

## Supplementary file 6. Details of low-value care assessments extracted from the included studies.

Study	Country	Type of low-value care examined	Care setting assessed	Lens used	Guideline(s)/recommendations used	Cohort size	Amount LVC	Prevalence estimate (95%CI)	Type
Badgery-Parker et al., 2019 [15]	Australia	- Endoscopy in adults <55 (for dyspepsia)	Secondary care	Service	CW Australia, RACP EVOLVE and NICE 'do not do' guidelines/recommendations	14 813	2 360	15.93 [15.35 ; 16.53]	Imaging
		- Arthroscopic lavage and debridement of knee for osteoarthritis or degenerative meniscal tears				4 218	3 002	71.17 [69.78 ; 72.53]	Imaging
		- Colonoscopy in adults < 50 (for constipation)				11 790	608	5.16 [4.76 ; 5.57]	Imaging
		- ERCP (endoscopic retrograde cholangiopancreatography) for acute gallstone pancreatitis without cholangitis				420	79	18.80 [15.18 ; 22.88]	Imaging
Bouck et al., 2019 [39]	Canada	- Spinal X-ray, CT, MRI following visit for low-back pain.	Primary care	Patient-indication	CW Canada guidelines/recommendations from the Canadian Anesthesiologists' Society (CAS), Canadian Cardiovascular Society (CCS) & Canadian Society of Internal Medicine (CSIM)	97 740	30 006	30.70 [30.41 ; 30.99]	Imaging
		- Cardiac tests (electrocardiogram, chest x-ray, stress test, or transthoracic echocardiogram) prior to low-risk procedures				527 691	167 278	31.70 [31.60 ; 31.80]	Imaging
Chalmers et al., 2019 [16]	Australia	- Knee arthroscopy in case of osteoarthritis or meniscal derangements	Secondary care	Service	RACP EVOLVE, CW Australia, CW USA, CW Canada, CW UK guidelines/recommendations	3 620	2 958	81.70 [80.41 ; 82.96]	Imaging
		- Endoscopy in case of dyspepsia below 50 years				5 021	501	9.97 [9.16 ; 10.84]	Imaging
		- Colonoscopy in case of constipation below 50 years				4 017	133	3.31 [2.78 ; 3.91]	Imaging
Charlesworth et al., 2016 [35] <sup>a</sup>	United States	- Imaging for nonspecific low-back pain	Both	Patient-indication	CW USA, NICE guidelines/recommendations and QualityNet measures from the Center for Medicaid & Medicare Services (CMS)	82 659	12 977	15.70 [15.45 ; 15.95]	Imaging
		- Head imaging for uncomplicated headache				65 931	7 252	11.0 [10.76 ; 11.24]	Imaging
		- Head imaging for syncope				7 466	672	9.0 [8.36 ; 9.67]	Imaging
		- Imaging for plantar fasciitis				10 986	1 999	18.20 [17.48 ; 18.93]	Imaging
		- T3 test for hypothyroidism				31 228	5 090	16.30 [15.89 ; 16.71]	Laboratory test
		- Pre-operative chest radiography				39 169	1 684	4.30 [4.10 ; 4.5]	Imaging
		- Abdomen CT combined studies				28 075	2 106	7.50 [7.20 ; 7.82]	Imaging
		- Simultaneous brain and sinus CT				9 742	360	3.70 [3.33 ; 4.09]	Imaging
- CT for uncomplicated acute rhinosinusitis	59 961	1 799	3.0 [2.87 ; 3.14]	Imaging					

