

**Appendices for “Trends in High-Intensity Billing for Emergency Care Accompanied by an Increase in Services Provided in the Emergency Department”**

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**Appendix 1. Proportion of Outpatient Emergency Department Visits Billed as High-Intensity Visits\* by Diagnosis Category<sup>†</sup>**

		2006	2009	2012	Absolute Change, % (95% CI)
1	Minor injuries	8.5%	14.4%	20.5%	12.2 (11.6 to 12.9)
2	Major injuries	34.0%	42.3%	51.7%	17.7 (14.8 to 20.6)
3	Other injuries	7.3%	12.3%	18.9%	12.0 (11.5 to 12.5)
4	Symptoms: abdominal pain	31.3%	44.0%	52.4%	21.0 (20.1 to 22.0)
5	Symptoms: chest pain	65.2%	77.5%	82.4%	17.2 (16.4 to 17.9)
6	Symptoms: dizziness, vertigo, and syncope	42.9%	57.3%	66.1%	23.0 (22.1 to 23.8)
7	Symptoms: headache	21.7%	30.5%	39.7%	17.9 (16.3 to 19.5)
8	Other symptoms	25.3%	35.7%	44.1%	18.8 (17.9 to 19.7)
9	Upper respiratory infections	12.8%	20.5%	27.6%	14.7 (13.5 to 15.9)
10	Intestinal infections	28.1%	40.1%	53.3%	25.2 (20.8 to 29.6)
11	Urinary tract infection	18.4%	27.3%	34.1%	15.9 (15.0 to 16.9)
12	Other infectious and parasitic diseases	12.6%	20.4%	23.6%	11.0 (9.1 to 12.9)
13	Skin and subcutaneous infection	5.9%	10.0%	13.6%	7.8 (6.4 to 9.3)
14	Endocrine, nutritional; immunity and metabolic disorders	29.0%	38.7%	45.8%	16.8 (15.6 to 18.0)
15	Diabetes mellitus	25.3%	33.5%	40.5%	15.0 (13.3 to 16.6)
16	Hypertension	24.4%	35.1%	41.4%	16.9 (15.6 to 18.3)
17	Nonatherosclerotic heart disease	61.2%	71.3%	78.3%	17.0 (14.6 to 19.4)
18	Dysrhythmias	52.7%	65.4%	72.4%	19.6 (18.4 to 20.9)
19	Ischemic heart disease	75.8%	82.6%	86.7%	11.0 (9.0 to 12.9)
20	Congestive heart failure	57.2%	68.7%	75.8%	18.3 (16.5 to 20.1)
21	Circulatory disorders	25.0%	35.6%	40.8%	15.8 (14.2 to 17.4)
22	Cerebrovascular disease	63.4%	74.5%	80.5%	16.8 (15.0 to 18.5)
23	Diseases of the blood	32.3%	43.7%	50.1%	17.7 (15.2 to 20.3)
24	Neoplasms	32.9%	47.1%	49.0%	16.0 (12.7 to 19.4)
25	Mental illness	27.1%	36.5%	43.9%	16.8 (15.5 to 18.1)
26	Nervous system disorders	23.5%	31.4%	36.0%	12.4 (11.4 to 13.5)
27	Pneumonia	36.6%	52.0%	57.6%	20.9 (19.1 to 22.6)
28	Other respiratory disease	27.3%	35.6%	42.4%	15.1 (14.2 to 16.0)
29	Chronic obstructive pulmonary disease	31.6%	43.0%	52.4%	20.6 (19.5 to 21.8)
30	Asthma	28.5%	38.8%	48.3%	19.5 (16.9 to 22.1)
31	Noninfectious lung disease	44.0%	60.2%	62.9%	18.8 (15.0 to 22.7)
32	GI system diseases	21.7%	32.2%	38.4%	16.7 (16.0 to 17.4)
33	Other renal and GU diseases	11.5%	18.3%	24.1%	12.6 (11.6 to 13.6)
34	End-stage renal disease	7.1%	10.1%	25.4%	17.8 (-3.2 to 38.9)
35	Chronic renal disease	47.4%	61.9%	66.1%	18.6 (14.3 to 23.0)
37	Diseases of the musculoskeletal system, skin, and connective tissue	10.3%	16.0%	21.4%	11.1 (10.5 to 11.7)
38	Complications and adverse events	10.5%	15.0%	18.3%	7.8 (6.4 to 9.3)
39	Other residual codes	21.2%	33.7%	36.1%	14.9 (13.8 to 16.1)

