient admitted to an inpatient setting and that placement's impact on LOS, mortality, and total cost of care delivered.

## TAKEAWAY POINTS

This is a retrospective analysis of outcomes for patients admitted to 1 tertiary academic medical center to either the primary or secondary specialized unit of their admitting diagnosis.

- ▶ After controlling for patient acuity, admitting to the primary specialized unit resulted in a 5.5% lower observed length of stay in the hospital compared with other units.
- ▶ Costs were found to be 17.8% higher on primary units compared with secondary units.
- ▶ Although not statistically significant ( $P = .101$ ), mortality was lower on primary units (odds ratio, 0.864).
- ▶ This study suggests that admitting patients in a referral center to an inpatient unit designed to focus on their specific disease condition might have a positive impact on their outcomes.
- ▶ The decision to admit to a specific unit must be balanced with the potential for boarding of patients in noninpatient settings when inpatient capacity rates are high.

## METHODS

### Study Design

This study is a retrospective review of all inpatient admissions to the Medical University of South Carolina Medical Center, a single tertiary academic medical center in Charleston, South Carolina, from August 1, 2014, to June 30, 2015. Institutional review board approval was obtained for this study. Patient information and all variables were extracted from the electronic health record (Epic Systems; Verona, Wisconsin). Expected LOS for patients was provided based on benchmarking data by Vizient, Inc (Irving, Texas). Patients admitted to the inpatient children's hospital, psychiatric hospital, labor and delivery unit, or subacute transitional care unit were excluded from the analysis because no alternative inpatient units were available to them at the time of admission. Patients were considered to be admitted to a primary specialty unit versus a secondary unit based on an algorithm used by a centralized bed management team. This algorithm was agreed on by nursing and hospital leadership to ensure that the minimum core competencies required to take care of patients were also available on secondary units, even if not their primary disease focus. Although all units to which the patients were admitted had the appropriate basic nursing skillsets and technological support to meet the needs of the patients, primary specialty units had greater focus on these particular types of patients and handled a higher volume of them on a regular basis. In our institution, there are units focused on neurologic, musculoskeletal, oncology, gastrointestinal, transplant, trauma, cardiovascular, and general medicine admitting diagnoses. Any unit can be a primary or secondary unit, depending on the patient's primary admitting diagnosis and service. Providers preferred to have their patients on these primary specialty units to help cohort their inpatient service in close proximity and maximize their efficiencies to deliver care, but the teams of providers taking care of these patients did not alter the care delivered whether the patient was on the primary or secondary unit.

### Analysis

SAS version 9.4 (SAS Institute; Cary, North Carolina) was used to conduct the data analysis. Characteristics of patients admitted

to the primary versus secondary units were compared to look for systematic differences between the 2 patient populations. *T* tests were used to compare differences in age;  $\chi^2$  tests were used to compare categorical variables, including gender, African American race, insurance status, readmission, and mortality. Gamma regression was used for LOS, total cost, and expected LOS (Table 1). Observed inpatient LOS, total cost, and mortality were the outcome variables of focus. Costs were based on standardized charges for services rendered and supplies used, regardless of reimbursement rates of individual patients and insurers. Confounding variables that could affect patient morbidity and acuity were factored into the analysis. These included age, gender, race, readmissions, and expected LOS. The expected LOS is a national benchmark calculated based on the discharged diagnoses of the patient as the expected time that patients with a similar presentation would stay in the hospital. To control for confounding variables of patient acuity or demographics that may impact the outcome variables, gamma regression analyses were conducted for LOS and total cost, given the propensity of positive continuous right-skewed outcomes, whereas a logistic regression was conducted for mortality (binary). Given the high correlation of age with insurance, insurance was not included in the multivariate analysis to avoid multicollinearity.

