How Much Does a Hospital Day Cost?

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ABSTRACT

Objectives: There are standard data sources for estimating the costs of inpatient and outpatient physician procedures, outpatient visits, and drug costs for the US, but no standard data source for estimating the average cost per day in the hospital at various levels of care (i.e., intensive or critical care units (ICU/CCU), regular care).

Methods: A method for estimating the cost per day in the hospital for different levels of care and different diagnoses was developed using data from the Healthcare Cost and Utilization Project's (HCUP) 2002 Michigan State Inpatient Database (SID). Linear regression models without an intercept were used to estimate the relationship between total cost and length of stay (LOS) at each level of care for selected diagnosis-related groups (DRGs).

Results: Nearly 1.3 million inpatient stays were initially included in the Michigan SID. Across all records with complete data (n=787,753), the mean cost per day, in 2005 dollars, in the hospital, for all medical conditions, was $1,237 (SE=$0.97). The mean cost per day by level of care across all conditions was $2,401 (SE=$3.60) in an ICU or CCU and $1,122 (SE=$0.97) in regular care. The mean cost per day in an ICU or CCU varied across DRGs analyzed, ranging from $1,241 (SE=$18.27) for DRG 387 (n=1,422), prematurity with major problems, to $3,315 (SE=$106.60) for DRG 105 (n=1,220), cardiac valve and other major cardiothoracic procedures without cardiac catheterization. The mean cost per day in regular care varied from $1,176.46 (SE=$12.92) for DRG 387, prematurity with major problems (n=1,422), to $3,081 (SE=$119.23) for DRG 106 (n=164), coronary bypass with PTCA.

Conclusions: A simple regression analysis method can be used with data from national or state inpatient datasets to estimate the mean cost per day in the hospital at different levels of care and for different diagnoses. These estimates can be used in cost-effectiveness studies.

INTRODUCTION

Economic evaluations of new healthcare interventions often require comparison of the increased costs associated with a new intervention to the increased health benefits obtained to determine whether or not that intervention is cost-effective.

- In order to compute the cost-effectiveness of a new health care intervention, it is necessary to estimate the impact of the new intervention on health care costs.
- Unfortunately, there are no standard data sources available for estimating the cost for a day at different levels of care in a US hospital (i.e., days in intensive or critical care units [ICU or CCU]).

We used data from a publicly available US hospital database to estimate the cost per day in the hospital for people hospitalized with different health conditions.

METHODS

This study was based on data collected from the 2002 Michigan State Inpatient Database (SID), provided by the Healthcare Cost and Utilization Project (HCUP).

The SID includes a number of both clinical and non-clinical variables for each hospital stay, including:

- primary and up to 15 secondary diagnosis and procedure codes
- admission and discharge status
- length of stay
- expected payment source
- patient demographics
- hospital characteristics
- total charges for services rendered during the hospitalization

Additionally, beyond total LOS, the Michigan SID contains information on LOS in ICUs and CCUs. This allows for estimating per-day cost estimates for these units, something that is not possible with data contained in the 2002 HCUP National Inpatient Sample.

All economic data in the SID are in the form of charges and are in 2002 dollars. To adjust these data to 2005 costs, we:

- applied appropriate DRG-specific cost-to-charge ratios
- inflated to 2005 dollars using a Medical Consumer Price Index-based adjustment factor

In this analysis, the mean cost per day at different levels of care was estimated both at the DRG level and for a specific condition. We included all DRGs that had a mean LOS in an ICU or CCU ≥1 day. We also estimate the mean cost per day for one specific condition, aspergillosis, evidenced by a primary or secondary diagnosis code of either 117.3 or 484.6.

Table 1 presents the full list of the DRGs/conditions analyzed, a brief description of each, and the prevalence of each in the state of Michigan in 2002.

Table 1. DRGs Analyzed, Their Descriptions, and Prevalence in Michigan in 2002

DRG/Condition	Description	N (All Stays)	N (Complete Data for Regression Models)
Overall	All inpatient stays	1,274,206	787,753
Aspergillosis	ICD-9 diagnosis codes 117.3 or 484.6	387	167
104	Cardiac valve & other major cardiothoracic procedure with cardiac catheterization	992	612
105	Cardiac valve & other major cardiothoracic procedure without cardiac catheterization	2,530	1,220
106	Coronary bypass with PTCA	287	164
107	Coronary bypass with cardiac catheterization	5,417	3,262
110	Major cardiovascular procedures with cc	3,874	2,326
385	Neonates, died or transferred to another acute care facility	2,484	1,306
386	Extreme immaturity or respiratory distress syndrome, neonate	2,078	1,322
387	Prematurity with major problems	2,384	1,422
475	Respiratory system diagnosis with ventilator support	8,551	5,180
483	Tracheostomy except for face, mouth and neck diagnoses	3,882	2,017
484	Craniotomy for multiple significant trauma	124	61
486	Other operating room procedures for multiple significant trauma	944	538
512	Simultaneous pancreas/kidney transplant	11	2

