

Supplementary Online Content

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

eTable 1: Summary of recommendations and technical specifications for each low-value care measure

Measure	Source of Recommendation	Source of technical specification	Low-value service (numerator definition)	Qualifying criteria (denominator definition)	Continuous Enrollment criteria
Abdomen CT Combined Studies	CMS “The intent of this measure is to assess questionable utilization of contrast agents and unnecessary radiation exposure that carries an element of patient risk and significantly increases diagnostic costs, with limited value for clinical decision making.”	QualityNet	Abdomen/Pelvis CT with and without contrast (CPT: 74170, 74178)	<p>Inclusion All Abdomen/Pelvis CTs (CPT: 74150, 74160, 74170, 74176, 74177, 74178)</p> <p>Exclusion ICD-9: 593.9 (kidney unspec); 599.0, 599.9, 595.xx, 597.xx (urinary disease); 120.0, 599.70, 599.71, 599.72 (hematuria); 250.8x, 251.0, 251.1, 251.2, 270.3, 577.0, 577.1 (pancreatic); 255.9, 194.xx, 237.xx, 227.xx (adrenal mass); 155.0, 155.1, 155.2, 197.7, 209.72, 211.5, 230.8, 235.3 (liver lesion); 188.x, 233.7 (bladder neoplasm); 157.0, 157.1, 157.2, 157.3, 157.4, 157.8, 157.9, 189.0, 211.6, 211.7, 223.0 (pancreas neoplasm); 863.xx-- 869.xx, 902.xx, 929.x (blunt abdominal trauma); 590.1x, 590.8x, 590.9 (kidney infection); 782.4 (jaundice)</p>	None
Arthroscopic Surgery for Knee Osteoarthritis	NICE “Do not refer for	Schwartz	Knee arthroscopy with chondroplasty (CPT: 29877 29879 29880	<p>Inclusion Chondromalacia, Osteoarthritis</p>	None

	arthroscopic lavage and debridement as part of treatment for osteoarthritis, unless the person has knee osteoarthritis with a clear history of mechanical locking (as opposed to morning joint stiffness, 'giving way' or X-ray evidence of loose bodies)"		29881 G0289)	(ICD-9: 7177 73392 71500 71509 71510 71516 71526 71536 71596) Exclusion Meniscal tear (ICD-9: 8360- 8362 7170 71741)	
Simultaneous Brain & Sinus CT	CMS "Simultaneous CT sinus and brain imaging for headache without suspected complications is generally considered inappropriateperforming both procedures is duplicative and results in inefficiency and lower quality care... there may [also] be safety concerns to the patient in undergoing two scans"	QualityNet	Sinus CT on the same date as Brain CT (CPT: 70486, 70487, 70488)	Inclusion Brain CT (CPT: 70450, 70460, 70470; Exclusion ICD-9: 140-239 (neoplasms), 800-839,850-854,860-869,905-909, 926.11, 926.12, 929, 952, 958-959 (trauma), 376.01 (orbital cellulitis), 324.0 (intracranial abscess)	None
CT for acute uncomplicated rhinosinusitis	Choosing Wisely "Don't order sinus computed tomography (CT) or indiscriminately prescribe antibiotics for uncomplicated acute rhinosinusitis"	Schwartz	CT of maxillofacial area (CPT: 70486-70488)	Inclusion Sinusitis (ICD-9: 461x 473x) Exclusions ICD-9: 2770x 042 07953 279xx (immune disorders), 471x (nasal polyp) 373xx 37600 (eyelid/orbit inflammation), 800xx-804xx 850xx-854xx 870xx-873xx 9590x 910xx 920xx-921xx (head or face trauma) Other exclusions: Chronic sinusitis , defined by presence of sinusitis diagnosis	10 of last 12 months

				between 30 and 365 days prior to imaging	
Electroencephalogram for Headaches	Choosing Wisely “Don’t perform electroencephalography (EEG) for headaches”	Schwartz	Electroencephalogram (CPT: 95812 95813 95816 95819 95822 95827 95830 95957)	Inclusion Headaches (ICD-9: 30781 339xx 346x 7840) Exclusions ICD-9: 345xx 7803x 7810 (epilepsy or convulsions) Other Exclusions Epilepsy or convulsions diagnosis during 1 year prior	10 of last 12 months prior to visit
Head Imaging for Uncomplicated Headache	Choosing Wisely “Don’t do imaging for uncomplicated headache”	Schwartz	CT or MRI of head or brain (CPT: 70450 70460 70470 70551-70553)	Inclusion Headache or migraine (ICD-9: 30781 339xx 346x 7840) Exclusions ICD-9: 33920-33922 33943 (post-traumatic or thunderclap headache), 14xx-208xx 230xx-239xx (cancer), 3463x 3466x (migraine with hemiplegia or infarction), 4465 (giant cell arteritis), 345xx 7803x (epilepsy or convulsions), 43xx (cerebrovascular diseases, including stroke/TIA and subarachnoid hemorrhage), 800xx-804xx 850xx-854xx 870xx-873xx 9590x 910xx 920xx-921xx (head or face trauma), 78097 781xx 7820 7845x 79953 (altered mental	None