		- Arthroscopic surgery for knee osteoarthritis				23 190	1 136	4.90 [4.62 ; 5.18]	Imaging
		- Thorax CT combined studies				9 287	111	1.20 [0.98 ; 1.44]	Imaging
		- Preoperative echocardiography				39 169	235	0.60 [0.53 ; 0.68]	Imaging
		- Preoperative stress testing				39 169	118	0.30 [0.25 ; 0.36]	Imaging
		- Electroencephalogram for headache				59 936	60	0.10 [0.08 ; 0.13]	Other test
Charlesworth et al., 2016 [35] <sup>b</sup>	United States	- Imaging for nonspecific low-back pain	Both	Patient-indication	CW USA , NICE	18 871	4 625	22.60 [22.01 ; 23.2]	Imaging
		- Head imaging for uncomplicated headache			guidelines/recommendations and	23 211	4 317	18.60 [18.10 ; 19.11]	Imaging
		- Head imaging for syncope			QualityNet measures from the	3 174	448	14.10 [12.92 ; 15.37]	Imaging
		- Imaging for plantar fasciitis			Center for Medicaid & Medicare	1 450	180	12.40 [10.76 ; 14.22]	Imaging
		- T3 test for hypothyroidism			Services (CMS)	5 891	619	10.50 [9.74 ; 11.32]	Laboratory test
		- Pre-operative chest radiography				7 848	753	9.60 [8.95 ; 10.27]	Imaging
		- Abdomen CT combined studies				13 416	657	4.90 [4.54 ; 5.28]	Imaging
		- Simultaneous brain and sinus CT				7 761	357	4.60 [4.14 ; 5.09]	Imaging
		- CT for uncomplicated acute rhinosinusitis				11 992	348	2.90 [2.61 ; 3.22]	Imaging
		- Arthroscopic surgery for knee osteoarthritis				6 143	166	2.70 [2.31 ; 3.14]	Imaging
		- Thorax CT combined studies				3 822	76	2.0 [1.57 ; 2.48]	Imaging
		- Preoperative echocardiography				7 848	86	1.10 [0.88 ; 1.35]	Imaging
		- Preoperative stress testing				7 848	47	0.60 [0.44 ; 0.8]	Imaging
		- Electroencephalogram for headache				20 091	60	0.30 [0.23 ; 0.38]	Other test
Chmiel et al., 2015 [19]	Switzerland	- Performance of a diagnostic coronary angiography without previous non-invasive ischemia testing	Unclear	Patient-indication	The American heart association (AHA), NICE, the European Society of Cardiology (ESC) & Swiss Society of Cardiology (SGK) guidelines/recommendations	2 714	1 018	37.50 [35.68 ; 39.36]	Imaging
Choi et al., 2011 [40]	United States	- Routine cross-sectional imaging (CT, MRI, endorectal coil MRI) for staging low-risk prostate cancer	Unclear	Patient-indication	American College of Radiology (ACR) & National Comprehensive Cancer Network (NCCN) guidelines/recommendations	2 330	548	23.50 [21.81 ; 25.3]	Imaging
		- Routine bone scan for staging low-risk prostate cancer				2 330	617	26.50 [24.70 ; 28.32]	Imaging
		- Routine abdominal ultrasound for staging low-risk prostate cancer				2 330	42	1.80 [1.30 ; 2.43]	Imaging
Colla et al., 2014 [27]	United States	- Low back X-ray, CT or MRI within six weeks of incident low-back pain diagnosis	Both	Patient-indication	American Academy of Family Physicians (AAFP), American College of Physicians (ACP) & North American Spine Society	8 440 000	1 899 000	22.50 [22.48 ; 22.52]	Imaging
		- Intravenous pyelogram or an abdominal CT, MRI, or ultrasound within 60 days of the				75 000 000	900 000	1.20 [1.20 ; 1.20]	Imaging

