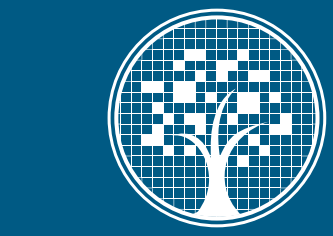

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HEALTHCARE COST AND UTILIZATION PROJECT

HCUP Methods Series

The Cost of "Treat and Release" Visits to Hospital Emergency Departments, 2003
Report# 2007-05

Agency for Healthcare Research and Quality

U.S. Department of Health and Human Services
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Recommended Citation: Friedman B, Owens P. The Cost of "Treat and Release" Visits to Hospital Emergency Departments, 2003. HCUP Methods Series Report # 2007-05 Online. July 2, 2007. U.S. Agency for Healthcare Research and Quality. Available:http://www.hcup-us.ahrq.gov/reports/methods.jsp.

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Executive Summary

Background

An accurate method for estimating the cost of producing ED visits in hospitals would be useful to community, state, and federal policymakers. In recent years, there have been many concerns and proposals for finding an efficient way to reduce perceived shortages of ED care and prepare for rare surges in demand. Policy reforms in reimbursement are typically a key component of proposals for improving the current supply of ED capacity and preparing for surges. To estimate the budgetary expense for such policies, information will be needed on the current levels of cost of production of ED care for different types of hospitals in different geographic areas. Variation of cost associated with area wage levels and the diagnostic mix and significant comorbidities of patients, and perhaps other determinants, would warrant variations in reimbursement.

HCUP Partners in 15 states collected data for each "treat and release" (T&R) visit from each hospital in 2003. In 8 of these states, the advances in collection and reporting of administrative data include the detailed charges for specific services to each patient seen in the ED. Detailed charges can be matched up with departmental cost to charge ratios (CCR) in standardized accounting data reported by hospitals to the Centers for Medicare and Medicaid Services (CMS). The CMS data provide cost and charges for all payers in each cost center.

This study demonstrates practical methods for estimating the cost of T&R visits in 8 states with data on detailed charges during each visit: Connecticut, Georgia, Maryland, Minnesota, Nebraska, South Carolina, Tennessee, and Utah. Detailed charges are desirable for making overall total cost estimates because the cost-to-charge ratio (CCR) is known to vary substantially between cost centers in any hospital. There were about 11 million T&R visits in these states. About 550 hospitals in the 8 states had complete accounting reports for 2003. Cost estimates could be made for about 10 million visits, with a median of 13,416 visits per hospital.

Once an estimate of cost is made for each ED visit, the average CCR for visits at each hospital can be calculated. The variation between hospitals and states is described. We examine whether a classification of hospitals into peer groups could be reasonably used to impute for missing data, and to extrapolate to other states.

Finally, we analyze the effect of area wage level differences, diagnostic casemix, selected comorbidity rates, and other determinants of the variation across hospitals in the average cost per visit.

Results

1.) There was substantial variation across states in the CCR for hospital ED visits, from a low of .339 in Tennessee to a high of .816 in Maryland. This variation could reflect

many factors including regulations and state programs to compensate for care to Medicaid and uninsured patients. The average was higher than the national inpatient CCR in the same year. Also, the correlation of the ED CCR with the inpatient CCR across hospitals was statistically significant but not very high at .52. So the inpatient CCR would not be a compelling tool for extrapolating the ED CCR from one state to another.

2.) A regression across hospitals of the ED CCR on hospital characteristics and state-specific effects was used to develop "peer groups" of hospitals. Except for the two peer groups with for-profit hospitals, the difference between groups was much smaller than the within-group standard deviation. Even so, that does rule out the peer groups being useful for imputing missing data within state and perhaps across states. Unfortunately, even after controlling for ownership type, volume of visits, urban vs. rural location and teaching status, substantial and significant variation remains between states. Six of the eight state "effects" different significantly from zero by sizable amounts: -.11, +.25, -.15, -.12, -.12, -.20. These are larger in absolute value than any effects of hospital characteristics on the ED CCR.

3.) A log-linear regression of cost variation across hospitals gives a number of strong results. The effect of the area wage index shows a high elasticity of about .78, not surprising since a service enterprise is subject to local labor costs. The casemix index has quite a high elasticity of 2, which calls for a clarifying comment. Cost and the casemix index have a high simple correlation but the casemix has a fairly narrow variation while the cost variation is larger, i.e., more spread out at the extremes. More specifically, the casemix index has a mean value of about 1. In the top 5% of hospitals the value starts at 1.15 (15% above the mean). But the cost for the top 5% starts at 65% above the mean. This may reflect a high fixed cost of maintaining the highest trauma designations in preparation for receiving the most acute emergency referrals.