				status, nervous and musculoskeletal system symptoms, including gait abnormality, meningismus, disturbed skin sensation, speech deficits), V1254 V10xx (personal history of stroke/TIA or cancer)	
Head Imaging for Syncope	Choosing Wisely, NICE “In the evaluation of simple syncope and a normal neurological examination, don’t obtain brain imaging studies (CT or MRI).”	Schwartz	CT or MRI of head or brain (CPT: 70450 70460 70470 70551-70553)	Inclusion Syncope (ICD-9: 7802 9921) Exclusion: ICD-9: 345xx 7803x (epilepsy or convulsions), 43xx (cerebrovascular diseases, including stroke/TIA and subarachnoid hemorrhage), 800xx-804xx 850xx-854xx 870xx-873xx 9590x 910xx 920xx-921xx (head or face trauma), 78097 781xx 7820 7845x (altered mental status, nervous and musculoskeletal system symptoms, including gait abnormality, meningismus, disturbed skin sensation, speech deficits), V1254 (personal history of stroke/TIA)	None
Total or Free T3 Tests for Patients with Hypothyroidism	Choosing Wisely “Don’t order a total or free T3 level when assessing	Schwartz	Total or free T3 (CPT: 84480 84481)	Inclusion Acquired hypothyroidism (ICD9: 244.0, 244.1, 244.2,	10 of 12 months prior to visit

	levothyroxine (T4) dose in hypothyroid patients”			244.3, 244.8, 244.9) in addition to history of acquired hypothyroidism (diagnosis during previous 1 year)	
Imaging for Non-specific Low Back Pain	Choosing Wisely, NICE “Don’t obtain imaging studies in patients with non-specific low back pain”	Schwartz	Radiologic, CT, and MRI imaging of spine (CPT: 72010 72020 72052 72100 72110 72114 72120 72200 72202 72220 72131-72133 72141 72142 72146-72149 72156 72157 72158)	<p>Inclusion Low back pain (ICD-9: 7213 72190 72210 72252 7226 72293 72402 7242-7246 72470 72471 72479 7385 7393 7394 846x 8472), occurring within 6 weeks of initial low back pain diagnosis. Initial diagnosis is defined as the earliest low back pain claim in 2013, and must have no 1 year history of low back pain.</p> <p>Exclusion 14xx–208xx 230xx-239xx (cancer), 800x-839xx 850xx-854xx 86xxx 905xx-909xx 92611 92612 929, 952xx 958xx-959xx (trauma), 3040x-3042x 3044x 3054x-3057x (IV drug abuse), 34460 7292x (neurologic impairment), 4210 4211 4219 (endocarditis), 038xx (septicemia), 01xxx (tuberculosis), 730xx (osteomyelitis),</p>	10 of last 12 months at time of initial low back pain diagnosis

				7806x 7830x 7832x 78079 7808x 2859x (fever, weight loss, malaise, night sweats, anemia not due to blood loss) 72142 72191 72270 72273 7244 (myelopathy, neuritis and radiculopathy)	
Imaging for Diagnosis of Plantar Fasciitis	Choosing Wisely “Don’t routinely order X-ray for diagnosis of plantar fasciitis/heel pain in employees who stand or walk at work.”	Schwartz	Radiographic, MRI, or ultrasound imaging (CPT:73620 73630 73650 73718 73719 73720 76880 76881 76882)	Inclusion Plantar fasciitis (ICD-9: 72871 7294), occurring within 2 weeks of initial plantar fasciitis diagnosis. Initial diagnosis is defined as the earliest plantar fasciitis claim in 2013, and must have no 1 year history of plantar fasciitis.	10 of last 12 months at time of initial plantar fasciitis diagnosis
Pre-operative Chest Radiography	Choosing Wisely “Don’t obtain preoperative chest radiography in the absence of a clinical suspicion for intrathoracic pathology”	Schwartz	Chest x-ray occurring within 30 days prior to surgery (CPT: 71010 71015 71020-71023 71030 71034 71035). Excludes services occurring in inpatient/emergency setting**	Inclusion Low or intermediate risk non -cardiothoracic surgery (BETOS: P1x P3D P4A P4B P4C P5C P5D P8A P8G) or relevant surgical code not included in BETOS categories (CPT: 19120 19125 47562 47563 49560 58558)	Enrolled during month prior to surgery
Pre-operative Echocardiography	Choosing Wisely “Avoid echocardiograms for pre/peri-operative assessment of patients with no history or symptoms of heart disease”	Schwartz	Echocardiogram occurring within 30 days prior to surgery (CPT: 93303 93304 93306-93308 93312 93315 93318) Excludes services occurring in inpatient/emergency setting**	Exclusion Surgeries occurring in inpatient or Emergency setting**	
Pre-operative Stress Testing	Choosing Wisely “Patients who have no cardiac history and good functional status do not require preoperative stress	Schwartz	Stress electrocardiogram, echocardiogram, nuclear medicine imaging, cardiac MRI or CT angiography occurring within 30		

