

## **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 2008 through June 2009 containing 772,522 discharges were used as the basis for the estimates. In Maryland hospitals are required to specify whether each reported diagnosis was present at admission (POA). Since the requirement to report the POA status of each diagnosis is a new requirement, hospitals with poor quality of the reporting of the POA status were excluded from the analysis. 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 \$10,460.46 to the hospital average CPC (CMI of 1.0). The hospital CPC targets used were from the FY2009 CPC Target December update file. The resultant analysis file contained 738,417 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 v27.0. 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) v27 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<sub>i</sub> is the total charge standardized for discharge i

APR DRG<sub>k,i</sub> is a binary variable (0,1) indicating which of the 1,256 APR DRGs was assigned to the i<sup>th</sup> discharge

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

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

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

$\beta_j$  is the coefficient associated with PPC  $j$  and measures the marginal additional charge above  $\alpha$  that is due to the presence of PPC  $j$

$\epsilon_i$  is the residual error of the model for discharge  $i$

The coefficient  $\beta_j$  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. Further, cases in APR-DRG cells that had significance ( $t$ ) values below 95% were also omitted from the regression since their coefficients are indicative of too wide a dispersion of values. 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. 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 \$10,460.46.

**Table 1. PPC charge regression**

FY2009					
PPC #	PPC Description	Additional Charge Amt	T-Stat T Value<1.96	Cases	Notes
1	Stroke & Intracranial Hemorrhage	\$11,882	38.833	1,036	
2	Extreme CNS Complications	\$13,656	35.862	703	
3	Acute Pulmonary Edema and Respiratory Failure without Ventilation	\$5,318	40.516	6,274	
4	Acute Pulmonary Edema and Respiratory Failure with Ventilation	\$23,062	70.322	940	
5	Pneumonia & Other Lung Infections	\$14,895	103.678	5,072	
6	Aspiration Pneumonia	\$11,181	49.681	1,953	
7	Pulmonary Embolism	\$12,165	33.225	723	
8	Other Pulmonary Complications	\$8,306	58.814	5,177	
9	Shock	\$17,634	78.155	2,038	
10	Congestive Heart Failure	\$3,274	16.403	2,442	
11	Acute Myocardial Infarction	\$4,983	19.794	1,519	
12	Cardiac Arrhythmias & Conduction Disturbances	\$1,878	5.896	1,258	
13	Other Cardiac Complications	\$1,923	3.946	397	
14	Ventricular Fibrillation/Cardiac Arrest	\$16,433	49.759	908	
15	Peripheral Vascular Complications Except Venous Thrombosis	\$9,894	18.362	329	
16	Venous Thrombosis	\$12,347	53.913	1,908	
17	Major Gastrointestinal Complications without Transfusion or Significant Bleeding	\$12,441	40.849	1,048	
18	Major Gastrointestinal Complications with Transfusion or Significant Bleeding	\$7,825	13.414	283	
19	Major Liver Complications	\$11,376	23.977	425	
20	Other Gastrointestinal Complications without Transfusion or Significant Bleeding	\$14,810	33.669	494	
21	Clostridium Difficile Colitis	\$16,487	65.684	1,538	Removed from List
22	Urinary Tract Infection	\$8,038	69.198	7,416	
23	GU Complications Except UTI	\$3,703	9.341	605	
24	Renal Failure without Dialysis	\$7,451	68.206	8,576	
25	Renal Failure with Dialysis	\$28,656	44.086	227	
26	Diabetic Ketoacidosis & Coma	\$9,834	7.596	56	
27	Post-Hemorrhagic & Other Acute Anemia with Transfusion	\$4,868	18.866	1,447	
28	In-Hospital Trauma and Fractures	\$10,893	14.419	168	
29	Poisonings Except from Anesthesia	\$1,138	1.729	217	
30	Poisonings due to Anesthesia	\$1,513	0.221	2	
31	Decubitus Ulcer	\$17,951	66.239	1,312	
32	Transfusion Incompatibility Reaction	\$1,837	0.462	6	
33	Cellulitis	\$4,474	16.937	1,464	
34	Moderate Infectious	\$13,849	50.688	1,317	
35	Septicemia & Severe Infections	\$16,731	97.373	3,659	
36	Acute Mental Health Changes	\$4,865	6.888	188	
37	Post-Operative Infection & Deep Wound Disruption Without Procedure	\$14,422	51.657	1,380	
38	Post-Operative Wound Infection & Deep Wound Disruption with Procedure	\$19,361	21.383	118	
39	Reopening Surgical Site	\$22,119	23.817	110	
40	Post-Operative Hemorrhage & Hematoma without Hemorrhage Control Procedure or I&D Pr	\$5,952	37.602	3,921	
41	Post-Operative Hemorrhage & Hematoma with Hemorrhage Control Procedure or I&D Proc	\$10,856	16.399	217	
42	Accidental Puncture/Laceration During Invasive Procedure	\$4,212	17.902	1,823	
43	Accidental Cut or Hemorrhage During Other Medical Care	\$8,289	9.453	126	
44	Other Surgical Complication - Mod	\$10,713	25.230	527	
45	Post-procedure Foreign Bodies	\$2,006	1.251	37	
46	Post-Operative Substance Reaction & Non-O.R. Procedure for Foreign Body	\$2,401	0.348	2	
47	Encephalopathy	\$10,566	42.272	1,567	
48	Other Complications of Medical Care	\$18,945	55.243	822	
49	Iatrogenic Pneumothrax	\$6,093	19.151	977	
50	Mechanical Complication of Device, Implant & Graft	\$14,829	38.850	650	
51	Gastrointestinal Ostomy Complications	\$25,138	49.828	374	
52	Inflammation & Other Complications of Devices, Implants or Grafts Except Vascular Infection	\$9,024	34.041	1,380	
53	Infection, Inflammation & Clotting Complications of Peripheral Vascular Catheters & Infusion	\$13,959	32.610	525	
54	Infections due to Central Venous Catheters	\$27,198	65.162	569	
55	Obstetrical Hemorrhage without Transfusion	\$318	2.144	4,643	Removed from List
56	Obstetrical Hemorrhage with Transfusion	\$2,137	4.787	489	
57	Obstetric Lacerations & Other Trauma Without Instrumentation	\$432	1.653	1,410	
58	Obstetric Lacerations & Other Trauma With Instrumentation	\$610	1.465	546	
59	Medical & Anesthesia Obstetric Complications	\$647	1.813	757	
60	Major Puerperal Infection and Other Major Obstetric Complications	\$145	0.268	325	
61	Other Complications of Obstetrical Surgical & Perineal Wounds	-\$207	-0.302	202	
62	Delivery with Placental Complications	\$627	1.009	246	
63	Post-Operative Respiratory Failure with Tracheostomy	\$107,665	90.451	68	Removed from List
64	Other In-Hospital Adverse Events	\$2,544	8.266	952	Removed from List