\* Proportions of high-intensity visits are estimated using logistic regression adjusted for patient age, sex, Medicaid eligibility and race. The absolute change is estimated using linear regression.

† Categories defined by Gabayan, G.Z., et al *Annals of emergency medicine* 2011;58(6):551-58 e2). Category 36, pregnancy and childbirth related disorders, is omitted as it is not applicable to the elderly, Medicare population.

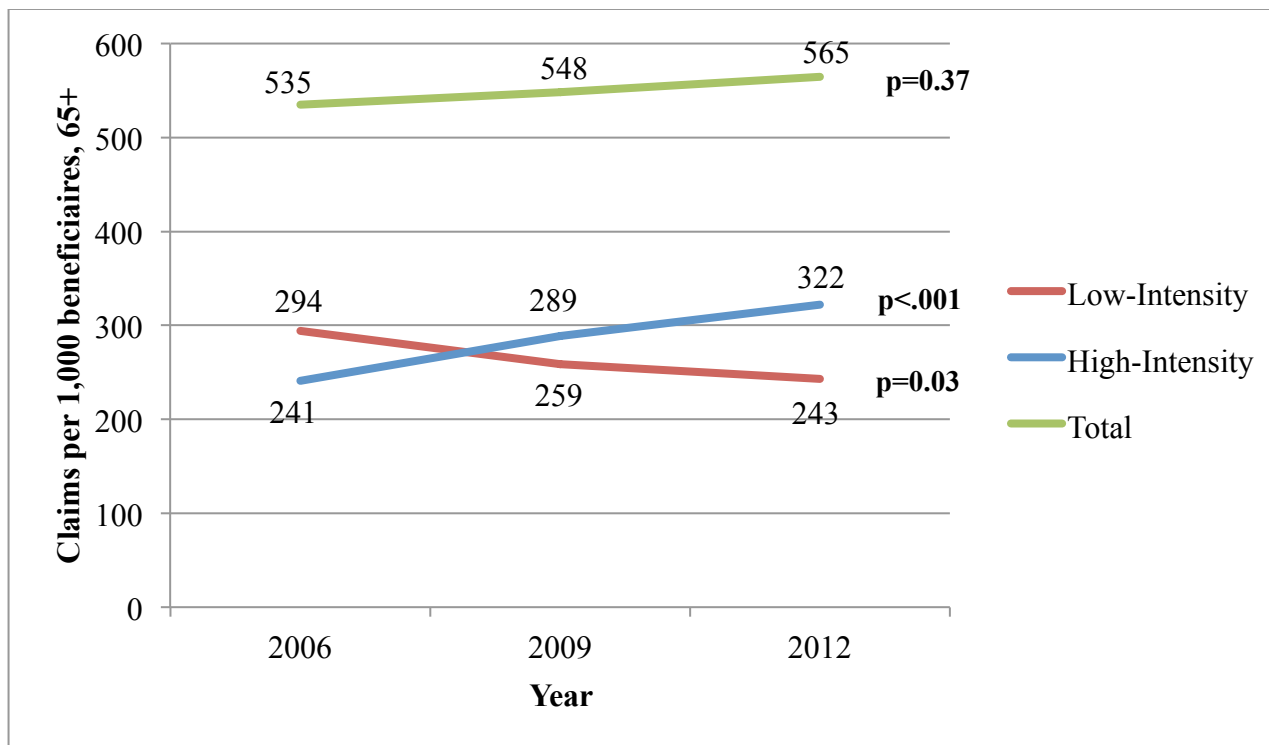
**Appendix 2. Trends\* in Billing for High-Intensity Emergency Care**