	testing prior to non-cardiac thoracic surgery”		days prior to surgery (CPT: 75552-75564 75574 78451-78454 78460 78461 78464 78465 78472 78473 78481 78483 78491 78492 93015-93018 93350 93351 0146T 0147T 0148T 0149T) Excludes services occurring in inpatient/emergency setting**		
Pre-operative Pulmonary Function Testing	Choosing Wisely “Prior to cardiac surgery, there is no need for pulmonary function testing in the absence of respiratory symptoms”	Schwartz	Spirometry (CPT: 94010) Excludes services occurring in inpatient/emergency setting**	Inclusion Low or intermediate risk non- cardiothoracic surgery (BETOS: P1x P2x P3D P4A P4B P4C P5C P5D P8A P8G (selected surgeries) Exclusion Surgeries occurring in inpatient or Emergency setting**	Enrolled during month prior to surgery
Spinal Injections for Low Back Pain	Literature Pinto (2012) Epidural corticosteroid injections in the management of sciatica: A systematic review and meta- analysis*	Schwartz	Epidural (not indwelling), facet, or trigger point injections (CPT: 62311 64483 20552 20553 64493 64475) Excludes injections associated with an inpatient stay (defined as injections occurring within the 14 day period following an inpatient stay**)	Inclusion Backpain (ICD-9: 7213 72190 72210 7222 72252 7226 72280 72283 72293 72400 72402 72403 7242 7245 7246 72470 72471 72479 7384 7385 7393 7394 75612 8460- 8463 8468 8469 8472) Exclusion Back pain with radiculopathy (ICD-9: 72142 72191 72270 72273 7243 7244) Other exclusion Backpain visits that occurred in	Enrolled during month prior to visit

				an inpatient setting**	
Thorax CT Combined Studies	Quality net/CMS “The indiscriminate use of combined thorax CT studies— defined as those that are performed both without and with contrast agents for the evaluation of solid organs and body cavities— represents a serious inefficiency of practice and a patient safety issue”	QualityNet	Thorax CTs with and without contrast (CPT: 71270)	Inclusion All Thorax CTs (CPT: 71250, 71260, 71270) Exclusion ICD-9: 860.xx-869.xx (chest/abd/pelvis injury); 901.xx-902.xx (injury blood vessels); 926.xx, 929.x (crush injury)	None

Notes: CT= computed tomography; Choosing Wisely is an initiative of the ABIM Foundation, a charity that aims to advance medical professionalism to improve health care quality. The Choosing Wisely initiative creates clinical guidelines to promote conversations between patients and physicians about appropriate care, and reduce waste. In partnership with Consumer Reports, corresponding patient resources are also available. More information can be found at <http://www.choosingwisely.org/about-us/> ;

The National Institute for Health and Care Excellence (NICE) is a non-departmental public body based in the United Kingdom; it is affiliated with the Department of Health but operates independently of government. NICE provides guidance about effective, high-value healthcare through several methods, including clinical guidelines. More information is available at <https://www.nice.org.uk/about>;

QualityNet was established by the Centers for Medicare & Medicaid Services to facilitate the exchange of quality improvement resources, such as technical specifications for quality measures. More information is available at <http://www.qualitynet.org>

* For additional lit review sources, see <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD001824.pub3/abstract> (Epidural, trigger point and facet injections, Cochrane 2008), <http://www.ncbi.nlm.nih.gov/pubmed/19363457> (intradiscal injections, American Pain Society), http://journals.lww.com/spinejournal/Abstract/2013/11010/Effect_of_Facet_Joint_Injection_Versus_Systemic.4.aspx (facet injections, Spine)

** based on HEDIS 2014 definitions of inpatient and emergency care claims

eTable 2: Classification of measures as higher vs lower cost, and more vs less likely to occur in the ED

Measure	Price Category	ED Category
Abdomen CT Combined Studies	Higher	Less likely
Arthroscopic Surgery for Knee Osteoarthritis	Higher	Less likely
Simultaneous Brain & Sinus CT	Higher	Less likely
CT for acute uncomplicated rhinosinusitis	Higher	Less likely
Electroencephalogram for Headaches	Higher	Less likely
Head Imaging for Uncomplicated Headache	Higher	More likely
Head Imaging for Syncope	Higher	More likely
Total or Free T3 Tests for Patients with Hypothyroidism	Lower	Less likely
Imaging for Non-specific Low Back Pain	Lower	More likely
Imaging for Diagnosis of Plantar Fasciitis	Lower	Less likely
Pre-operative Chest Radiography	Lower	Less likely
Pre-operative Echocardiography	Higher	Less likely
Pre-operative Stress Testing	Higher	Less likely
Pre-operative Pulmonary Function Testing	Lower	Less likely
Spinal Injections for Low Back Pain	Higher	Less likely
Thorax CT Combined Studies	Higher	Less likely

eTable 3: Adjusted odds ratios and low-value care risk differences associated with Medicaid versus commercial insurance coverage.