## RESULTS

A total of 13,294 patients with 17,625 encounters were included in the study. Table 1 presents the characteristics of patients placed on their primary unit compared with patients placed on a secondary unit. Overall, patients placed on the primary unit were older (by 0.9 years), less likely to be female (49.7% vs 54.1%, respectively), and less likely to be African American (35.0% vs 42.0%). Patients placed on their primary unit also were less likely to have Medicaid and more likely to have private insurance. Readmission rates were higher for patients originally admitted to the secondary unit (15.5% vs 12.7%). The LOS, both mean and median, were found to be higher on the secondary units than the primary units (6.98 vs 6.67 and 4.25 vs 4.04 days, respectively). In addition, the mean and median costs of care were found to be higher on the primary units

## TRENDS FROM THE FIELD

**TABLE 1.** Univariate Comparison Between Primary and Secondary Units

Variable	Primary Unit (n = 13,325; 75.6%)	Secondary Unit (n = 4300; 24.4%)	P
Age, years, mean ± SD	56.6 ± 17.2	55.7 ± 17.8	.0073
Female, n (%)	6625 (49.7)	2327 (54.1)	<.0001
African American race, n (%)	4660 (35.0)	1804 (42.0)	<.0001
Insurance, n (%)			<.0001
Medicare	6701 (50.3)	2157 (50.2)	.8856
Medicaid	1029 (7.7)	451 (10.5)	<.0001
Commercial	4190 (31.4)	1262 (29.3)	.0097
Other	667 (5.0)	158 (3.7)	.0003
None	738 (5.5)	272 (6.3)	.0535
30-day readmit rate, n (%)	1686 (12.7)	665 (15.5)	<.0001
Observed LOS, days			
Mean ± SD	6.67 ± 9.95	6.98 ± 9.55	.0032
Median (range)	4.04 (0.08-254.3)	4.25 (0.13-189.0)	
Total cost, \$			
Mean ± SD	23,417 ± 34,593	19,876 ± 30,319	<.0001
Median (range)	13,448 (863-847,821)	11,031 (987-522,411)	
Mortality, n (%)	507 (3.8)	188 (4.4)	.0966
Expected LOS, days			
Mean ± SD	6.26 ± 5.28	6.31 ± 5.22	.4605
Median (range)	4.81 (1.36-118.7)	4.91 (1.36-97.7)	

LOS indicates length of stay.

**TABLE 2.** Regression Analysis for LOS, Mortality, and Total Cost

Gamma Regression for LOS			
Effect	Relative Difference	95% CI	P
Patient placement (primary vs secondary)	-0.055	-0.078 to -0.031	<.0001
Age	0.002	0.001-0.002	<.0001
Sex (female vs male)	-0.027	-0.047 to -0.006	.012
Race (AA vs non-AA)	0.115	0.091-0.140	<.0001
Expected LOS	0.111	0.108-0.114	<.0001
30-day readmit rate	0.151	0.116-0.187	<.0001
Logistic Regression for Mortality			
Effect	Odds Ratio	95% CI	P
Patient placement (primary vs secondary)	0.864	0.725-1.029	.101
Age	1.029	1.024-1.034	<.0001
Sex (female vs male)	0.772	0.660-0.903	.001
Race (AA vs non-AA)	1.253	1.066-1.472	.006
Expected LOS	1.073	1.064-1.083	<.0001
Gamma Regression for Total Cost			
Effect	Relative Difference	95% CI	P
Patient placement (primary vs secondary)	0.178	0.146-0.210	<.0001
Age	0.002	0.001-0.003	<.0001
Sex (female vs male)	-0.070	-0.092 to -0.048	<.0001
Race (AA vs non-AA)	-0.042	-0.065 to -0.018	.001
Expected LOS	0.103	0.100-0.106	<.0001

AA indicates African American; LOS, length of stay.

than on the secondary units (\$23,417 vs \$19,876 and \$13,448 vs \$11,031, respectively). There was no statistically significant difference between mortality and the expected LOS for primary and secondary unit placements.

