## **Supplementary Online Content**

Marin JR, Rodean J, Hall M, et al. Trends in Use of Advanced Imaging in Pediatric Emergency Departments, 2009-2018. *JAMA Pediatr.* Published online August 3, 2020. doi:10.1001/jamapediatrics.2020.2209

eTable 1. Proportions of Encounters With Advanced Imaging by Disposition

**eTable 2.** Multivariable Model of Factors Associated With Emergency Department Advanced Imaging Studies

**eTable 3.** Frequency of Advanced Imaging, Admission, and Proportions of Total ED Visits for the 8 APR-DRGs

eTable 4. Ten Most Frequent ICD-9 and ICD-10 Codes as Principal Diagnosis for the 8 APR-DRGs

**eTable 5.** Multivariable Model of Factors Associated With Secondary Outcome Measures for the 8 APR-DRGs

**eFigure 1.** Hospital-Specific Changes in CT Imaging Overall and for Each of the 8 APR-DRGs Comparing 2009-2013 to 2014-2018

eFigure 2. Trends in Secondary Outcome Measures 2009-2018 for the 8 DRGs

This supplementary material has been provided by the authors to give readers additional information about their work.

		ED visi	its		СТ			US			MRI			y adva imagin	
	2009 % total	2018 % total	% change	2009 %	2018 %	% change									
Total (n = 26,082,062)				3.9	2.9	-1.0	2.5	5.8	3.3	0.3	0.6	0.3	6.4	8.7	2.3
Discharged (n = 23,236,597)	89.1	88.9	-0.2	2.7	2.0	-0.8	1.5	4.5	2.9	0.1	0.3	0.2	4.3	6.4	2.2
Admitted (n = 2,845,465)	10.9	11.1	0.2	13.2	10.4	-2.8	10.7	16.9	6.2	2.6	3.6	1.0	24.0	27.0	3.1

eTable 1. Proportions of Encounters with Advanced Imaging by Disposition

© 2020 American Medical Association. All rights reserved.

	Any advanced imaging (aOR)	CT (aOR)	US (aOR)	MRI (aOR)	
Age in years					
<1	Ref	Ref	Ref	Ref	
1-4	0.63 (0.63, 0.64)	1.06 (1.05, 1.07)	0.60 (0.60, 0.60)	1.17 (1.14, 1.20)	
5-12	1.23 (1.23, 1.24)	1.96 (1.95, 1.98)	1.15 (1.15, 1.16)	2.47 (2.43, 2.52)	
13-17	2.11 (2.10, 2.12)	3.19 (3.17, 3.22)	1.77 (1.76, 1.78)	3.77 (3.69, 3.85)	
Sex, male	1.08 (1.08, 1.08)	1.17 (1.17, 1.18)	0.98 (0.98, 0.98)	0.96 (0.95, 0.97)	
Race/Ethnicity					
Non-Hispanic White	Ref	Ref	Ref	Ref	
Non-Hispanic Black	0.50 (0.50, 0.51)	0.63 (0.63, 0.64)	0.55 (0.54, 0.55)	0.61 (0.60, 0.62)	
Hispanic	0.73 (0.73, 0.73)	0.75 (0.75, 0.76)	0.87 (0.87, 0.88)	0.69 (0.67, 0.70)	
Other	0.78 (0.77, 0.78)	0.83 (0.82, 0.84)	0.84 (0.84, 0.85)	0.85 (0.83, 0.87)	
Complex chronic condition(s)	3.20 (3.19, 3.21)	1.63 (1.62, 1.64)	1.19 (1.18, 1.20)	2.20 (2.17, 2.23)	
Insurance					
Public	Ref	Ref	Ref	Ref	
Private	1.36 (1.35, 1.36)	1.27 (1.26, 1.27)	1.26 (1.25, 1.27)	1.26 (1.24, 1.28)	
Other	0.97 (0.96, 0.98)	1.08 (1.07, 1.1)	0.99 (0.98, 0.99)	1.06 (1.03, 1.09)	
Disposition					
Discharged	Ref	Ref	Ref	Ref	
Inpatient admission	4.98 (4.97, 5.00)	4.34 (4.32, 4.36)	4.47 (4.45, 4.49)	13.75 (13.60, 13.93)	
Transferred	0.71 (0.69, 0.73)	0.97 (0.94, 1.00)	0.57 (0.55, 0.59)	0.81 (0.72, 0.91)	
Died	0.97 (0.84, 1.12)	1.52 (1.28, 1.8)	0.56 (0.43, 0.72)	0.17 (0.02, 1.12)	
Other	0.71 (0.70, 0.72)	0.72 (0.7, 0.73)	0.74 (0.73, 0.75)	1.25(1.18, 1.33)	