Measure	Odds ratio ^a [95% CI]	p-value	Risk difference ^b (%) [95% CI]	p-value
Imaging for non-specific low back pain	1.57 [1.51, 1.64]	<0.001	6.9 [6.2, 7.6]	<0.001
Head imaging for uncomplicated headache	1.68 [1.60, 1.76]	<0.001	6.1 [5.5, 6.7]	<0.001
Head imaging for syncope	1.52 [1.32, 1.74]	<0.001	4.1 [2.6, 5.5]	<0.001
Imaging for plantar fasciitis	0.61 [0.51, 0.72]	<0.001	-6.3 [-8.2, -4.3]	<0.001
T3 tests for hypothyroidism	0.59 [0.53, 0.65]	<0.001	-5.9 [-6.8, -5.0]	<0.001
Preoperative chest radiography	2.07 [1.87, 2.29]	<0.001	3.7 [3.1, 4.3]	<0.001
Abdomen CT combined studies	0.74 [0.67, 0.82]	<0.001	-1.6 [-2.1, -1.1]	<0.001
Simultaneous Brain and Sinus CT	1.31 [1.12, 1.55]	0.001	1.0 [0.4, 1.6]	0.001
CT for uncomplicated acute rhinosinusitis	1.04 [0.92, 1.18]	0.51	0.1 [-0.2, 0.5]	0.518
Arthroscopic surgery for knee osteoarthritis	0.56 [0.47, 0.67]	<0.001	-2.0 [-2.5, -1.5]	<0.001
Thorax CT combined studies	1.73 [1.26, 2.36]	0.001	0.8 [0.3, 1.3]	0.002
Preoperative echocardiography	1.53 [1.17, 2.00]	0.002	0.2 [0.1, 0.4]	0.008
Spinal injections for low back pain	0.37 [0.33, 0.42]	<0.001	-1.2 [-1.3, -1.1]	<0.001
Preoperative stress testing	2.28 [1.56, 3.27]	<0.001	0.3 [0.1, 0.4]	0.001
Preoperative pulmonary function testing	1.74 [1.15, 2.58]	0.007	0.2 [0.0, 0.3]	0.026
Electroencephalogram for headache	2.13 [1.44, 3.12]	<0.001	0.1 [0.1, 0.2]	0.002

a. Estimates are presented for Medicaid insurance. Reference group is commercial insurance. Models adjusted for patient age, sex, rural or urban residence, and Charlson Comorbidity Index.

b. Risk differences were calculated from logistic regression models, as the predicted probability of receiving low-value care with Medicaid insurance, minus the predicted probability of receiving low-value care with commercial insurance, for the average qualifying patient.

eTable 4: Logistic regression models for the association between Medicaid insurance and low-value care, by price category

Price Category		p-value for interaction
Lower OR [95% CI]	Higher OR [95% CI]	
1.33 [1.29, 1.38]	1.32 [1.28, 1.36]	0.64

Notes: Reference group is commercial insurance.

Models adjusted for age, sex, Charlson Comorbidity Index, and rural or urban residence.

Errors were clustered by patient to account for correlation among patients who qualified for multiple measures.

Lower priced services include: Total or Free T3 Tests for Patients with Hypothyroidism, Imaging for Non-specific Low Back Pain, Imaging for Diagnosis of Plantar Fasciitis, Pre-operative Chest Radiography, and Pre-operative Pulmonary Function Testing.

Higher priced services include: Abdomen CT Combined Studies, Arthroscopic Surgery for Knee Osteoarthritis, Simultaneous Brain & Sinus CT, CT for acute uncomplicated rhinosinusitis, Electroencephalogram for Headaches, Head Imaging for Uncomplicated Headache, Head Imaging for Syncope, Pre-operative Echocardiography, Pre-operative Stress Testing, Spinal Injections for Low Back Pain, and Thorax CT Combined Studies

eTable 5: Logistic regression models for the association between Medicaid insurance and low-value care, by ED category

ED Category		p-value for interaction
Less likely OR [95% CI]	More likely OR [95% CI]	
0.78 [0.75, 0.81]	1.57 [1.52, 1.62]	< 0.001

Notes: Reference group is commercial insurance.

Models adjusted for: age, sex, Charlson Comorbidity Index, and rural or urban residence.

Errors were clustered by patient to account for correlation among patients who qualified for multiple measures.

Services less likely to occur in the ED include: Abdomen CT Combined Studies, Arthroscopic Surgery for Knee Osteoarthritis, Simultaneous Brain & Sinus CT, CT for acute uncomplicated rhinosinusitis, Electroencephalogram for Headaches, Total or Free T3 Tests for Patients with Hypothyroidism, Imaging for Diagnosis of Plantar Fasciitis, Pre-operative Chest Radiography, Pre-operative Echocardiography, Pre-operative Stress Testing, Pre-operative Pulmonary Function Testing, Spinal Injections for Low Back Pain, and Thorax CT Combined Studies.

Services more likely to occur in the ED include: Head Imaging for Uncomplicated Headache, Head Imaging for Syncope, and Imaging for Non-specific Low Back Pain.

eTable 6: Variation in raw PCSA-level low-value care rates, by insurance type

Measure	PCSA-level low-value care rates	
	Commercial IQR	Medicaid IQR
Imaging for non-specific low back pain	5.6%	8.5%
Head imaging for uncomplicated headache	4.7%	8.7%
Head imaging for syncope	11.6%	18.9%
Imaging for plantar fasciitis	16.0%	17.3%
T3 tests for hypothyroidism	10.0%	13.9%
Preoperative chest radiography	4.0%	10.2%
Abdomen CT combined studies	4.7%	6.7%
Simultaneous Brain and Sinus CT	4.4%	5.7%
CT for uncomplicated acute rhinosinusitis	2.8%	3.9%
Arthroscopic surgery for knee osteoarthritis	6.0%	4.1%
Spinal injections for low back pain	1.6%	1.4%

Notes: IQR= Interquartile range. Displayed low-value services are those that met the threshold for inclusion in geographic analyses. Rates are unsmoothed.

eTable7: Adjusted odds ratios and low-value care risk differences associated with a Medicaid patient moving to a PCSA with a 1% higher commercial low-value care rate.