Linear regression models were used to assess the relationship between the patients' LOS at each level of care, and the total cost of the stay. Formally, the regressions that we estimated were of the form:

$$Y_i = \beta_j X_j + \varepsilon$$

where Y_i is total cost for the ith DRG (or condition), X_j is a vector of j explanatory variables (in this case, various LOS measures), β_j is the incremental effect of X_j on total costs, and ε is the error term.

- Notice that there is no intercept in this model, which is an intuitively appealing specification.
  - The lack of an intercept ensures that the total cost will be zero when LOS is zero.

The estimates of cost per day were validated using regression estimates as follows:

- computed estimated mean total cost as product of
  - mean cost per day by level of care (Table 2)
  - mean LOS for each level of care (Figure 1)
- compared estimated with observed mean total cost

RESULTS: Prevalence

Descriptive analyses of the Michigan SID data demonstrated that:

- there were nearly 1.3 million inpatient stays in the state of Michigan in 2002
- slightly more than 387 stays in Michigan had evidence of aspergillosis as a primary or secondary diagnosis
- among the DRGs analyzed in Michigan, the prevalence ranged from 11 stays (DRG 512) to nearly 8,600 (DRG 475)

LOS (Figure 1) and Total Costs (Figure 2)

Across all stays, we estimate that in Michigan:

- among observations that were not missing LOS or total cost data,
  - the mean LOS was 4.7 days
  - the mean LOS in an ICU/CCU was 0.2 days
  - the mean LOS in a non-ICU/CCU was 4.3 days
  - the mean total cost was slightly more than $5,780

Among those hospital stays with evidence of aspergillosis, we estimate that in Michigan:

- among observations that were not missing LOS or total cost data,
  - the mean LOS was 14.2 days
  - the mean LOS in an ICU/CCU was 1.5 days
  - the mean LOS in a non-ICU/CCU was 12.7 days
  - the mean total cost was $29,399

Finally, among the DRGs analyzed in Michigan:

- among observations that were not missing LOS or total cost data,
  - the mean LOS ranged from 5.6 days (DRG 385) to 36.7 days (DRG 386)
  - the mean LOS in an ICU/CCU ranged from 1.6 days (DRG 105) to 12.8 days (DRG 386)
  - the mean LOS in a non-ICU/CCU ranged from 3.6 days (DRG 385) to 25.1 days (DRG 483)
  - the mean total cost ranged from $10,994 (DRG 385) to $88,180 (DRG 483)

Figure 1. Mean LOS, Overall and in Specific Units of Care—Michigan SID

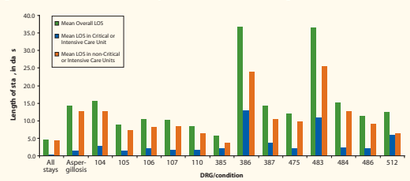
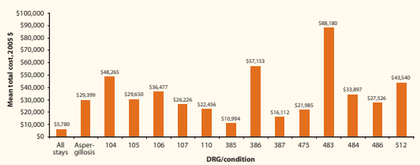


Figure 2. Mean Total Costs, by DRG/Condition—Michigan SID



RESULTS: Cost Estimates

Table 2 presents the regression-based estimates, by DRG or condition, as derived from the Michigan SID. We omitted observations that were missing data on total charges and/or LOS.

Table 2. Michigan SID-Based Regression Results—Ordinary Least Squares, No Intercept