## eTable 2. Multivariable Model of Factors Associated with Emergency Department Advanced Imaging Studies

© 2020 American Medical Association. All rights reserved.

Census region					
Midwest	0.89 (0.88, 0.91)	0.75 (0.55, 1.02)	1.14 (1.11, 1.16)	0.85 (0.54, 1.36)	
Northeast	0.98 (0.97, 0.99)	0.78 (0.51, 1.19)	1.64 (1.60, 1.67)	1.43 (0.76, 2.69)	
South	1.16 (1.14, 1.17)	1.19 (0.89, 1.57)	1.71 (1.68, 1.74)	1.03 (0.68, 1.57)	
West	Ref	Ref	Ref	Ref	
Pre-2014 Year	1.01 (1.01, 1.01)	0.917 (0.915, 0.919)	1.102 (1.100, 1.104)	1.057 (1.052, 1.061)	
Post-2014 Year	1.06 (1.06, 1.06)	1.005 (1.003, 1.007)	1.085 (1.083, 1.087)	1.058 (1.053, 1.063)	

aOR= adjusted odds ratio

© 2020 American Medical Association. All rights reserved.

**eTable 3**. Frequency of Advanced Imaging, Admission, and Proportions of Total ED Visits for the 8 APR-DRGs

		ED vis	its		Admitte	ed		СТ			US			MRI	
APR-DRG	2009 % total	2018 % total	% change	2009 %	2018 %	% change									
Abdominal pain (n = 663,925)	2.1	2.7	0.7	5.9	3.8	-2.2	11.1	5.0	-6.1	19.0	39.2	20.3	0.0	0.6	0.6
Appendectomy (n = 104,787)	0.4	0.4	0.0	99.5	97.2	-2.3	28.4	13.5	-14.9	32.9	75.4	42.5	0.0	1.4	1.4
Concussion, closed skull fracture, uncomplicated intracranial injury, coma <1h or no coma (n = 191,044)	0.5	0.7	0.2	20.1	10.5	-9.6	58.3	35.3	-23.0	0.2	0.7	0.5	0.7	1.2	0.5
Migraine & other headaches (n = 367,863)	1.2	1.4	0.3	7.6	8.1	0.4	27.0	14.7	-12.4	0.6	1.8	1.2	2.9	5.5	2.6
Other disorders of nervous system (n = 88,095)	0.3	0.4	0.1	26.5	25.6	-0.8	22.5	12.4	-10.1	2.3	4.8	2.5	8.6	11.4	2.8
Other ear, nose, mouth, throat & cranial/facial diagnoses (n = 1,055,095)	3.9	3.9	0.0	2.5	2.0	-0.5	13.3	7.4	-5.9	0.3	2.0	1.7	0.1	0.3	0.1
Seizure (n = 368,515)	1.5	1.4	-0.1	27.1	29.5	2.4	16.5	11.3	-5.3	0.7	1.7	1.0	3.1	3.8	0.7
Ventricular shunt procedures (n = 14,765)	0.1	0.0	0.0	99.6	100.0	0.4	77.8	64.5	-13.3	8.7	13.5	4.8	9.9	27.8	17.9

## eTable 4. Ten Most Frequent ICD-9 and ICD-10 Codes as Principal Diagnosis for the 8 APR-DRGs

APR-DRG	Principal diagnosis code (ICD9 or ICD10)	Description	Count
Abdominal	78900	Abdominal pain, unspecified site	214429
Pain	R109	Unspecified abdominal pain	78805
	78909	Abdominal pain, other specified site	55448
	78903	Abdominal pain, right lower quadrant	44349
	R1031	Right lower quadrant pain	36676
	R1084	Generalized abdominal pain	36511
	78906	Abdominal pain, epigastric	25800