Measure	Odds ratio ^a [95% CI]	p-value	Risk difference ^b (%) [95% CI]	p-value
Imaging for non-specific low back pain	1.05 [1.03, 1.07]	< 0.001	0.8 [0.5, 1.2]	<0.001
Head imaging for uncomplicated headache	1.04 [1.01, 1.08]	0.011	0.6 [-0.2, 1.4]	0.130
Head imaging for syncope	0.94 [0.53, 1.69]	0.832	-0.8 [-7.1, 5.6]	0.814
Imaging for plantar fasciitis	1.03 [1.00, 1.06]	0.074	0.3 [0, 0.6]	0.080
T3 tests for hypothyroidism	1.08 [1.06, 1.10]	<0.001	0.7 [0.5, 0.9]	<0.001
Preoperative chest radiography	1.19 [1.10, 1.30]	<0.001	1.3 [0.6, 2.1]	0.001
Abdomen CT combined studies	1.23 [1.07, 1.42]	0.004	0.9 [0.1, 1.6]	0.029
Simultaneous Brain and Sinus CT	1.33 [0.67, 2.60]	0.409	1.1 [-2.4, 4.7]	0.534
CT for uncomplicated acute rhinosinusitis	1.65 [1.40, 1.94]	<0.001	1.3 [0.7, 1.8]	<0.001
Arthroscopic surgery for knee osteoarthritis	1.42 [1.18, 1.71]	<0.001	0.8 [0.4, 1.3]	<0.001
Spinal injections for low back pain	1.41 [1.19, 1.66]	<0.001	0.3 [0.1, 0.4]	0.003

a. Estimates are presented for a 1% change in commercial low-value care rates in a Medicaid patient's PCSA of residence. Models adjusted for patient age, sex, urban or rural residence, and Charlson comorbidity index.

b. Risk differences were calculated from logistic regression models, as the change in predicted probability of receiving low-value care for the average qualifying Medicaid patient, when the commercial rate of low-value care in their PCSA of residence increases by 1%.

eTable 8a: Full logistic regression model output for the association between insurance type and low-value care for the measure: Imaging for non-specific lower back pain

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-1.983	0.021	<0.001
Medicaid coverage ¹	0.452	0.022	<0.001
Age (years) ²			
35-49	0.060	0.023	0.010
50-64	0.320	0.023	<0.001
Male sex	0.141	0.017	<0.001
Rural residence ³	0.156	0.018	<0.001
Charlson Comorbidity Index	0.068	0.006	<0.001

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8b: Full logistic regression model output for the association between insurance type and low-value care for the measure: Head imaging for uncomplicated headache

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-2.334	0.022	<0.001
Medicaid coverage ¹	0.517	0.023	<0.001
Age (years) ²			
35-49	-0.015	0.025	0.546
50-64	0.048	0.027	0.081
Male sex	0.442	0.023	<0.001
Rural residence ³	-0.021	0.022	0.360
Charlson Comorbidity Index	0.192	0.007	<0.001

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8c: Full logistic regression model output for the association between insurance type and low-value care for the measure: Head imaging for syncope

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-2.501	0.074	<0.001
Medicaid coverage ¹	0.416	0.072	<0.001
Age (years) ²			
35-49	0.092	0.090	0.307
50-64	0.215	0.085	0.011
Male sex	-0.118	0.068	0.083
Rural residence ³	0.080	0.069	0.243
Charlson Comorbidity Index	0.096	0.015	<0.001

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8d: Full logistic regression model output for the association between insurance type and low-value care for the measure: Imaging for diagnosis of plantar fasciitis

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-1.667	0.072	<0.001
Medicaid coverage ¹	-0.498	0.091	<0.001
Age (years) ²			
35-49	0.096	0.078	0.216
50-64	0.210	0.076	0.006
Male sex	-0.107	0.050	0.032
Rural residence ³	0.239	0.051	<0.001
Health conditions	-0.009	0.021	0.669

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8e: Full logistic regression model output for the association between insurance type and low-value care for the measure: Total or Free T3 tests for patients with hypothyroidism

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-1.384	0.046	<0.001
Medicaid coverage ¹	-0.533	0.049	<0.001
Age (years) ²			
35-49	0.044	0.050	0.380
50-64	-0.290	0.048	<0.001
Male sex	-0.500	0.044	<0.001
Rural residence ³	0.074	0.031	0.016
Charlson Comorbidity Index	-0.064	0.011	<0.001

1. Reference is commercial insurance

2. Reference is 18-34

3. Reference is urban residence

eTable 8f: Full model output for the association between insurance type and low-value care for the measure: Pre-operative chest radiography

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-4.105	0.073	<0.001
Medicaid coverage ¹	0.728	0.051	<0.001
Age (years) ²			
35-49	0.354	0.079	<0.001
50-64	0.884	0.073	<0.001
Male sex	0.070	0.045	0.116
Rural residence ³	0.281	0.045	<0.001
Charlson Comorbidity Index	0.210	0.008	<0.001