		index diagnosis benign prostatic hyperplasia (BPH)			(NASS) guidelines/recommendations				
		- DXA scans performed on female beneficiaries at low risk for fracture within 23 months of a previous scan				147 420 000	14 299 740	9.70 [9.70 ; 9.70]	Imaging
		- Non-indicated cardiac test, including stress tests, echocardiograms, electrocardiograms and advanced cardiac imaging in the 30 days before cataract surgery				6 490 000	999 460	15.40 [15.37 ; 15.43]	Imaging
		- Non-indicated cardiac test, including stress tests, echocardiograms, electrocardiograms, CTs, MRIs or PETs within 30 days before low-risk surgery				3 550 000	1 650 750	46.50 [46.46 ; 46.54]	Imaging
Colla et al., 2018 [36] <sup>a</sup>	United States	- Early imaging inf patients with uncomplicated, incident low-back pain who received nonindicated low-back-pain imaging in the 6 weeks following diagnosis	Both	Patient-indication	American Academy of Family Physicians (AAFP)& American College of Physicians (ACP) guidelines/recommendations	3 110 000	895 680	28.80 [28.76 ; 28.84]	Imaging
		- Short-interval repeat bone densitometry (DXA)				8 000 000	600 000	7.50 [7.48 ; 7.52]	Imaging
Colla et al., 2018 [36] <sup>c</sup>	United States	- Early imaging inf patients with uncomplicated, incident low-back pain who received nonindicated low-back-pain imaging in the 6 weeks following diagnosis	Both	Patient-indication	American Academy of Family Physicians (AAFP)& American College of Physicians (ACP) guidelines/recommendations	8 400 000	1 898 400	22.60 [22.58 ; 22.62]	Imaging
		- Short-interval repeat bone densitometry (DXA)				143 000 000	12 155 000	8.50 [8.50 ; 8.5]	Imaging
Doukky et al., 2016 [41]	United States	- SPECT-MPI (myocardial perfusion imaging)	Unclear	Patient-indication	The American College of Cardiology (ACC)& American Society of Nuclear Cardiology (ASNC) revised appropriate use criteria (AUC) for SPECT MPI of 2009	1 511	688	45.53 [22.58 ; 22.62]	Imaging
Drangsholt et al., 2019 [42]	United States	- Routine imaging for staging low-risk prostate cancer (Whole body scan)	Secondary care	Patient-indication	National Comprehensive Cancer Network (NCCN) guidelines/recommendations	414	381	92.0 [88.99 ; 94.45]	Imaging
		- Routine imaging for staging low-risk prostate cancer (CT)				414	273	66.0 [61.15 ; 70.5]	Imaging

		- Routine imaging for staging low-risk prostate cancer (abdominal/pelvic MRI)				414	8	2.0 [0.84 ; 3.77]	Imaging
Farghaly et al., 2006 [43]	United States	- V-Pap after T-Hyst	Unclear	Service	US Preventive Services Task Force (USPTF) & American Society for Colposcopy and Cervical Pathology (ASCCP) guidelines/recommendations	1 303	581	44.59 [41.87 ; 47.34]	Laboratory test
Feng et al., 2016 [44]	United States	- Preoperative ECGs in patients undergoing sling surgery	Unclear	Service	Summary guidelines from the American Academy of Family Physicians (AAFP)	63	13	20.60 [11.47 ; 32.7]	Imaging
		- Preoperative chest X-ray (CXR) in patients undergoing sling surgery				23	9	39.10 [19.71 ; 61.46]	Imaging
		- Preoperative basic metabolic panel in patients undergoing sling surgery				59	28	47.50 [34.30 ; 60.88]	Laboratory test
		- Preoperative complete blood count determination in patients undergoing sling surgery				63	46	73.0 [60.35 ; 83.43]	Laboratory test
		- Preoperative coagulation studies in patients undergoing sling surgery				41	31	75.60 [59.70 ; 87.64]	Laboratory test
Flaherty et al., 2018 [38]	United States	- MRI use in case of uncomplicated LBP	Both	Patient-indication	American College of Radiology (ACR) guidelines	5 103	1 838	36.01 [59.70 ; 87.64]	Imaging
		- MRI use in case of non-traumatic Knee pain				6 935	3 384	48.79 [47.61 ; 49.98]	Imaging
		- MRI use in case of non-traumatic shoulder pain				9 388	4 011	42.72 [41.72 ; 43.73]	Imaging
		- X-ray use in case of uncomplicated LBP				10 540	6 650	63.09 [62.16 ; 64.02]	Imaging
		- X-ray use in case non-traumatic Knee pain				37 543	25 668	68.37 [67.90 ; 68.84]	Imaging
		- X-ray use in case of non-traumatic shoulder pain				36 453	26 100	71.60 [71.13 ; 72.06]	Imaging
Ganguli et al., 2019 [45]	United States	- EKGs for cataract surgeries	Unclear	Patient-indication	Choosing Wisely recommendations from the American Academy of Ophthalmology & American Society for Clinical Pathology	110 183	12 451	11.30 [11.11 ; 11.49]	Imaging
Gidwani et al., 2016 [46]	United States	- Lumbar Spine MRI's for non-specific or nonpersistent low-back pain	Unclear	Service	The American College of Physicians (ACP) and the American Association of Neurological Surgeons (AANS) guidelines/recommendations and	110 661	33 973	30.70 [30.43 ; 30.97]	Imaging