78905 R1013 R1033 78907 78904 R1032 78901	Abdominal pain, periumbilicEpigastric painPeriumbilical painAbdominal pain, generalizedAbdominal pain, left lower quadrantLeft lower quadrant pain	23380 22482 21494 20755
R1033 78907 78904 R1032	Periumbilical painAbdominal pain, generalizedAbdominal pain, left lower quadrant	21494 20755
78907 78904 R1032	Abdominal pain, generalized Abdominal pain, left lower quadrant	20755
78904 R1032	Abdominal pain, left lower quadrant	
R1032		13005
	l Left lower quadrant bain	11115
	Abdominal pain, right upper quadrant	10988
R1030	Lower abdominal pain, unspecified	9722
R1011	Right upper quadrant pain	8616
7897	Colic	7986
		6501
	• • • •	5418
	· · · · ·	4149
5409	Acute appendicitis without mention of peritonitis	44307
K3580	Unspecified acute appendicitis	18489
5400	Acute appendicitis with generalized peritonitis	15825
K352	Acute appendicitis with generalized peritonitis	
K353	Acute appendicitis with localized peritonitis	6727
5401	Acute appendicitis with peritoneal abscess	
541		
K3589		
K3532	Acute appendicitis with localized peritonitis,	
K37	Unspecified appendicitis	437
78903	Abdominal pain, right lower quadrant	314
K3533	Acute appendicitis with perforation and localized peritonitis, with abscess.	268
5439	Other and unspecified diseases of appendix	252
K3530	Acute appendicitis with localized peritonitis, without perforation or gangrene.	248
542		159
K3520	Acute appendicitis with generalized	129
2892		125
		114
		62
56081	Intestinal or peritoneal adhesions with	54
	obstruction (postoperative) (postinfection)	
	78902     R1012     R1083     5409     K3580     5400     K352     K353     5401     541     K3589     K3532     K37     78903     K3530     5439     K3530     542     K3520     2892     K36     78900	78902Abdominal pain, left upper quadrantR1012Left upper quadrant painR1083Colic5409Acute appendicitis without mention of peritonitisK3580Unspecified acute appendicitis5400Acute appendicitis with generalized peritonitisK352Acute appendicitis with generalized peritonitisK353Acute appendicitis with peritoneal abscess541Appendicitis, unqualifiedK3589Other acute appendicitisK353Acute appendicitis with localized peritonitisK353Acute appendicitis with peritoneal abscess541Appendicitis, unqualifiedK3532Acute appendicitis with localized peritonitis, without perforation or gangreneK37Unspecified appendicitisK3533Acute appendicitis with perforation and localized peritonitis, with abscess.5439Other and unspecified diseases of appendixK3530Acute appendicitis with localized peritonitis, without perforation or gangrene.542Other appendicitis with generalized peritonitis, without abscess5439Other and unspecified diseases of appendixK3520Acute appendicitis with generalized peritonitis, without abscess2892Nonspecific mesenteric lymphadenitisK36Other appendicitis

Concussion,	8500	Concussion with no loss of consciousness	61326
closed skull fx,	S060X0A	Concussion without loss of consciousness,	45827
uncomp IC		initial encounter	
injury, coma	8509	Concussion, unspecified	18170
<1 hr or no	85011	Concussion, with loss of consciousness of 30	14997
coma		minutes or less	
	80001	Closed fracture of vault of skull without	6728
		mention of intracranial injury, with no loss of	
		consciousness	
	S060X1A	Concussion with loss of consciousness of 30	6548
		minutes or less, initial encounter	
	8505	Concussion with loss of consciousness of	6535
		unspecified duration	
	S060X9A	Concussion with loss of consciousness of	6190
		unspecified duration, initial encounter	
	S020XXA	Fracture of vault of skull, initial encounter for	4819
		closed fracture	
	80101	Closed fracture of base of skull without	4417
		mention of intracranial injury, with no loss of	
		consciousness	
	S069X1A	Unspecified intracranial injury with loss of	1705
		consciousness of 30 minutes or less, initial	
		encounter	
	S069X9A	Unspecified intracranial injury with loss of	1463
		consciousness of unspecified duration, initial	
		encounter	
	S0219XA	Other fracture of base of skull, initial	1177
		encounter for closed fracture	
	S02119A	Unspecified fracture of occiput, initial	1153
		encounter for closed fracture	
	80000	Closed fracture of vault of skull without	1103
		mention of intracranial injury, with state of	
		consciousness unspecified	
	80301	Other closed skull fracture without mention	1051
		of intracranial injury, with no loss of	
		consciousness	
	85401	Intracranial injury of other and unspecified	1016
		nature, without mention of open intracranial	
		wound, with no loss of consciousness	
	80300	Other closed skull fracture without mention	988
		of intracranial injury, with state of	
		consciousness unspecified	