1. Reference is commercial insurance

2. Reference is 18-34

3. Reference is urban residence

eTable 8g: Full logistic regression model output for the association between insurance type and low-value care for the measure: Abdomen CT combined studies

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-3.461	0.065	<0.001
Medicaid coverage ¹	-0.299	0.049	<0.001
Age (years) ²			
35-49	0.622	0.071	<0.001
50-64	1.046	0.067	<0.001
Male sex	0.200	0.041	<0.001
Rural residence ³	-0.029	0.043	0.493
Charlson Comorbidity Index	0.056	0.007	<0.001

1. Reference is commercial insurance

2. Reference is 18-34

3. Reference is urban residence

eTable 8h: Full logistic regression model output for the association between insurance type and low-value care for the measure: Simultaneous brain and sinus CT

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-2.907	0.091	<0.001
Medicaid coverage ¹	0.273	0.084	0.001
Age (years) ²			
35-49	-0.207	0.100	0.040
50-64	-0.320	0.103	0.002
Male sex	0.147	0.082	0.072
Rural residence ³	-0.134	0.086	0.120
Charlson Comorbidity Index	-0.173	0.027	<0.001

1. Reference is commercial insurance

2. Reference is 18-34

3. Reference is urban residence

eTable 8i: Full logistic regression model output for the association between insurance type and low-value care for the measure: CT for acute uncomplicated rhinosinusitis

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-3.811	0.055	<0.001
Medicaid coverage ¹	0.043	0.065	0.512
Age (years) ²			
35-49	0.270	0.061	<0.001
50-64	0.417	0.062	<0.001
Male sex	0.211	0.046	<0.001
Rural residence ³	-0.223	0.050	<0.001
Health conditions	0.071	0.016	<0.001

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8j: Full logistic regression model output for the association between insurance type and low-value care for the measure: Arthroscopic surgery for knee osteoarthritis

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-2.516	0.096	<0.001
Medicaid coverage ¹	-0.582	0.091	<0.001
Age (years) ²			
35-49	-0.069	0.104	0.507
50-64	-0.606	0.098	<0.001
Male sex	0.127	0.058	0.029
Rural residence ³	-0.060	0.061	0.331
Charlson Comorbidity Index	-0.105	0.026	<0.001

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8k: Full logistic regression model output for the association between insurance type and low-value care for the measure: Thorax CT combined studies

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-4.310	0.250	<0.001
Medicaid coverage ¹	0.547	0.160	0.001
Age (years) ²			
35-49	0.152	0.258	0.557
50-64	-0.112	0.244	0.647
Male sex	0.225	0.152	0.140
Rural residence ³	-0.318	0.166	0.056
Charlson Comorbidity Index	-0.030	0.024	0.209

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8l: Full logistic regression model output for the association between insurance type and low-value care for the measure: Pre-operative echocardiography

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-6.101	0.210	<0.001
Medicaid coverage ¹	0.427	0.137	0.002
Age (years) ²			
35-49	0.290	0.234	0.215
50-64	0.873	0.215	<0.001
Male sex	-0.217	0.124	0.079
Rural residence ³	0.076	0.122	0.533
Charlson Comorbidity Index	0.253	0.016	<0.001

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8m: Full logistic regression model output for the association between insurance type and low-value care for the measure: Spinal injections for low back pain

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-4.663	0.058	<0.001
Medicaid coverage ¹	-0.991	0.066	<0.001
Age (years) ²			
35-49	0.598	0.063	<0.001
50-64	1.012	0.060	<0.001
Male sex	0.000	0.038	0.995
Rural residence ³	0.228	0.039	<0.001
Charlson Comorbidity Index	0.084	0.012	<0.001

1. Reference is commercial insurance

2. Reference is 18-34

3. Reference is urban residence

eTable 8n: Full logistic regression model output for the association between insurance type and low-value care for the measure: Pre-operative stress testing

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-7.520	0.394	<0.001
Medicaid coverage ¹	0.823	0.188	<0.001
Age (years) ²			
35-49	1.154	0.416	0.005
50-64	1.935	0.395	<0.001
Male sex	0.063	0.165	0.702
Rural residence ³	-0.068	0.171	0.692
Charlson Comorbidity Index	0.113	0.029	<0.001

1. Reference is commercial insurance

2. Reference is 18-34

3. Reference is urban residence

eTable 8o: Full logistic regression model output for the association between insurance type and low-value care for the measure: Pre-operative pulmonary function testing

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-6.265	0.255	<0.001
Medicaid coverage ¹	0.554	0.206	0.007
Age (years) ²			
35-49	-0.290	0.304	0.341
50-64	0.284	0.265	0.284
Male sex	0.045	0.178	0.798
Rural residence ³	-0.433	0.202	0.032
Charlson Comorbidity Index	0.190	0.027	<0.001

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eTable 8p: Full logistic regression model output for the association between insurance type and low-value care for the measure: Electroencephalogram for headaches

Covariate	Coefficient	Standard Error	p- value
(Intercept)	-7.150	0.213	<0.001
Medicaid coverage ¹	0.755	0.196	<0.001
Age (years) ²			
35-49	0.127	0.225	0.572
50-64	0.065	0.245	0.789
Male sex	0.478	0.193	0.013
Rural residence ³	0.426	0.186	0.022
Charlson Comorbidity Index	0.111	0.048	0.021