		2006	2009	2012	Trend, % change per year (95% CI)	P-Value
<b>Proportion of ED Visits by Intensity Level CPT Code‡</b>	99281	0.60%	0.40%	0.40%	-0.03 (-0.04 to -0.03)	<.001
	99282	3.70%	2.60%	2.00%	-0.30 (-0.31 to -0.29)	<.001
	99283	22.20%	17.50%	14.80%	-1.25 (-1.27 to -1.22)	<.001
	99284	27.10%	25.60%	24.70%	-0.42 (-0.45 to -0.40)	<.001
	99285	39.70%	45.90%	49.40%	+1.60 (1.57 to 1.63)	<.001
	99291	5.00%	6.60%	7.60%	+0.40 (0.39 to 0.41)	<.001
	99292	0.70%	0.80%	0.70%	+0.004 (-0.0003 to 0.009)	.07

\* Longitudinal linear regression models were used to estimate the time trends, adjusting for patient age, race, sex, and Medicaid coverage. The yearly estimates were based on binomial regression using generalized estimating equations to adjust for clustering at the level of the emergency department.

‡Current Procedural Terminology Healthcare Common Procedure Coding System codes 99281-99285 denote increasing levels of intensity of emergency physician evaluation and management. Codes 99291 and 99292 indicate critical care services were provided.

**Appendix 3. Unadjusted Rate of Emergency Department Visits per 1,000 Medicare\* Beneficiaries Overall and Stratified by Intensity**



\*Traditional Medicare beneficiaries age 65 and over with continuous coverage during the year.

**Appendix 4. Trends\* in the Most Common Services† among Admitted Patients**

Service	2006 (%)‡	2009 (%)	2012 (%)	Absolute Change/Year, % (95% CI)§
Blood transfusion	12.4	14.3	15.4	+0.52 (0.48 to 0.56)
Diagnostic cardiac catheterization	10.4	9.3	9.7	-0.11 (-0.16 to -0.06)
Respiratory intubation and mechanical ventilation	9.9	11.1	12.6	+0.45 (0.41 to 0.49)
Other vascular catheterization; not heart	7.6	8.9	10.0	+0.41 (0.38 to 0.44)
Upper gastrointestinal endoscopy; biopsy	6.5	6.1	5.9	-0.11 (-0.13 to -0.08)
Other therapeutic procedures	5.8	5.7	7.1	+0.21 (0.18 to 0.24)
Other OR procedures on vessels other than head and neck	4.7	4.7	6.2	+0.24 (0.21 to 0.27)
Hemodialysis	5.9	6.3	6.5	+0.10 (0.08 to 0.12)
Colonoscopy and biopsy	3.2	2.8	2.6	-0.11(-0.13 to -0.10)
Diagnostic ultrasound of heart (echocardiogram)	2.9	3.4	4.0	+0.17 (0.16 to 0.19)

\* Longitudinal linear regression models were used to estimate the time trends, adjusting for patient age, race, sex, and Medicaid coverage. The adjusted yearly estimates were based on binomial regression, using generalized estimating equations.

† Most common services among patients admitted from the ED occurring in the ED or during an inpatient stay. Services were defined by ICD9 procedure codes and categorized using the Clinical Classifications Software for Services and Procedures software.

‡ Percentage of all admissions including the service.