	S069X0A	Unspecified intracranial injury without loss of consciousness, initial encounter	715		
	S0291XA	Unspecified fracture of skull, initial encounter for closed fracture	538		
Migraine &	7840	Headache	153853		
other	R51		77412		
headaches	34690	Headache 77   Migraine, unspecified, without mention of 47			
includency	54090	intractable migraine without mention of status migrainosus	47240		
	G43909	Migraine, unspecified, not intractable, without status migrainosus	20178		
	3102	Postconcussion syndrome	7452		
	G43009	Migraine without aura, not intractable, without status migrainosus	5110		
	G43A0	Cyclical vomiting, not intractable	4553		
	34692				
	G43901	Migraine, unspecified, not intractable, with status migrainosus	3317		
	F0781	Postconcussional syndrome	3138		
	G43109	Migraine with aura, not intractable, without status migrainosus	3006		
	G44209	Tension-type headache, unspecified, not intractable	2994		
	34600	Migraine with aura, without mention of intractable migraine without mention of status migrainosus	2465		
	30781	Tension headache	2294		
	G43809	Other migraine, not intractable, without status migrainosus	2110		
	G43001	Migraine without aura, not intractable, with status migrainosus	2047		
	34680 Other forms of migraine, without mention intractable migraine without mention of status migrainosus		1752		
	34620	Variants of migraine, not elsewhere classified, without mention of intractable migraine without mention of status migrainosus	1489		
	3490	Reaction to spinal or lumbar puncture	1480		

	34610	Migraine without aura, without mention of intractable migraine without mention of	1333
		status migrainosus	
Other	7810	Abnormal involuntary movements	15489
disorders of	7812	Abnormality of gait	9075
the nervous	7820	Disturbance of skin sensation	5608
system	R259	Unspecified abnormal involuntary movements	4186
	R2689	Other abnormalities of gait and mobility	3861
	30720	Tic disorder, unspecified	2989
	7813	Lack of coordination	2118
	3482	Benign intracranial hypertension	1978
	R251	Tremor, unspecified	1957
	R258	Other abnormal involuntary movements	1932
	R269	Unspecified abnormalities of gait and mobility	1835
	78199	Other symptoms involving nervous and musculoskeletal systems	1716
	3332	Myoclonus	1656
	R200	Anesthesia of skin	1560
	F959	Tic disorder, unspecified	1437
	9962	Mechanical complication of nervous system device, implant, and graft	1267
	R202	Paresthesia of skin	1243
	G932	Benign intracranial hypertension	1124
	G253	Myoclonus	912
	37700	Papilledema, unspecified	534
Other ear,	95901	Head injury, unspecified	249776
nose, mouth,	S0990XA	Unspecified injury of head, initial encounter	11810
throat, &	47819	Other disease of nasal cavity and sinuses	56550
cranial/facial	38870	Otalgia, unspecified	56358
diagnoses	95909	Injury of face and neck	49954
	38010	Infective otitis externa, unspecified	43970
	7847	Epistaxis	43728
	931	Foreign body in ear	33722
	932	Foreign body in nose	33347
	R0981	Nasal congestion	29660
	R040	Epistaxis	23909
	T171XXA	Foreign body in nostril, initial encounter	16763
	S0993XA	Unspecified injury of face, initial encounter	13713

