Estimate of the Marginal Additional Charge of PPCs in Maryland

Objective: Estimate the marginal hospital charge increase when a patient develops a PPC during a hospital stay (i.e., acquired post admission) in Maryland.

Data Source: Maryland inpatient acute care all payer statewide hospital data from July 2009 through June 2010 containing 759,991 discharges were used as the basis for the estimates. Forth Washington Hospital is excluded from the analysis due to problems with present at admission (POA) codes. Discharges that died or were transferred to another acute care facility were excluded. Discharges from two inpatient rehab hospitals were excluded. Further, discharges with charge values below $200 or above $2,000,000 were excluded. Individual case level charges were standardized based the ratio of the statewide average hospital CPC $12,491.48to the hospital average CPC (CMI of 1.0). The hospital CPC targets used were from the FY2010 CPC Targets, updated in February 2011. The resultant analysis file contained 727,430 discharges.

Method: Since the marginal charge impact of a PPC, will vary depending on a patient's reason for admission and severity of illness at the time of admission, it was necessary to adjust for these factors in order to determine the marginal charges of a PPC. 3M All Patient Refined Diagnosis Related Groups (APR-DRGs) classify discharges to one of 314 reasons for admission and one of four severity of illness levels (1,256 unique patient categories). Each discharge in the analysis database was assigned to an APR DRG v28.0. Since patients who develop a post admission complication often develop multiple associated complications, it was necessary to adjust for the presence of multiple complications in order to determine the marginal charge of an individual PPC. 3M Potentially Preventable Complications (PPCs) v28 identify 64 different types of post admission complications analyzing 1,450 ICD-9-CM diagnosis codes and a select set of procedure codes. All PPCs present on each discharge (potentially preventable or not) were identified and used in the regression analysis.

A simple linear regression was specified of the form:

$$\text{Charge}_i = \alpha + \beta_j \text{PPC}_{j,i} + \gamma_k \text{APR-DRG}_{k,i} + \varepsilon_i$$

Where:

Charge_i is the total charge standardized for discharge i

$\text{APR DRG}_{k,i}$ is a binary variable (0,1) indicating which of the 1,256 APR DRGs was assigned to the i^{th} discharge

$PPC_{j,i}$ is a binary variable (0,1) indicating which of the j PPCs were present for the i^{th} discharge

α is a constant value applied to each discharge in the model. α is the average baseline charge for a reference APR DRG.

γ_k is the coefficient associated with APR-DRG k and measures the marginal additional charge above α that is due to the patient's reason for admission and severity of illness level at the time of admission.

β_j is the coefficient associated with PPC j and measures the marginal additional charge above α that is due to the presence of PPC j

ε_i is the residual error of the model for discharge i

The coefficient β_j for each PPC is a measure of the marginal additional charges due to the occurrence of the PPC taking into account the patient's reason for admission, severity of illness and the presence of any other post admission complications (PPCs).

Cases in low volume APR-DRGs were omitted from the regression (less than 20 cases in each APR-DRG SOI combination). No effort was made to identify and exclude outlier cases.

Results: A regression model was calculated. For each of the PPC categories, coefficients (additional per case charges) and t-values are shown in table 1 below.

The results of the regression are used for computing the dollar impact for each of the 64 PPCs. The dollar impact is used to create an index of either additional, or averted, resource use based on a hospital's rate of a PPC summed across all PPCs. Eleven (11) PPCs with less predictive t-values (under 1.96) were excluded from the quality based payment adjustment PPC policy in FY2009. This list was kept constant for the second year to maintain consistency. Only two of these PPCs had t-value above 1.96 and sufficient number of cases. None of the PPCs included in FY 2009 had non-significant t-values in FY2010. Four additional PPCs are excluded from the program due to clinical and coding problems. Since the charge values in the regression file used standardized charges, the additional per case charge value for each PPC needs to be converted back to a hospital specific value by the ratio of the hospital CPC divided by the statewide average CPC of $12,491.48.