§ All changes were statistically significant at p<.001

**Appendix 5. Trends\* in the Most Common Services† among Patients Discharged from the ED**

Service	2006	2009	2012	Trend, %† (95% CI)	P-Value
Laboratory-chemistry and hematology	3.35	3.68	3.85	0.083 (0.080 to 0.086)	<.001
Medications	0.60	0.42	0.56	-0.007 (-0.008 to -0.007)	<.001
Other therapeutic procedures	0.48	0.97	1.06	0.096 (0.095 to 0.097)	<.001
Microscopic examination (bacterial smear, culture, toxicology)	0.49	0.58	0.63	0.023 (0.023 to 0.024)	<.001
Electrocardiogram (ECG)	0.38	0.38	0.39	0.001 (0.000 to 0.0001)	.003
Other diagnostic radiology and related techniques	0.34	0.32	0.30	-0.007 (-0.007 to -0.006)	<.001
Routine chest X-ray	0.37	0.37	0.38	0.002 (0.002 to 0.003)	<.001
Other laboratory	0.17	0.19	0.22	0.008 (0.007 to 0.008)	<.001
Computerized axial tomography (CT) scan of the head	0.14	0.17	0.18	0.006 (0.006 to 0.007)	<.001
Durable Medical Equipment and supplies	0.10	0.18	0.26	0.026 (0.026 to 0.027)	<.001

\* Services were defined by the Current Procedural Terminology (CPT) Healthcare Common Procedure Coding System codes (HCPCS) and categorized using the Clinical Classifications Software for Services and Procedures software.

† Longitudinal linear regression models were used to estimate the time trends, adjusting for patient age, race, sex, and Medicaid coverage. The adjusted yearly estimates were based on negative binomial regression using generalized estimating equations.

**Appendix 6. Ten Most Frequent Physician Services\* by Year for Emergency Department Visits**

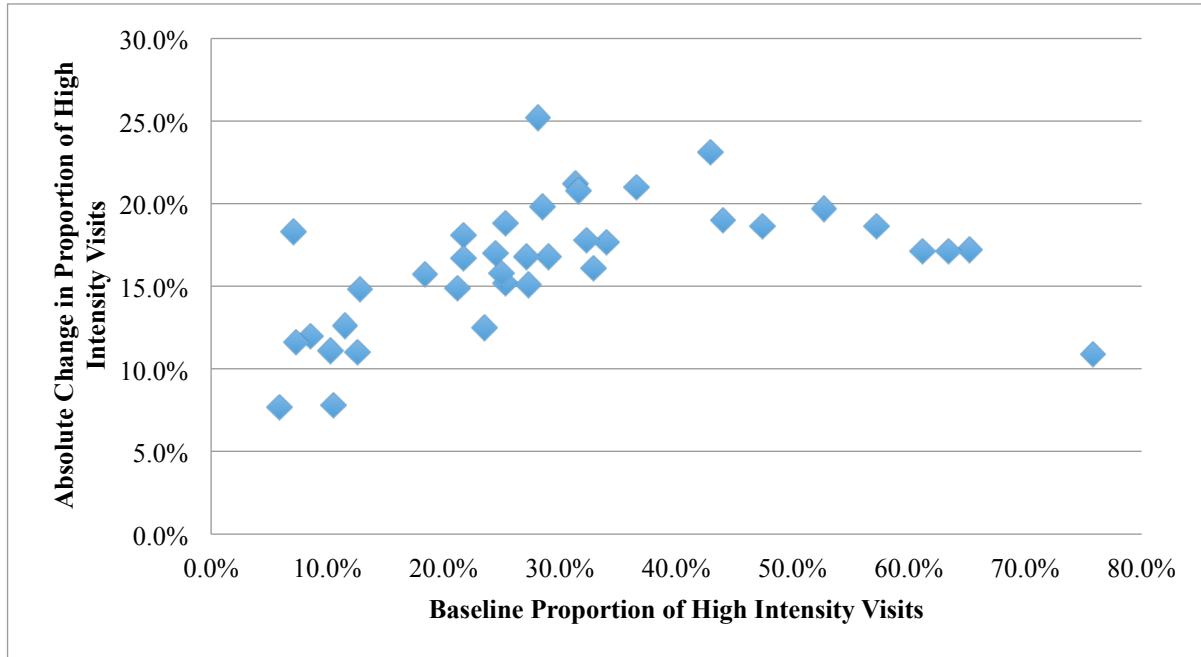
	2006		2009		2012	
	Service	%†	Service	%	Service	%
<i>1</i>	Electrocardiogram	63.5%	Electrocardiogram	64.4%	Electrocardiogram	67.4%
<i>2</i>	Suture of skin and subcutaneous tissue	8.3%	Suture of skin and subcutaneous tissue	8.2%	Suture of skin and subcutaneous tissue	7.4%
<i>3</i>	Other therapeutic procedures	6.1%	Routine chest X-ray	4.1%	Routine chest X-ray	3.2%
<i>4</i>	Routine chest X-ray	3.7%	Laboratory - Chemistry and Hematology	3.3%	Laboratory - Chemistry and Hematology	3.1%
<i>5</i>	Other diagnostic radiology and related techniques	2.2%	Other diagnostic radiology and related techniques	2.2%	Other diagnostic radiology and related techniques	1.7%
<i>6</i>	Laboratory - Chemistry and Hematology	1.7%	Other therapeutic procedures	1.8%	Traction, splints, and other wound care	1.6%
<i>7</i>	Control of epistaxis	1.7%	Control of epistaxis	1.6%	Other OR therapeutic procedures on nose, mouth and pharynx	1.6%
<i>8</i>	Traction, splints, and other wound care	1.6%	Traction, splints, and other wound care	1.6%	Control of epistaxis	1.4%
<i>9</i>	Respiratory intubation and mechanical ventilation	1.5%	Respiratory intubation and mechanical ventilation	1.5%	Other therapeutic procedures	1.4%
<i>10</i>	Other vascular catheterization, not heart	1.1%	Other fracture and dislocation procedure	1.3%	Other fracture and dislocation procedure	1.4%