	78499	Other symptoms involving head and neck	12732		
	3804	Impacted cerumen	10784		
	H2901	Otalgia, right ear	10098		
	T161XXA	Foreign body in right ear, initial encounter	9884		
	H9202	Otalgia, left ear	9024		
	T162XXA	Foreign body in left ear, initial encounter	7620		
	H9203	Otalgia, bilateral	7502		
Seizure	78039	Other convulsions	82278		
	78031	Febrile convulsions (simple), unspecified	70001		
	34590	Epilepsy, unspecified, without mention of intractable epilepsy	39088		
	R569	Unspecified convulsions	36867		
	R5600	Simple febrile convulsions	32337		
	G40909	Epilepsy, unspecified, not intractable, without status epilepticus	19944		
	3453	Grand mal status	10226		
	78032				
	34510 Generalized convulsive epilepsy, without 7 mention of intractable epilepsy				
	R5601	Complex febrile convulsions	5645		
	G40409	Other generalized epilepsy and epileptic syndromes, not intractable, without status epilepticus	4414		
	G40919	Epilepsy, unspecified, intractable, without status epilepticus	4366		
	34591	Epilepsy, unspecified, with intractable epilepsy	4357		
	34550	Localization-related (focal) (partial) epilepsy and epileptic syndromes with simple partial seizures, without mention of intractable epilepsy	3877		
	34540	Localization-related (focal) (partial) epilepsy and epileptic syndromes with complex partial seizures, without mention of intractable epilepsy	3813		
	G40901	G40901 Epilepsy, unspecified, not intractable, with status epilepticus			
	34580	Other forms of epilepsy and recurrent seizures, without mention of intractable epilepsy	3009		
	G40109	Localization-related (focal) (partial) symptomatic epilepsy and epileptic	2222		

		syndromes with simple partial seizures, not	
		intractable, without status epilepticus	
	G40209	Localization-related (focal) (partial)	2090
		symptomatic epilepsy and epileptic	
		syndromes with complex partial seizures, not	
		intractable, without status epilepticus	
	G4089	Other seizures	1705
Ventricular	9962	Mechanical complication of nervous system	7785
shunt		device, implant, and graft	
procedures	T8501XA	Breakdown (mechanical) of ventricular	2101
		intracranial (communicating) shunt, initial encounter	
	3314	Obstructive hydrocephalus	831
	T8509XA	Other mechanical complication of ventricular	738
		intracranial (communicating) shunt, initial	
		encounter	
	99663	Infection and inflammatory reaction due to	647
		nervous system device, implant, and graft	
	99675	Other complications due to nervous system	546
		device, implant, and graft	
	7423	Congenital hydrocephalus	218
	G919	Hydrocephalus, unspecified	154
	G911	Obstructive hydrocephalus	137
	3313	Communicating hydrocephalus	111
	99709	Other nervous system complications	69
	G910	Communicating hydrocephalus	68
	Q039	Congenital hydrocephalus, unspecified	61
	T8502XA	Displacement of ventricular intracranial	56
		(communicating) shunt, initial encounter	
	3480	Cerebral cysts	54
	1917	Malignant neoplasm of brain stem	51
	4321	Subdural hemorrhage	50
	G918	Other hydrocephalus	26
	G9782	Other postprocedural complications and	26
		disorders of nervous system	
	Q030	Malformations of aqueduct of Sylvius	21