Controlling for all other factors, the placement of a patient on the primary service was associated with a 5.5% lower observed LOS (Table 2) compared with on the secondary service. For every 1-year increase in age, observed LOS increased by 0.2%. Each additional day in expected LOS was associated with an 11.1% higher observed LOS. Patients who had a 30-day readmission were found to have a 15.1% higher observed LOS. Female patients were found to have a 2.7% lower LOS than their comparable male counterparts. African American patients had a 11.5% higher LOS compared with non-African Americans. Increasing age (OR, 1.029; 95% CI, 1.024-1.034), expected LOS (OR, 1.073; 95% CI, 1.064-1.083), and African American race (OR, 1.253; 95% CI, 1.066-1.472) were associated with higher mortality, and female gender was associated with lower mortality (OR, 0.772; 95% CI, 0.660-0.903). The placement of a patient on a primary service was found to be associated with a lower mortality rate, although the difference did not approach statistical significance ( $P = .101$ ), and a 17.8% higher total cost compared with the secondary unit, after controlling for all other confounding variables. Every year of increasing age led to a 0.2% higher cost, and those with 1 day higher expected LOS were found to have 10.3% higher costs. Female patients were found to have 7.0% lower total costs compared with males. African Americans were found to have 4.2% lower total costs than non-African Americans.

## DISCUSSION

The findings of this study reveal that the placement of patients on their primary units leads to a lower LOS, after controlling for age, gender, race, expected LOS, and readmissions. Given that the same group of physicians and support services takes care of patients whether they are on the primary or secondary unit, it is possible that the specialized skillset of nurses on primary units, along with an infrastructure to support specific patient populations, may have a positive impact on improving patient care. Another potential variable not captured

in the analysis is that primary units may have better familiarity and relationships with resources available for patients when they are ready to transition to the postacute care setting outside of the hospital. This may expedite the transitions of care and result in a lower observed LOS.

In addition, a noticeable difference between primary and secondary unit placement was the increased costs seen on the primary unit. Whether or not this increased amount of resources spent on patients led to improved outcomes remains to be seen. There may have been specific therapies provided on the primary units that were not available on the secondary units, leading to the difference. One other variable not factored into the total costs is the higher readmission rate on the secondary units, as reimbursement for readmissions will be reduced and eventually eliminated by Medicare and other insurers over time.

Also notable are the demographic differences, regarding age, gender, race, and insurance type, seen between the primary and secondary unit placements. It is unclear why patients with Medicaid and younger, female, and African American patients were more likely to be placed on secondary units. Although the placement of patients is not based on these factors, there may be underlying systemic influences leading to this discrepancy, such as differences in elective versus unscheduled admissions. Although it was controlled for in statistical modelling, the assignment of patients to specific units did not seem to be completely randomized.

Given the negative effects associated with placing a patient on a secondary unit, the decision on where to admit a patient when dealing with high inpatient occupancy rates must be balanced with the decision of whether to leave a patient boarding in the ED or post-anesthesia care unit or at an outside hospital. Future studies should explore whether or not allowing boarding while waiting for availability on the primary unit is better for the patient versus admitting to the secondary unit.

## Limitations

As this was a study conducted in a single academic medical center, the results may not be generalizable to other sites, especially those that do not specialize their medical/surgical inpatient units. Patients in this patient population may be sicker than those typically seen in community hospitals, so results in a community setting may vary. In addition, the placement of patients was based on their admitting diagnoses, which may or may not reflect the true condition or acuity of the patient. One risk of a too-low LOS is an increased rate of readmissions, whether to the same or different hospitals, and there was no way to determine if patients were readmitted to outside hospitals. The number of minority races beyond African American captured in the sample size was extremely small, making an analysis beyond the binary one presented here underpowered. This study lacked sufficient power to explore when a patient was first admitted to the secondary unit, then later transferred to the primary unit, and what effect this had on patient outcomes. Finally, patients were more likely to be placed on secondary units when the inpatient census was higher, and

higher occupancy rates may confound outcomes, including higher LOS and mortality. This study was unable to attribute the inpatient occupancy rate to specific patients at the time of their admission.

## CONCLUSIONS

Admitting patients to an inpatient hospital unit that has specialized services to focus on each patient's disease process has been shown to lower the observed LOS with a trend toward improved mortality. The trade-off in these improved outcomes is a higher total cost for the care provided. In the future, studies of patient placement should focus on a comprehensive model to meet the goals of the triple aim of improving the patient's experience and improving the health of the population, all while reducing the cost per capita. ■

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