1. Reference is commercial insurance
2. Reference is 18-34
3. Reference is urban residence

eAppendix: Methods and Results

Evaluating the relationship between insurance and any type of low-value care

To examine the association between insurance type and receiving any of the 16 low-value services, we conducted aggregate analyses, similar to those done in other studies¹. Like models for individual measures, the outcome of interest was a binary variable indicating whether a patient received low-value care. The primary independent variable was an indicator of Medicaid vs. commercial insurance coverage. Covariates included patient-level demographics, rural or urban residence, and Charlson comorbidity Index. While models for individual measures considered only patients who qualified for the measure of interest, in aggregate analyses we pooled patient-level data for all low-value service types, included measure-level fixed effects to adjust for low-value care qualifying type, and used patient-level clustered standard errors to account for multiple observations of patients. The risk difference associated with insurance type was calculated from the resulting logistic regression model, as the difference in marginal effects for the average qualifying patient. Results of this analysis showed that overall, Medicaid patients were more likely than commercial patients to receive low-value care during 2013, although the effect was quite small (risk difference= 0.57%, 95% CI=0.50%-0.65%).

Evaluating the relationship between insurance and low-value care across subgroups of services

Higher versus lower cost services

We used cost classifications created by Schwartz and colleagues for 13 of the 16 low-value care measures.² For the remaining three measures that were not previously classified, we assigned services as lower (<\$150) or higher (≥\$150) cost, similar to price ranges used for previously classified measures. Prices were estimated using national Medicare payment rates from the American Medical Association³, for relevant procedures. Eleven of the sixteen measures were classified as higher cost, and the remaining five measures were classified as lower cost. A summary of cost classifications is presented in **eTable 2**.

We then conducted logistic regression to examine the relationship between insurance type and low-value care, across strata of price category. Similar to the models described above, this analysis used aggregate data that included patient-level information for all measures. However in this case, fixed effects for low-value care qualifying type were replaced with an indicator of whether the measure was classified as higher or lower cost. Stratified results of this analysis are presented in **eTable 4**.

More versus less likely to occur in the ED

To classify measures that were more likely versus less likely to occur in the ED, we used a combination of assessments by clinicians, and information about the measure specifications. More specifically, we first collected assessments about the likelihood of each service occurring in the ED from two different practicing emergency department physicians, and a co-author who is a physician medical student. In addition, we used information about the measures, where applicable, to aid in classifications. For example, technical specifications for the measure “Preoperative Chest Radiography” explicitly exclude any services that occur in an emergency setting. Three of the sixteen measures were classified as more likely to occur in the ED, with the remaining thirteen measures classified as less likely to occur in the ED. A summary of ED classifications is presented in **eTable 2**.

We then conducted logistic regression to examine the relationship between insurance type and low-value care, across strata of ED category. Similar to the models described above, this analysis used aggregate data that included patient-level information for all measures. However in this case, fixed effects for low-value care qualifying type were replaced with an indicator of whether the measure was classified as more or less likely to occur in the emergency department. Stratified results of this analysis are presented in **eTable 5**.

Examining the influence of local practice patterns: detailed analytic approach

To examine the potential influence of local practice patterns, we assessed the association between receipt of low-value care among Medicaid patients, and the rate of low-value care among commercially insured patients residing in the same PCSA. This analysis required five steps:

1. We restricted the analysis to low-value care services with a minimum of 150 instances observed among Medicaid patients during 2013. Eleven of sixteen services met this requirement. This threshold was used to ensure adequate statistical power for small area geographic analyses.

2. For each service, we computed “smoothed” PCSA-level rates of low-value care for the commercial population. “Smoothed” rates were generated from hierarchical mixed-effects models using standard Fay-Herriot small area estimation techniques.^{4,5} The hierarchical mixed effects models were run as generalized linear-mixed effect models containing a global fixed intercept and a PCSA-level random intercept term. The model took the following functional form:

$$Y_{ij} \sim \text{Bernoulli}(p_j)$$
$$\text{logit}(p_j) = \alpha + \omega_j$$
$$\omega_j \sim N(0, \sigma_\alpha^2)$$