	ED LOS (aRR)	Admit (aOR)	3 Day ED Revisit (aOR)
Age in years			
<1	Ref	Ref	Ref
2-4	0.94 (0.94, 0.95)	0.41 (0.41, 0.42)	0.80 (0.79, 0.82)
5-12	0.97 (0.97, 0.98)	0.35 (0.34, 0.36)	0.72 (0.70, 0.74)
13-17	1.11 (1.11, 1.11)	0.37 (0.36, 0.38)	0.72 (0.70, 0.73)
Sex, male	0.96 (0.96, 0.97)	0.91 (0.9, 0.92)	1.00 (0.99, 1.02)
Race/Ethnicity			
Non-Hispanic White	Ref	Ref	Ref
Non-Hispanic Black	0.95 (0.95, 0.95)	0.68 (0.67, 0.69)	0.92 (0.91, 0.94)
Hispanic	0.98 (0.97, 0.98)	0.71 (0.7, 0.72)	1.00 (0.99, 1.02)
Other	0.98 (0.97, 0.98)	0.82 (0.8, 0.83)	0.87 (0.85, 0.89)
Complex chronic condition(s)	1.08 (1.07, 1.08)	1.59 (1.57, 1.62)	1.18 (1.13, 1.22)
Insurance			
Public	Ref	Ref	Ref
Private	1 (1, 1)	1.07 (1.06, 1.08)	0.96 (0.95, 0.98)
Other	1 (1, 1.01)	0.77 (0.75, 0.79)	0.79 (0.77, 0.82)
Disposition			
Discharged	Ref	-	-
Inpatient admission	-	-	-
Transferred	0.81 (0.8, 0.81)	-	-
Died	1.5 (1.36, 1.65)	-	-
Other	1.07 (1.06, 1.08)	-	-
Census region			
Midwest	0.87 (0.77, 1)	1.01 (0.7, 1.44)	1.14 (1.13, 1.16)
Northeast	1.17 (0.97, 1.39)	1.75 (1.07, 2.85)	0.77 (0.75, 0.79)
South	1.06 (0.94, 1.2)	1.37 (0.99, 1.89)	0.79 (0.77, 0.80)
West	Ref	Ref	Ref
Pre-2014 Year	0.996 (0.995,0.996)	0.997 (0.994, 1.001)	0.990 (0.986, 0.994)
Post-2014 Year	1.003 (1.003, 1.004)	0.94 (0.94, 0.94)	0.979 (0.974, 0.985)
СТ	1.43 (1.36, 1.51)	2.54 (2.51, 2.57)	1.07 (1.04, 1.09)
US	1.5 (1.42, 1.58)	3.23 (3.17, 3.3)	1.08 (1.05, 1.10)
MRI	1.77 (1.68, 1.87)	8.67 (8.46, 8.89)	2.26 (2.14, 2.39)

**eTable 5-** Multivariable Model of Factors Associated with Secondary Outcome Measures for the 8 APR-DRGs

aRR= adjusted rate ratio

aOR= adjusted odds ratio

**eFigure 1.** Hospital-Specific Changes in CT imaging Overall and for Each of the 8 APR-DRGs Comparing 2009-2013 to 2014-2018

	Overall		Abdominal Pain	Appendectomy	Concussion <sup>a</sup>	Migraine <sup>b</sup>	Other nervous system disorders	Other ENT/cranial diagnoses <sup>c</sup>	Seizure	Ventricular Shunt <sup>d</sup>
Hospital	Baseline CT rate <sup>e</sup>	Change	Change	Change	Change	Change	Change	Change	Change	Change
1		-10.6	-7.5	-1.3	-19.8	-16.6	-15.2	-8.2	-10.8	-4.7
ť2		-10.7	-12.6	-21.9	-17.1	-11	-9.7	-6.7	-6.9	-21.3
f3	25.2	-8.9	-14.2	-16.1	-18.5	-11.8	-9.7	-3.4	-4.9	-10.2
f4	24	-10.3	-8.8	-9.5	-21.3	-11	-12	-9.6	-4.7	-16.9
5	20.8	-4.3	-1.8	-8	-3.6	-6.5	-5	-6.8	1.9	-29.5
6	20.6	-3.8	-2.2	-2.8	-13.4	-11.9	-5.7	-3.3	-2.4	-2.9
7	19.4	-0.9	-1.1	11.7	-6	-4.9	1.3	-3.1	1.1	16.2
8	18.9	-10	-6.2	-17	-11.4	-19.7	-14.5	-8.7	-9.7	-24
9	18.5	-3.2	-1.9	-7.5	-2.6	-7.8	-4.5	-0.2	-1.9	2.2
<sup>f</sup> 10	18.4	-5.4	-4.2	-27.5	-12.7	-6.9	-9.5	-3.3	-3.8	-32
11	17	-5.3	-4	-15.4	-14.3	-10.7	-5.1	-3.1	-3.4	-1
12	17	-4.2	-2.9	-3	-8.1	-3.5	-6.8	-2.6	-0.7	3.6
13	16.6	-4.3	-1.3	0.1	-13.7	-10	-8.4	-4.3	-3.4	-5.4
14	16	-7.4	-5.4	-29.8	-21.5	-9.2	-3.6	-3.1	-3.9	-5
15	16	-4.2	-2.6	-7.1	-14.1	-5.3	-0.7	-1.3	0.1	5.6
16		-2.2	0.3	-3.1	-16.2	-2.9	-0.2	-3.1	0.9	14.5
17	14.7	-3.3	-0.6	2.8	-9.8	-10.4	-10.8	-3.4	-4.7	5.6
18	14.6	-4.4	-1.9	-7.5	-10.6	-8.1	-6	-2.7	-6	-14.1
19	14.2	-4.8	-3.2	-26.9	-23.6	-9.5	-1.4	-2.7	-2.6	-10.6
20	13.4	-5.7	-2.2	-8.3	-7.3	-16.4	-8.8	-2.4	-7.6	-35.4
21	13.2	-2.8	-2.7	-7.4	-4.9	-2.6	-1.8	-1.8	-0.7	-36.7
22	12.8	-4.2	-1.4	-20.6	-16.7	-6.1	0	-1.1	2.5	-11.5
23	12.5	-0.5	0.7	7.1	-6.8	-6.1	1.9	-0.7	1.9	-9.3
24	12	-6.2	-5.5	-9	-5.7	-9.2	-4.9	-3.9	-3.5	-33.8
25	11.5	-3	0.3	-1.5	-12.4	-3.2	-4.7	-2.9	-3	1
26	11.2	-4.5	-5.9	-36.4	-10.7	-3.5	-3.9	-2.1	-2.7	-28.1
27	10.9	1.4	1	1.2	-4.7	-2	-4.7	1.5	-3.9	-7
28	10.3	-3.1	-2	-3.5	-14.4	-4.2	-2.5	-2.6	-2.9	-2.6
29	9.8	-1.4	-0.9	0.4	-6.4	-5.1	-0.6	-0.3	-2.9	-3.3
30	9.7	-1.7	-4.5	-31.5	-19.9	-2	-3.5	-0.9	-1.3	-39
31	9.4	0.2	1	0.8	-0.7	-1.3	0	1.6	-0.4	1.8
32	8.3	-3.4	-5	-13.8	-11.3	-3.7	-3.8	-1.3	-2.9	-12.6