Table 1. PPC charge regression

		FY2010			
PPC #	PPC Description	Adm $	Adm T	Cases	Notes
			T Value<1.96		Exclusion Reason
1	Stroke & Intracranial Hemorrhage	$12,653	40.71	1,005	
2	Extreme CNS Complications	$15,059	35.16	542	
3	Acute Pulmonary Edema and Respiratory Failure without Ventilation	$5,559	40.79	5,824	
4	Acute Pulmonary Edema and Respiratory Failure with Ventilation	$22,105	67.72	949	
5	Pneumonia & Other Lung Infections	$16,847	110.38	4,470	
6	Aspiration Pneumonia	$12,949	55.85	1,853	
7	Pulmonary Embolism	$13,655	34.62	623	
8	Other Pulmonary Complications	$9,112	61.22	4,669	
9	Shock	$14,911	65.51	2,010	
10	Congestive Heart Failure	$4,023	18.56	2,071	
11	Acute Myocardial Infarction	$5,438	19.87	1,280	
12	Cardiac Arrythmias & Conduction Disturbances	$2,069	6.17	1,119	
13	Other Cardiac Complications	$5,127	9.43	316	
14	Ventricular Fibrillation/Cardiac Arrest	$17,928	49.40	747	
15	Peripheral Vascular Complications Except Venous Thrombosis	$16,183	26.85	266	
16	Venous Thrombosis	$12,571	50.01	1,576	
17	Major Gastrointestinal Complications without Transfusion or Significant Bleeding	$12,959	37.16	786	
18	Major Gastrointestinal Complications with Transfusion or Significant Bleeding	$11,954	21.22	298	
19	Major Liver Complications	$14,705	30.89	431	
20	Other Gastrointestinal Complications without Transfusion or Significant Bleeding	$14,523	31.90	458	
21	Clostridium Difficile Colitis	$16,901	64.85	1,420	Clinical/Coding
22	Urinary Tract Infection	$10,104	76.36	5,665	
23	GU Complications Except UTI	$4,125	9.44	496	
24	Renal Failure without Dialysis	$7,873	70.34	8,069	
25	Renal Failure with Dialysis	$34,892	52.74	215	
26	Diabetic Ketoacidosis & Coma	$3,164	2.35	53	
27	Post-Hemorrhagic & Other Acute Anemia with Transfusion	$5,526	19.51	1,191	
28	In-Hospital Trauma and Fractures	$3,553	4.39	148	
29	Poisonings Except from Anesthesia	$1,661	2.31	181	t-value
30	Poisonings due to Anesthesia	-$8,687	-0.90	1	t-value
31	Decubitus Ulcer	$21,968	72.78	1,063	
32	Transfusion Incompatibility Reaction	$22,003	4.57	4	t-value
33	Cellulitis	$4,648	15.86	1,194	
34	Moderate Infectious	$17,957	59.25	1,085	
35	Septicemia & Severe Infections	$16,146	82.11	2,789	
36	Acute Mental Health Changes	$4,343	12.40	766	
37	Post-Operative Infection & Deep Wound Disruption Without Procedure	$16,589	56.54	1,246	
38	Post-Operative Wound Infection & Deep Wound Disruption with Procedure	$21,994	21.58	92	
39	Reopening Surgical Site	$16,595	21.50	160	
40	Post-Operative Hemorrhage & Hematoma without Hemorrhage Control Procedure or I&D P	$7,053	40.82	3,267	
41	Post-Operative Hemorrhage & Hematoma with Hemorrhage Control Procedure or I&D Proc	$17,974	26.04	198	
42	Accidental Puncture/Laceration During Invasive Procedure	$6,070	23.16	1,463	
43	Accidental Cut or Hemorrhage During Other Medical Care	$3,603	3.86	112	
44	Other Surgical Complication - Mod	$17,458	37.62	445	
45	Post-procedure Foreign Bodies	$4,917	2.70	30	t-value
46	Post-Operative Substance Reaction & Non-O.R. Procedure for Foreign Body	-$21,314	-3.03	2	t-value
47	Encephalopathy	$13,304	51.88	1,480	
48	Other Complications of Medical Care	$17,459	48.75	755	
49	Iatrogenic Pneumothrax	$6,173	19.33	963	
50	Mechanical Complication of Device, Implant & Graft	$15,006	36.13	552	
51	Gastrointestinal Ostomy Complications	$23,849	45.67	350	
52	Inflammation & Other Complications of Devices, Implants or Grafts Except Vascular Infect	$8,795	30.49	1,163	
53	Infection, Inflammation & Clotting Complications of Peripheral Vascular Catheters & Infusi	$10,554	21.25	382	
54	Infections due to Central Venous Catheters	$30,766	68.62	495	
55	Obstetrical Hemorrhage without Transfusion	$386	2.85	5,574	Clinical/Coding
56	Obstetrical Hemorrhage wtih Transfusion	$2,271	5.19	508	
57	Obstetric Lacerations & Other Trauma Without Instrumentation	$310	1.11	1,219	t-value
58	Obstetric Lacerations & Other Trauma With Instrumentation	$811	1.84	484	t-value
59	Medical & Anesthesia Obstetric Complications	$210	0.63	865	t-value
60	Major Puerperal Infection and Other Major Obstetric Complications	$116	0.20	289	t-value
61	Other Complications of Obstetrical Surgical & Perineal Wounds	-$364	-0.5	182	t-value
62	Delivery with Placental Complications	$907	1.47	248	t-value
63	Post-Operative Respiratory Failure with Tracheostomy	$110,834	97.21	75	Clinical/Coding
64	Other In-Hospital Adverse Events	$3,578	9.79	725	Clinical/Coding

Note: Shaded PPCs are excluded