Y_{ij} represents receipt of low-value care for patient i in PCSA j

p_j represents the rate of low-value care in region j

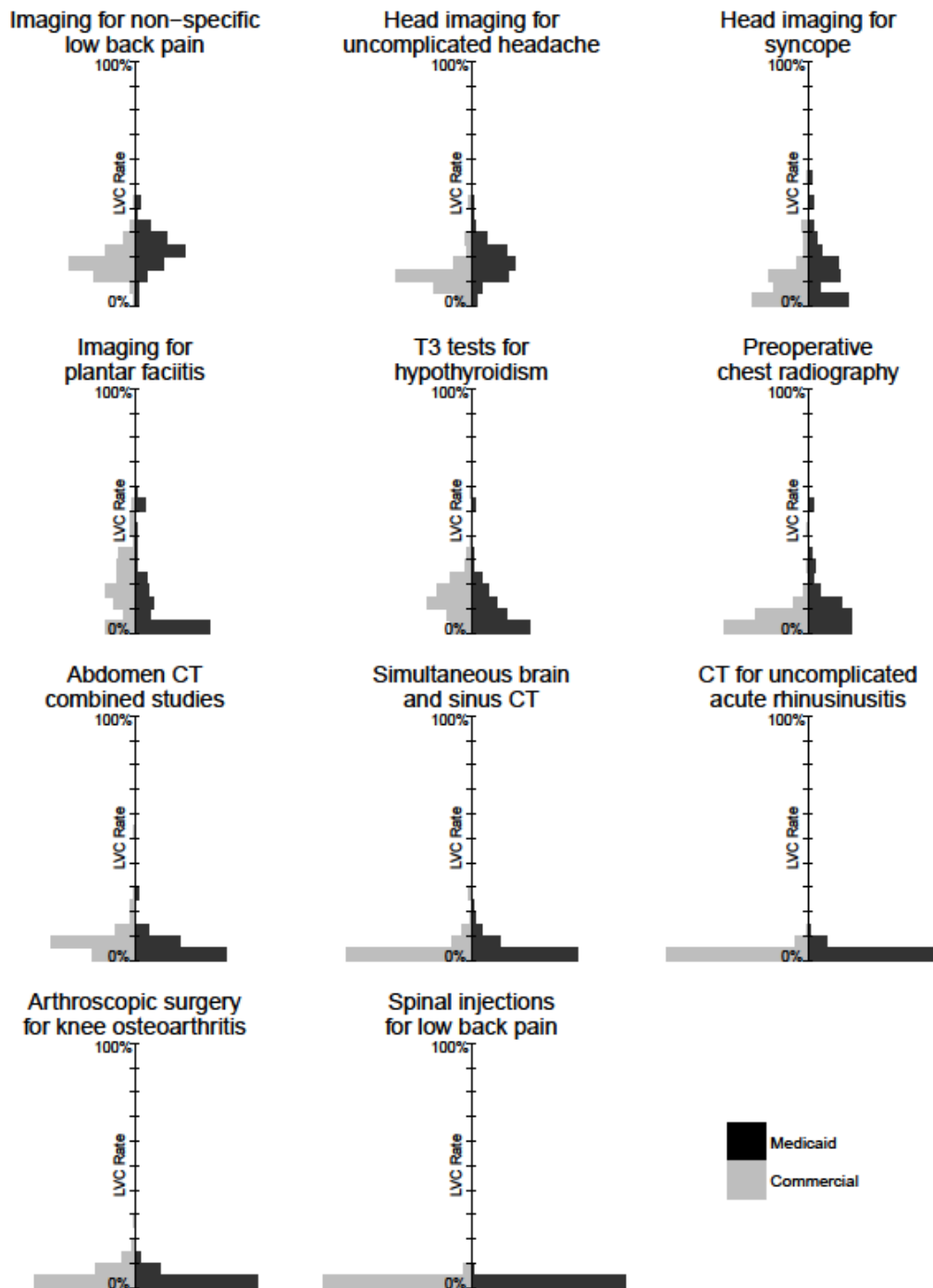
α represents the intercept of the logistic regression model. It is also the logit of the state low-value care rate due to the lack of other covariates in the model

ω_j represents the random PCSA-level intercept

σ_α^2 represents the variance between PCSA level rates of low-value care

3. The resulting smoothed estimate is a weighted average of the raw PCSA rate and the statewide rate, where the weight given to each PCSA rate relative to the weight given to the state rate is based on the precision of the PCSA estimate, which is a function of population size⁶. In the absence of smoothing, PCSAs with small populations tend to have very noisy estimates which are less representative of the actual rate of low-value care. Smoothing addresses this problem by bringing rates for PCSAs with small populations closer to the state mean. This approach is similar to methodology used in other studies, to produce smoothed rates of health outcomes or utilization.
4. We restricted subsequent analyses to the Medicaid population. Patient-level logistic regression was used to test the association between receipt of low-value care among Medicaid patients, and the smoothed commercial rate of low-value care in their PCSA of residence.
5. Using marginal effects, we computed the change in predicted probability of receiving low-value care for an average Medicaid patient when commercial low-value care rates in their PCSA of residence increased by 1%.

eFigure: Distribution of raw low-value care rates in PCSAs, by insurance type



Notes: displayed low-value services are those that met the threshold for inclusion in geographic analyses. Rates are unsmoothed.

eReferences

1. Song Z, Safran DG, Landon BE, et al. Health care spending and quality in year 1 of the alternative quality contract. *N Engl J Med*. 2011;365(10):909-918. doi:10.1056/NEJMsa1101416.
2. Schwartz AL, Chernew ME, Landon BE, McWilliams JM. Changes in Low-Value Services in Year 1 of the Medicare Pioneer Accountable Care Organization Program. *JAMA Intern Med*. 2015;175(11):1815-1825. doi:10.1001/jamainternmed.2015.4525.
3. American Medical Association. cpt Code/Relative Value Search. <https://ocm.ama-assn.org/OCM/CPTRelativeValueSearch.do?submitButton=accept>.
4. Rao JNK. *Small Area Estimation*. Wiley & Sons; 2003.
5. Bates D, Maechler M, Bolker B, Walker S. Fitting Linear Mixed-Effects Models Using lme4. *J Stat Softw*. 2015;67(1):1-48. doi:doi:10.18637/jss.v067.i01.
6. Gelman A, Hill J. *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge University Press; 2007.