DRG/Condition[1]	Parameter[2]	Estimate	Standard Error	Ratio of Estimated to Observed Total Costs
All stays [N=787,753]	Critical days	$2,401.11 **	$3.61	0.955
	All other days	$1,121.59 **	$0.97	
Aspergillosis [N=167]	Critical days	$3,362.12 **	$384.41	1.059
	All other days	$2,053.59 **	$93.12	
104 [N=612]	Critical days	$2,996.71 **	$164.09	0.899
	All other days	$2,716.94 **	$59.47	
105 [N=1,220]	Critical days	$3,315.06 **	$106.60	0.878
	All other days	$2,808.30 **	$39.79	
106 [N=164]	Critical days	$3,295.60 **	$318.39	0.893
	All other days	$3,081.19 **	$119.23	
107 [N=3,262]	Critical days	$2,472.56 **	$50.94	0.899
	All other days	$2,307.92 **	$17.33	
110 [N=2,326]	Critical days	$3,133.54 **	$57.32	0.833
	All other days	$1,994.63 **	$28.25	
385 [N=1,306]	Critical days	$2,284.47 **	$28.03	1.056
	All other days	$1,959.75 **	$20.02	
386 [N=1,322]	Critical days	$1,656.41 **	$20.35	1.082
	All other days	$1,699.34 **	$14.36	
387 [N=1,422]	Critical days	$1,241.43 **	$18.27	1.053
	All other days	$1,176.46 **	$12.92	
475 [N=5,180]	Critical days	$2,513.02 **	$33.85	0.878
	All other days	$1,388.23 **	$10.11	
483 [N=2,017]	Critical days	$2,681.37 **	$39.80	0.948
	All other days	$2,121.40 **	$22.26	
484 [N=61]	Critical days	$2,220.90 **	$400.36	0.814
	All other days	$1,762.19 **	$106.01	
486 [N=538]	Critical days	$2,938.56 **	$129.77	0.939
	All other days	$2,150.32 **	$48.55	
512 [N=2]	Critical days		NA[3]	
	All other days		NA[3]	

* Significant at the 95% level ** Significant at the 99% level

[1] Separate models were estimated for each DRG/condition.
[2] Each model was estimated without an intercept and included the number of days in an ICU/CCU ("Critical days") and the number of days in all other units ("All other days") as the explanatory variables.
[3] Inadequate number of analyzable observations for model estimation.

As Table 2 illustrates, across all stays, we find that in the state of Michigan:

- a 1-day increase in LOS in an ICU/CCU will increase total costs by $2,401
- a 1-day increase in LOS in a non-ICU/CCU will increase total costs by $1,122

Among those with evidence of aspergillosis, we estimate that, in the state of Michigan:

- a 1-day increase in LOS in an ICU/CCU will increase total costs by $3,362
- a 1-day increase in LOS in a non-ICU/CCU will increase total costs by $2,054

Among all DRGs analyzed, we estimate that, in the state of Michigan:

- the incremental effect of a 1-day increase in LOS in an ICU/CCU on total costs ranged from $1,241 (DRG 387) to $3,315 (DRG 105)
- the incremental effect of a 1-day increase in LOS in a non-ICU/CCU on total costs ranged from $1,176 (DRG 387) to $3,081 (DRG 106)

Table 2 also presents the percentage difference between the observed mean total costs for those patients with complete data and the estimated mean total costs using our estimates of the mean cost per day at each level of care multiplied by the observed number of days at each level of care. This table illustrates that all estimates of mean costs are within 20 percent of the observed mean costs.

LIMITATIONS

- Detailed information on charge categories is not available in the Michigan SID. As a result, various components (i.e., drug costs, physician costs) that constitute the total charge for a hospital stay cannot be assessed separately.
- Because it is impossible to confirm diagnoses, results must be based solely on what is reported in the dataset.
- Small sample sizes due to incomplete data (i.e., DRG 484) may result in unreliable estimates for some models (i.e., deviation of estimated total costs from observed total costs by close to 20 percent [Table 2]).
- The variance between estimated and observed mean total costs (Table 2) may be at least partially explained by a non-linear relationship between total costs and LOS measures, which was not included in our regression model.

CONCLUSIONS

- This study used regression analysis without an intercept term to assess the relationship between total costs for a hospital stay and time spent at different levels of care.
- The regression analyses provided estimates of the average daily costs by level of care in the hospital.
- The results of this study demonstrate that hospital daily costs vary by DRG or diagnosis, as well as by level of care.
- Estimated mean total costs were within 20 percent of observed mean total costs.
- The analyses could be extended to allow for a non-linear relationship between costs and LOS at different levels of care.
- Analyses such as these that are based on administrative datasets can provide a convenient and inexpensive source of information with large sample size and locally or nationally representative data.

REFERENCE

Healthcare Cost and Utilization Project (HCUP), 2002 Michigan State Inpatient Database (SID). Public-use data file. Rockville, MD: Agency for Healthcare Research and Quality (AHRQ). 2002.

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Presented at: 11th Annual International Meeting of the International Society for Pharmacoeconomics and Outcomes Research
May 20-24, 2006, Philadelphia, PA