For each APR-DRG and overall, changes in CT rates comparing 2009-2013 to 2014-2018 are shaded according to their quartile, with darker shades corresponding to larger magnitude decreases (darkest to lightest shades: dark red $\rightarrow$ red $\rightarrow$ orange $\rightarrow$ yellow). Hospitals were ranked from largest to smallest baseline rate in CT imaging and shaded by quartile, with darker shades corresponding to larger baseline rates.

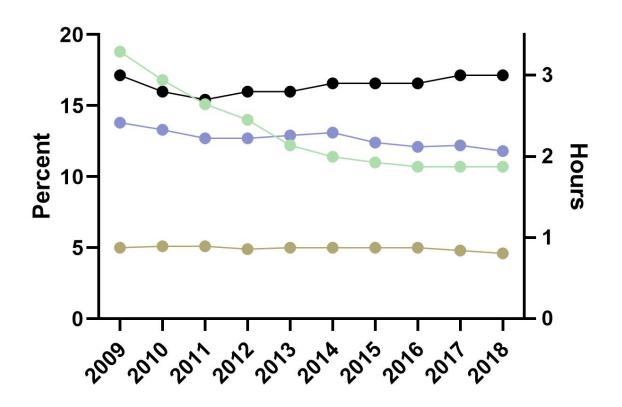
<sup>a</sup>Concussion, closed skull fracture, uncomplicated IC injury, coma <1 hour or no coma <sup>b</sup>Migraine and other headaches

°Other ear, nose, mouth, throat, & cranial/facial diagnoses

<sup>d</sup>Ventricular shunt procedures

•Baseline CT rate indicates the rate of CT imaging during the 2009-2013 period across the 8 APR-DRGs. For this column, lower baseline values are indicated by the darker shading.

The four EDs with consistent reductions in CT above the median decrease for each of the 8 APR-DRG.



eFigure 2. Trends in Secondary Outcome Measures 2009-2018 for the 8 DRGs

Year

	2009	2018	p, trend
-●- CT (%)	18.8	10.7	<.001
Hospitalized (%)	13.8	11.8	0.036
3-day ED revisit (%)	5.0	4.6	0.017
ED LOS (hours)	3.0	3.0	0.742