					the National Quality forum (NQF)- endorsed CMS criteria				
Gill et al., 2017 [47]	Canada	- Thyroid testing	Unclear	Service	Clinical practice guidelines and Choosing Wisely guidelines/recommendations from the American Society for Clinical Pathology (ASCP), American Association for Clinical Chemistry (AACC), American Association of Clinical Endocrinologists (AACE), Canadian Society of Endocrinology and Metabolism (CSEM), Endocrine society.	752 217	75 974	10.10 [10.04 ; 10.16]	Laboratory test
Gold et al., 2016 [37] <sup>d</sup>	United States	- Imaging in patients with non-specific low-back pain (X-ray, CT, MRI)	Primary care	Patient-indication	American Academy of Family Physicians National Quality Measures Clearinghouse (NQMC) guidelines/recommendations	19 503	3 288	16.86 [16.34 ; 17.39]	Imaging
Gold et al., 2016 [37] <sup>e</sup>	United States	- Imaging in patients with non-specific low-back pain (X-ray, CT, MRI)	Primary care	Patient-indication	American Academy of Family Physicians National Quality Measures Clearinghouse (NQMC) guidelines/recommendations	2 694	449	16.67 [15.28 ; 18.13]	Imaging
Hajati et al., 2018 [48]	Australia	- High density lipoprotein cholesterol testing more often than once every 12 months for high-risk groups	Unclear	Patient-indication	Royal Australian College of General Practitioners (RACGP) guidelines	1 628 477	309 411	19.0 [18.95 ; 19.05]	Laboratory test
Kool et al., 2020 [18]	The Netherlands	- Doppler or plethysmography for diagnosis of varices	Primary care	Patient-indication	Dutch general practitioner, CW USA & CW Canada guidelines/recommendations	15 990	1 279	8.0 [7.58 ; 8.43]	Imaging
Kovacs et al., 2013 [20]	Spain	- Lumbar Spine MRI's for low-back pain without red flags.	Unclear	Service	National Institute for Clinical Excellence (NICE), the American College of Physicians and the American College of Radiologists guidelines/recommendations	602	64	10.60 [8.28 ; 13.37]	Imaging

Lalude et al., 2014 [49]	United States	- Inappropriate Single photon emission computed tomography myocardial perfusion imaging (SPECT MPI) utilization	Unclear	Service	The American College of Cardiology (ACC)& American Society of Nuclear Cardiology (ASNC) revised appropriate use criteria (AUC) for SPECT MPI of 2009	54	8	14.0 [6.62 ; 27.12]	Imaging
Lehnert et al., 2010 [50]	United States	- CT use - MRI use	Primary care	Service	American College of Radiology (ACR) Appropriateness Criteria and other evidence-based guidelines/recommendations	284	77	27.11 [17.37 ; 30.41]	Imaging
						175	41	23.43 [22.03 ; 32.68]	Imaging
Mafi et al., 2017 [17]	United States	- Baseline lab tests for low risk patients having low-risk surgery - Stress cardiac or other cardiac imaging in low-risk, asymptomatic patients - Routine head CT scans for Emergency Department visits for severe dizziness - EKGs, chest x-rays, or pulmonary function tests in low-risk patients having low-risk surgery - Routine imaging for uncomplicated acute rhinosinusitis - Imaging for low-back pain within the first six weeks of symptom onset, in absence of red flags	Unclear	Service	CW USA, US Preventive Services Task Force (USPTF), Medicare's Healthcare Effectiveness Data and Information Set (HEDIS) criteria and other clinical guidelines/recommendations	595 552	468 104	78.60 [78.51 ; 78.69]	Laboratory test
						244 487	27 383	11.20 [11.08 ; 11.32]	Imaging
						29 816	15 713	52.70 [52.13 ; 53.27]	Imaging
						33 754	32 910	97.50 [97.33 ; 97.66]	Imaging
						14 196	7 226	50.90 [50.08 ; 51.73]	Imaging
						48 857	48 857	86.20 [85.89 ; 86.51]	Imaging
Martin et al., 2012 [51]	United States	- MRI use in musculoskeletal oncology	Both	Patient-indication	Referral guidelines for patients with cancer	320	20	6.25 [3.86 ; 9.49]	Imaging
McAlister et al. 2018 [52]	Canada	- PSA testing for men 75 or older with no history of prostate cancer - Bone mineral density testing within 2 years of prior scan - Hypercoagulability testing in patients with first Deep Vein Thrombosis/ Pulmonary Embolism - Preoperative coronary CT scan or cardiac stress test before non-cardiac surgery - Homocysteine testing without B12/folate	Both	Patient-population	CW and NICE guidelines/recommendations	100 227	55 596	55.47 [55.16 ; 55.78]	Laboratory test
						271 854	31 617	11.63 [11.52 ; 11.74]	Imaging
						21 311	744	3.49 [3.25 ; 3.75]	Laboratory test
						698 683	7 266	1.04 [1.02 ; 1.06]	Imaging
						2 585 832	10 602	0.41 [0.40 ; 0.42]	Laboratory