Two of the comorbidity rates were also plausibly positive (abdominal pain and fever of unknown origin) while one was surprisingly negative (other lower respiratory infection). After controlling for casemix and the labor cost index, hospital ownership was not significant, while teaching hospitals had 8% higher cost. The admission rate from the ED had a small positive and significant effect on cost of T&R visits, reflecting presumably the more expensive capacities that some hospitals maintain to deal with more severely ill patients.

Conclusion

The methods of this study demonstrate that the cost of an ED T&R visit can be estimated, based on detailed charges and detailed accounting data, for a large number of visits and hospitals in available statewide databases. Unfortunately, the variation of the CCR is too high across states, and the effects of peer-group factors too weak, to make reasonable extrapolations to other states. This may become less of a constraint on cost-related research in future years as the number of states with detailed reporting

increases. Still, for 2003 analysts can assemble a usefully large database of over 10 million ED visits in 550 hospitals with estimates of cost per case.

The variation of cost with respect to area wages, casemix, comorbidities and other determinants is plausible and could be useful in program planning, specifically in designing compensation to hospitals for expanding capacity or meeting surges in demand.

Introduction

During the past decade, administrative data for the full set of emergency department (ED) visits have been collected in a number of states. Previously, it was only possible to study the use of ED visits for the entire country, a region, or a defined population, using a sample survey of hospitals or households (see Cunningham, 2006). In 2003, HCUP Partners in 15 states collected data for each "treat and release" (T&R) visit from each hospital.

In some states, the advances in collection and reporting of administrative data include the detailed charges for specific services to each patient seen in the ED. Detailed charges can be matched up with standardized accounting data reported by hospitals to CMS. Although collected for use by the federal payment programs, costs are for services to all payer groups.

An accurate method for estimating the cost of producing ED visits in hospitals would be useful to community, state, and federal policymakers. In recent years, there have been many concerns and proposals for finding the most efficient way of reducing perceived shortages of ED care and preparing for rare surges in demand. The Institute of Medicine (IOM, 2006) recently assembled evidence of shortages of ED care and vulnerability to catastrophes. Hospitals have to weigh a number of factors in deciding on the amount of ED capacity they are willing to establish and support. They will be concerned about whether, in expanding capacity or meeting surges in demand, they will be reimbursed an adequate amount to cover the cost of producing services.

Policy reforms in reimbursement are generally a key component of proposals for improving the current supply of ED capacity and preparing for surges. To estimate the budgetary expense for such policies, information will be needed on the current levels of cost of production of ED care for different types of hospitals in different geographic areas. Variation of cost associated with area wage levels and the diagnostic mix and significant comorbidities of patients, and perhaps other determinants, would warrant variations in reimbursement.

Purpose

This paper will demonstrate practical methods for estimating the cost of T&R visits in a large subset of all states currently supplying ED visit data, selecting hospitals with linkable, standardized accounting reports to CMS. In addition, an effort will be devised to remove inconsistent reporting of the physician services component of an ED visit.

Once an estimate of cost is made for each ED visit, the average CCR for visits at each hospital will be calculated. The variation between hospitals and states will be described. We will test whether the classification of hospitals into peer groups

(somewhat analogous to the method for HCUP inpatient peer groups) could be used to impute for missing data, and to extrapolate to other states.

Finally, we will analyze the effect of area wage level differences, diagnostic casemix, and selected comorbidity rates in the variation across hospitals in the average cost per visit.

Methods

Hospital ED visit summaries for 2003 are drawn from 8 states: Connecticut, Georgia, Maryland, Minnesota, Nebraska, South Carolina, Tennessee, and Utah. These are states where detailed charges are reported for each visit. Detailed charges are desirable for making overall total cost estimates because the cost-to-charge ratio (CCR) is know to vary substantially between cost centers in any hospital. There were about 11 million T&R visits in these states. About 550 hospitals in the 8 states had complete accounting reports for 2003. Cost estimates could be made for about 10 million visits, with a median of 13,416 visits per hospital.