\* Services were defined by the Current Procedural Terminology (CPT) Healthcare Common Procedure Coding System codes (HCPCS) and categorized using the Clinical Classifications Software for Services and Procedures software. Codes for emergency physician evaluation and management codes (99281-99285, 99291, 99292) were excluded.

†Percentage of all physician services in the sample.



**Appendix 7.** Absolute Change\* in Proportion of High-Intensity Visits versus Baseline Proportion of High-Intensity Visits by Diagnosis Category\* for Outpatient Emergency Department Visits†



\*Longitudinal linear regression models were used to estimate the time trends, adjusting for patient age, race, sex, and Medicaid coverage. †Thirty-nine diagnosis categories previously defined in the emergency medicine literature (Gabayan, G.Z., et al *Annals of emergency medicine* 2011;58(6):551-58 e2)‡Proportion of high-intensity visits is adjusted for patient age, sex and Medicaid eligibility.

**Appendix 8.** Comparison of Observed versus Expected Number of High-Intensity Visits\* in 2006 Using Multivariable Modeling

	<i>Observed High-Intensity Visits 2006</i>	<b>Using 2009 Regression Coefficients†</b>		<b>Using 2012 Regression Coefficients</b>	
		<i>Predicted High-Intensity‡</i>	<i>Observed - Expected (%)</i>	<i>Predicted High-Intensity</i>	<i>Observed - Expected (%)</i>
<b>Inpatient (N=261,239)</b>	203,344	228,163	-24,819	238,848	-35,504
<b>Outpatient (N=409,864)</b>	98,801	99,902	-1,101	115,706	-16,905

\* High-intensity visits were defined as visits with an emergency physician professional claim for evaluation and management codes 99285, 99291, and 99292.

† Generalized logistic regression models that accounted for clustering at the level of the ED were run separately for emergency department (ED) visits in 2009 and 2012 incorporating patient age, sex, Medicaid eligibility, race, chronic conditions (Hierarchical Condition Categories). The model also incorporated the number of services billed for the associated facility and physician professional claims (excluding evaluation and management services). Models were run separately for inpatient and outpatient ED visits.

‡ The coefficients for each variable in the regression model were applied to the 2006 data to obtain an expected number of high-intensity visits.

§ The difference between the observed and predicted number of high-intensity visits represents the degree to which high-intensity billing has changed in ways that cannot be explained by the variables in our model.