		deficiency							test
		- Carotid artery imaging but without history of stroke / TIA				3 162 394	2 846	0.09 [0.09 ; 0.09]	Imaging
		- Carotid artery imaging for patients with syncope but no history of stroke / TIA				74 060	355	0.48 [0.43 ; 0.53]	Imaging
Morden et al., 2014 [53]	United States	- Short-interval (repeated in under 2 years) dual-energy X-ray absorptiometry tests (DXAs) for bone density	Unclear	Service	The American College of Rheumatology guidelines/recommendations	13 800 000	1 393 800	10.10 [10.08 ; 10.12]	Imaging
Mou et al., 2017 [54]	United States	- Thrombophilia in adult patients with venous thromboembolism occurring in the setting of major transient risk factors (surgery, trauma, or prolonged immobility)	Secondary care	Service	The American Society of Hematology (ASH) and Clinical guidelines/recommendations	1 817	777	42.76 [40.47 ; 45.08]	Laboratory test
Pendrith et al., 2017 [55]	Canada	- Imaging for low back pain in absence of red flags - DEXA scans repeated under 2 years	Primary care	Patient-indication	CW Canada, CW USA	271 588 2 229 113	12 222 468 114	4.5 [4.42 ; 4.58] 21.0 [20.95 ; 21.05]	
Petruzzello et al., 2012 [21]	Italy	- Colonoscopy use	Both	Patient-indication	The American Society for Gastrointestinal Endoscopy (ASGE) guidelines/recommendations	432	125	29.0 [24.70 ; 33.46]	Imaging
Schwartz et al., 2014 [13]	United States	- Bone mineral density test <2 y after prior bone mineral density test - Homocysteine testing for cardiovascular disease - Hypercoagulability testing for patients with deep vein thrombosis - PTH (parathyroid hormone) measurement for patients with stage 1-3 CKD (chronic kidney disease) - Preoperative chest radiograph specified as a preoperative assessment or occurring within 30 days before a low- or intermediate-risk noncardiothoracic surgical procedure - Preoperative echocardiography before a low- or intermediate-risk noncardiothoracic surgery	Both	Patient-population	CW USA, the US Preventive Services Task Force "D", NICE "do not do", Canadian Agency for Drugs and Technologies in Health (CADTH) guidelines/recommendations and guidelines from peer-reviewed medical literature	1 360 908 1 360 908 1 360 908 1 360 908 1 360 908 1 360 908	127 925 20 414 1 361 34 023 69 406 10 887	9.40 [9.35 ; 9.45] 1.50 [1.48 ; 1.52] 0.10 [0.09 ; 0.11] 2.50 [2.47 ; 2.53] 5.10 [5.06 ; 5.14] 0.80 [0.78 ; 0.82]	Imaging Laboratory test Laboratory test Laboratory test Imaging Imaging