The detailed charges for an ED visit may arise from services in a number of standard cost centers: the ED unit itself, and ancillary centers such as radiology, or pathology laboratories, or pharmacy. Data collection agencies in the various states do not all use the same standard categories of charges, or scheme of aggregation of ancillary services. After checking variation in the CCR by ancillary center in the CMS database, we adopted a "lowest common denominator" approach, grouping all ancillary cost centers together. When that is done, it is clear that the CCR is significantly and substantially higher in the ED than in ancillary cost centers – the means in the CMS database for 3700 hospitals are .55 versus .32. For each hospital visit, the total cost estimate will be the sum of (1) ED unit CCR multiplied by detailed charges for that unit and (2) ancillary aggregate CCR multiplied by ancillary aggregate charges.

One additional adjustment was made for consistency of cost estimates. Physicians not employed directly by the hospital can bill directly for services in the ED unit or ancillary units, but sometimes these fees are billed by the hospital on behalf of the physicians. Such fees can be found in the visits for a few states. To remove this inconsistency we dropped all charges billed by the hospital specifically for physician fees. For some analyses of cost of non-urgent visits in a hospital ED vs. a different setting, it is helpful to have an estimate of the cost for attending physicians. We provide an imputed estimate of physician cost based on survey data from the Medical Expenditure Panel Survey (MEPS). A MEPS report is available with data by region for 2003 including physician charges, physician revenue, and hospital charges per ED visit by region (Machlin, 2006). We used the ratio per visit of average physician revenue/average hospital charge and applied it to the total hospital charge for every visit in the relevant hospital.

After cost is calculated for each visit and aggregated to the hospital level, we will examine variation of the CCR across hospitals in relation to characteristics such as ownership, volume of visits, rural/urban location and teaching status, allowing for fixed differences between states. Based on the results for the hospital characteristics, peer groups of hospitals will be defined and the differences between the groups will examined in relation to the variation within groups. If state differences that remain are not statistically significant, or are small, then peer groups of hospitals could be useful for imputing missing data for the CCR within and across states. Hospital characteristics are derived from the American Hospital Association.

A log-linear regression analysis is used to analyze variation of hospital average visit cost with the area wage index (from CMS), a casemix index, several comorbidity proportions, bed capacity of the hospital, ownership, teaching status, and the proportion of visits admitted to inpatient care (these were not included as T&R visits).

For every 100 T&R visits there are about 11.5 visits admitted from the ED for inpatient care. Unfortunately, the cost of ED services cannot be estimated fully for those patients later admitted. We assume that admission from the ED is determined by clinical assessments of physicians. If a hospital expects a higher proportion of ED visits to require admission (i.e., the patients will require extra resources for diagnosis and stabilization), the cost per visit of T&R visits is hypothesized to be higher.

A standard type of casemix index is used here, such as used for calculating Medicare national DRG relative payment weights. The diagnostic casemix of the ED visits is measured as $\sum_i(C_i*W_{ih})$ where C_i is the average cost in category i of primary diagnosis, over the entire set of all patients in all hospitals, and W_{ih} is the proportion of visits for hospital h that are in category i (see HCUP, 2006, for definitions and citations for the diagnostic categories).

About half of ED visits had secondary diagnoses listed. Comorbidities can affect cost by triggering additional tests to determine if the patient needs to be admitted to an inpatient unit. We searched the frequent comorbidities for overlaps with a list of 30 comorbidities that have been shown to significantly affect charges for inpatients (Elixhauser, et al., 1998). There were three overlapping diagnostic groups: benign hypertension, diabetes, and substance abuse. We consulted with clinical advisors with experience managing EDs or working in EDs for advice about selecting some of other relatively frequent categories of comorbidities that would raise cost in the ED. They selected the following: fever of unknown origin, abdominal pain, nausea and vomiting, other lower respiratory infections. We then calculated the proportion of visits at each ED with each of the seven comorbidity categories.

It would be possible to control for payer mix (proportion Medicare, proportion uninsured, etc.) for most hospitals providing data on ED visits. This was not used here because the payer mix is subject to the statistical threat of endogeneity. It is plausible that a hospital with a lower-cost ED would be willing to supply more service to uninsured and lower-paying patients.

Findings

The average ED visit cost for the 8 states was estimated to be $302 in 2003. This took into account different CCRs for each hospital's ED unit and ancillary departments. Also, inconsistency in the reporting of physician fees billed by the hospital was removed. Total hospital charge per visit was $657 and the average CCR was .460. This compares to a national, inpatient CCR in the same year of.386.

As Table 1 shows, there was substantial variation across states, from a low of .339 in Tennessee to a high of .816 in Maryland. This variation can reflect many factors including regulations and state programs to compensate for care to Medicaid and uninsured patients. Because of the variation between states it would be hazardous to extrapolate the average of .460 to other states without detailed charge reporting, unless there were a close association of the CCR with hospital characteristics. Also, the correlation of the ED CCR with the inpatient CCR across hospitals was statistically significant but not very high at .52. Therefore the inpatient CCR would not be a compelling aid to extrapolating the ED CCR from the 8 states in the study to other states.

A regression across hospitals of the CCR on ownership, high or low volume of visits, urban or rural location, determined that there was a significantly lower CCR for investor-owned hospitals. The CCR was significantly higher for government-owned hospitals, and a higher number of visits. The CCR was lower for urban hospitals, but only at a significance level of P<.08. There was no independent effect of teaching status. Peer group averages were calculated so that there would be a sufficient cell size within peer group, analogous to the way groups are defined for inpatient CCR. Table 2 shows the average within peer group, and the standard deviation within peer group. Except for the two peer groups with for-profit hospitals, the difference between groups was much smaller than the within-group standard deviation. Even so, that does rule out the peer groups being useful for imputing missing data within state and perhaps across states. Unfortunately, after controlling for hospital characteristics, substantial and significant variation remains between states. Six of the eight state "effects" different significantly from the overall average by sizable amounts: -.11, +.25, -.15, -.12, -.12, -.20. These are larger in absolute value than any effects of hospital characteristics on the ED CCR. Due to these significant differences between states, the peer groups are not a good tool for generalizing to other states.

Table 3 shows the regression results for the log-linear cost variation across hospitals. Coefficients of continuous variables are interpreted as the approximate percentage change in cost for a 1% change in the independent variable. For discrete 0/1 variables, the coefficient is interpreted as the approximate percentage change in cost if the independent variable changes from 0 to 1. The effect of the area wage index shows a high elasticity of about .78, not surprising for a service enterprise cannot escape local labor costs. The casemix index has quite a high elasticity of 2, which calls for a

clarifying comment. The two variables have a high simple correlation but the casemix has a fairly narrow variation while the cost variation is larger, i.e., more spread out at the extremes. More specifically, the casemix index has a mean value of about 1. In the top 5% of hospitals the value starts at 1.15 (15% above the mean). But the cost for the top 5% starts at 65% above the mean. This may reflect a high fixed cost of maintaining the highest trauma designations in preparation for receiving the most acute emergency referrals.

Two of the comorbidity rates were also plausibly positive (abdominal pain and fever of unknown origin) while one was surprisingly negative (other lower respiratory infection). After controlling for casemix and the labor cost index, hospital ownership was not significant, while teaching hospitals had 8% higher cost. The admission rate from the ED had a small positive and significant effect on cost. The inpatient bed capacity did not have a significant effect on ED visit cost, although presumably with a higher bed capacity more seriously ill patients could be admitted to an inpatient unit. Apparently, once the casemix index for T&R patients is given, as well as the rate of admission from the ED, then the bed capacity does not affect observed annual average cost of T&R visits.

Discussion

The methods of this study demonstrate that the cost of an ED T&R visit can be estimated, based on detailed charges and detailed accounting data, for a large number of visits and hospitals in available statewide databases. The variation of cost with respect to area wages, casemix, comorbidities and other determinants is plausible and could be useful in program planning, specifically in designing compensation to hospitals for expanding capacity or meeting surges in demand.

A limitation for any study of the cost of ED visits is that billing is different for those patients admitted from the ED to an inpatient unit. The total cost of such ED care for those patients is not measurable, but we do measure the effect of an expected high proportion of admissions from the ED on the cost of T&R visits.

The imputation for physician cost removes a bias, but smooths out some legitimate variation by applying a regional percentage allowance to each hospital's charges in the region. An additional complication is this: hospitals can pay resident physicians a salary to provide ED services. But this does not prohibit attending physicians from also billing for seeing the same patient. In fact major teaching hospitals will generally pay clinical faculty to supervise the residents and then the hospital will bill patients for the fees to support clinical faculty services. The higher cost for resident salaries in teaching hospitals appears to be picked up in the regression analyses by the effect of teaching

status, controlling for casemix. Overall, attending physician cost was estimated to be about 15% to 20% of total visit cost.