		- CT of the sinuses for uncomplicated acute rhinosinusitis				1 360 908	8 165	0.60 [0.59 ; 0.61]	Imaging
		- Head imaging in the evaluation of syncope				1 360 908	17 692	1.30 [1.28 ; 1.32]	Imaging
		- Head imaging for uncomplicated headache				1 360 908	42 188	3.10 [3.07 ; 3.13]	Imaging
		- EEG for headaches				1 360 908	1 361	0.10 [0.09 ; 0.11]	Other test
		- Back imaging for patients with nonspecific low back pain				1 360 908	127 925	9.40 [9.35 ; 9.45]	Imaging
		- Arthroscopic surgery for knee osteoarthritis				1 360 908	2 722	0.2 [0.19 ; 0.21]	Imaging
Scott et al., 2014 [56]	United States	- Carotid duplex ultrasound (CDUS) for simple syncope in the absence of focal neurological signs or symptoms suggestive of stroke	Unclear	Patient-indication	European Society of Cardiology's Task Force on Syncope & American College of Physicians' Clinical (ACP) Efficacy Assessment Project guidelines/recommendations	137 424	8 933	6.50 [6.37 ; 6.63]	Imaging
Sharp et al., 2015 [57]	United States	- CT scan for acute sinusitis	Both	Patient-indication	American Academy of Family Physicians (AAFP), American Academy of Allergy, Asthma and Immunology (AAAAI), American Academy of Otolaryngology-Head and Neck surgery (AAO-HNS) CW guidelines/recommendations	152 774	1681	1.1 [1.05 ; 1.15]	Imaging
Sheffield et al., 2013 [58]	United States	- Cardiac Stress tests prior to elective non-cardiac, non-vascular surgery: Echocardiograms, Myocardial nuclear imaging, Exercise treadmill or pharmacological stress tests	Secondary care	Patient-indication	American College of Cardiology (ACC) & American Heart Association guidelines (AHA) guidelines/recommendations	74 785	2 804	3.75 [3.61 ; 3.89]	Imaging
Sprenger et al., 2016 [59]	Austria	- DEXA scans more often than every 2 years	Primary care	Patient-population	CW USA, CW Canada, NICE recommendations/guidelines and contradicted medical practices and potentially low-value health care practices identified by the studies Prasad et al., 2013 and Elshaug et al., 2012	246 131	12 282	4.99 [4.91 ; 5.07]	Imaging
		- Total or free T3 level when assessing levothyroxine (T4) dose in hypothyroid patients				246 131	34 434	13.99 [13.86 ; 14.12]	Laboratory test
		- Men 75 to 80 years old with a PSA less than 3ng/ml are unlikely to die or experience aggressive prostate cancer during their remaining life, suggesting that PSA testing may be safely discontinued in these men.				246 131	13 390	5.44 [5.35 ; 5.53]	Laboratory test
		- Pap smears on women younger than 21				246 131	10 387	4.22 [4.14 ; 4.3]	Laboratory



		years who have had a hysterectomy for non-cancer disease.							test
		- Routine monitoring of bone mineral density after starting bisphosphonate treatment				246 131	271	0.11 [0.10 ; 0.12]	Imaging
Xu et al., 2013 [8]	United States	- X-ray in outpatient management of uncomplicated Upper Respiratory Infections (URI's)	Primary care	Patient-indication	Centres for Disease Control and Prevention (CDC) guidelines	2 200 000	1 012 000	46.0 [45.95 ; 46.05]	Imaging
		- CT in outpatient management of uncomplicated Upper Respiratory Infections (URI's)				2 200 000	44 000	2.0 [1.98 ; 2.02]	Imaging

Among the included studies, some studies contained multiple assessments undertaken in different cohorts. These assessments are distinguished by the following: <sup>a</sup> assessment performed among a commercially insured population, <sup>b</sup> assessment performed among Medicaid beneficiaries, <sup>c</sup> assessment performed among Medicare beneficiaries, <sup>d</sup> assessment performed using Kaiser Permanente Epic EHR data, <sup>e</sup> assessment performed using data derived from the Oregon Community Health Information Network. Abbreviations: CT, Computed Tomography; CW, Choosing Wisely; DEXA or DXA, Dual Energy X-ray absorptiometry; EKG, Electrocardiogram; LBP, low-back pain; MRI, Magnetic Resonance Imaging; NICE, National Institute for Health and Care Excellence; PSA, Prostate-Specific Antigen; RACP, Royal Australasian College of Physicians; SPECT MPI, Single-Photon Emission computed tomography; TIA, Transient Ischemic Attack; T-hyst, Total Hysterectomy.