Acknowledgements

The authors are grateful to William Encinosa and Steve Machlin for discussion of cost measurement, to Richard Jordan of SSS for programming assistance, and to Nils Nordstrand of Thomson, Inc. for programming assistance with the CMS accounting database. The authors also would like to thank the state data organizations that contributed data to HCUP State Inpatient Databases (SID) and State Emergency Department Databases (SEDD) in 2003 for this analysis: Connecticut – Chime, Inc.; Georgia – GHA: An Association of Hospitals & Health Systems; Maryland Health Services Cost Review Commission; Minnesota Hospital Association, Nebraska Hospital Association, South Carolina State Budget & Control Board, Tennessee Hospital Association, and Utah Department of Health. For detailed information and ordering of selected state ED databases from the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality, see <http://www.hcup-us.ahrq.gov/databases.jsp>, accessed December, 2006.

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Table 1: ED visit cost and charge averages in 8 states, 2003

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(Treat and Release visits)

State	Hospital cost ($)	Physician Cost ($)	Total visit cost ($)	Total charges ($)	CCR	N of Visits with full data	N of hospitals with full data
	note [1]	note [2]					
CT	328	76	404	774	0.522	1,052,829	31
GA	241	75	316	703	0.450	2,739,719	99
MD	246	37	283	347	0.816	1,647,579	45
MN	226	69	295	626	0.471	932,267	100
NE	261	68	329	616	0.534	339,846	67
SC	229	78	307	727	0.422	1,444,994	59
TN	176	84	260	766	0.339	2,411,360	120
UT	220	48	268	555	0.483	565,078	35
						11,133,672	556
average over all visits:			302	657	0.460		

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[1] billed professional charges were removed

[2] based on MEPS survey data by region

Table 2: Hospital and Group Mean CCR for possible imputations

Table 2: Hospital and Group Mean CCR for possible imputations

Type	Descriptors	N of Hospitals	Weighted mean CCR	Standard Deviation
1	Rural, low volume, Gov't [1]	41	0.570	0.230
2	Rural, low volume, PNFP or Prof	33	0.571	0.173
3	Rural, Non-low volume, Gov't	70	0.527	0.204
4	Rural, Non-low volume, PNFP	110	0.529	0.226
5	Rural, Non-low volume, Prof	42	0.361	0.177
6	Urban, Gov't	30	0.457	0.379
7	Urban, PFNP	185	0.552	0.217
8	Urban, Prof	46	0.395	0.215
	ALL HOSPITALS	556	0.514	0.232

NOTES

PFNP= Private Not for Profit; Gov't=owned by state or local government

[1] low volume was set at the lower 25% point. Few urban hospitals had low volume.

Table 3: Regression Results, Log of Average Cost for Treat and Release (non admitted) ED Visits, 2003

Table 3: Regression Results, Log of Average Cost for Treat and Release (non-admitted) ED Visits, 2003 ***[1]***

	Variable mean	Coefficient	standard error	t	
Log (Area wage index)	-0.075	0.781	0.100	7.70	**
Log (casemix index), based on primary diagnosis category ***[2,3]***	0.012	2.037	0.157	12.90	**
Proportion of cases with selected comorbidities ***[3]***					
Diabetes	0.044	0.405	0.885	0.4	
substance use disorder	0.047	-0.114	0.159	-0.7	
hypertension	0.112	0.491	0.280	1.7	
other lower respiratory disease	0.047	-1.019	0.452	-2.2	*
fever of unknown origin	0.027	1.476	0.548	2.6	**
nausea/vomiting	0.042	-0.870	0.569	-1.5	
abdominal pain	0.029	2.107	0.810	2.6	**
Hospital variables					
Investor-owned hospital	0.158	0.005	0.029	0.1	
government-owned hospital	0.254	-0.005	0.024	-0.1	
Teaching hospital (COTH member)	0.182	0.080	0.032	2.4	**
Log (acute medical and surgical beds)	4.672	-0.018	0.013	-1.40	
Log (admission rate from the ED)	-2.479	0.020	0.010	2.0	*
Mean of dependent variable	5.666				
Adj. R-squared	0.38				
F=24.2, degrees of freedom=531, P<.0001					

NOTES:

[1] In 8 states with detailed charges reported for T&R ED visits: CT, GA, MD, MN, NE, SC, TN, UT. In these states 556 hospitals had usable discharge data and cost reports.

[2] The primary diagnosis is first-listed except in a few cases where the later diagnosis is associated with greater cost of treatment.

[3] The Clinical Classification Software categories are defined at http://www.hcup-us.ahrq.gov/tools_software.jsp.

** $p<.01$ * $p<.05$