QUERI

Evidence Brief: Use of Performance Measures as Criteria for Selecting Community Cardiac and Orthopedic Surgical Providers for the Veterans Choice Program Supplemental Materials

June 2017

Prepared for:
Department of Veterans Affairs
Veterans Health Administration
Quality Enhancement Research Initiative
Health Services Research & Development Service
Washington, DC 20420

Prepared by:
Evidence-based Synthesis Program (ESP)
Coordinating Center
Portland VA Health Care System
Portland, OR
Mark Helfand, MD, MPH, MS, Director

Investigators:
Kim Peterson, MS
Johanna Anderson, MPH
Donald Bourne, MPH
Erin Boundy, MS
Mark Helfand, MD, MS, MPH

TABLE OF CONTENTS

APPENDIX A: EXISTING PERFORMANCE MEASURE SETS

Organization	Clinical Area	Number of Measures	Measure Development Process
NQF[1-3]	All Includes surgery specific measures – cardiac, orthopedic	NQF: · 50 - Search of cardiac surgery, orthopedic surgery, hip/pelvic fracture surgery, thoracic surgery CMS Core Measure Sets: · CABG – 4 · Ortho - 9	Expert consensus
VASQIP[4,5]	Surgery - all	97	National VA Surgical Risk Study (NVASRS) 1991-1993. Prospective study on surgical measures and outcomes aimed at developing risk prediction models.
NSQIP[6-8]	Surgery – all	135 from Shiloach 2010 75 cardiac specific, reported in Dixon 2015 - 46 preoperative - 4 intraoperative - 25 postoperative	Model taken from VASQIP and now managed by ACS
SCIP[9]	Surgery – all	15 Infection – 7 Cardiac – 2 VTE – 4 Global – 2	Expert consensus
STS[6]	Cardiac	27 counted on website - 1 composite - 18 outcome - 7 process - 1 structure 121 reported from Dixon 2015 - 59 preoperative - 45 intraoperative - 17 postoperative	Endorsed or considered for endorsement by NQF

APPENDIX B: SEARCH STRATEGIES

1. Readmissions	
A. Required sources:	**Evidence:**
Medline Date: 3/15/17	Database: Ovid MEDLINE(R) <1946 to March Week 2 2017>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <March 15, 2017> Search Strategy: ---------- 1 exp Patient Readmission/ (11478) 2 Readmission*.ti,ab,kw. (16316) 3 1 or 2 (21425) 4 exp Quality Indicators, Health Care/ (16977) 5 exp "Outcome and Process Assessment (Health Care)"/ (908342) 6 (Quality or ACS NSQIP).ti,ab. (739312) 7 4 or 5 or 6 (1577404) 8 exp Thoracic Surgery/ (11984) 9 Thorax/su [Surgery] (2527) 10 exp Cardiovascular Surgical Procedures/ (337795) 11 exp Thoracic Surgical Procedures/ (297945) 12 Orthopedics/su [Surgery] (152) 13 exp Orthopedic Procedures/ (251138) 14 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1933243) 15 8 or 9 or 10 or 11 or 12 or 13 or 14 (2369834) 16 3 and 7 and 15 (2241) 17 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (7133227) 18 surg*.ti,ab. (1581744) 19 16 and 18 (1059) 20 17 and 19 (601) 21 (surg* and measure* and quality and readmission*).ti. (9) 22 20 or 21 (605) 23 limit 22 to english language (588) 24 remove duplicates from 23 (560) **********
Cochrane Database of Systematic Reviews & Methodology Register Date: 3/15/17	Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to March 15, 2017> Search Strategy: ---------- 1 [exp Patient Readmission/] (0) 2 Readmission*.ti,ab,kw. (39) 3 1 or 2 (39) 4 [exp Quality Indicators, Health Care/] (0) 5 [exp "Outcome and Process Assessment (Health Care)"/] (0) 6 (Quality or ACS NSQIP).ti,ab. (5026) 7 4 or 5 or 6 (5026) 8 [exp Thoracic Surgery/] (0) 9 [Thorax/su [Surgery]] (0) 10 [exp Cardiovascular Surgical Procedures/] (0) 11 [exp Thoracic Surgical Procedures/] (0) 12 [Orthopedics/su [Surgery]] (0) 13 [exp Orthopedic Procedures/] (0) 14 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1077) 15 8 or 9 or 10 or 11 or 12 or 13 or 14 (1077) 16 3 and 7 and 15 (4)

	17 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (3124) 18 surg*.ti,ab. (1518) 19 16 and 18 (1) 20 17 and 19 (0) 21 (surg* and measure* and quality and readmission*).ti. (0) 22 20 or 21 (0) 23 limit 22 to english language [Limit not valid; records were retained] (0) 24 remove duplicates from 23 (0) **********
CCRCT Date: 3/15/17	Database: EBM Reviews - Cochrane Central Register of Controlled Trials <February 2017> Search Strategy: --- 1 exp Patient Readmission/ (727) 2 Readmission*.ti,ab,kw. (2312) 3 1 or 2 (2670) 4 exp Quality Indicators, Health Care/ (295) 5 exp "Outcome and Process Assessment (Health Care)"/ (113624) 6 (Quality or ACS NSQIP).ti,ab. (63313) 7 4 or 5 or 6 (164168) 8 exp Thoracic Surgery/ (151) 9 Thorax/su [Surgery] (2) 10 exp Cardiovascular Surgical Procedures/ (16505) 11 exp Thoracic Surgical Procedures/ (13683) 12 Orthopedics/su [Surgery] (0) 13 exp Orthopedic Procedures/ (9539) 14 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (118774) 15 8 or 9 or 10 or 11 or 12 or 13 or 14 (131844) 16 3 and 7 and 15 (295) 17 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (355878) 18 surg*.ti,ab. (103574) 19 16 and 18 (75) 20 17 and 19 (40) 21 (surg* and measure* and quality and readmission*).ti. (0) 22 20 or 21 (40) 23 limit 22 to english language (39) 24 remove duplicates from 23 (38) **********
NHS Economic Evaluation Date: 3/15/17	Database: EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016> Search Strategy: --- 1 exp Patient Readmission/ (161) 2 Readmission*.ti,ab,kw. (20) 3 1 or 2 (164) 4 exp Quality Indicators, Health Care/ (27) 5 exp "Outcome and Process Assessment (Health Care)"/ (4159) 6 (Quality or ACS NSQIP).ti,ab. (302) 7 4 or 5 or 6 (4372) 8 exp Thoracic Surgery/ (10) 9 Thorax/su [Surgery] (0) 10 exp Cardiovascular Surgical Procedures/ (710) 11 exp Thoracic Surgical Procedures/ (629) 12 Orthopedics/su [Surgery] (0) 13 exp Orthopedic Procedures/ (547) 14 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab.

	(1026) 15 8 or 9 or 10 or 11 or 12 or 13 or 14 (2004) 16 3 and 7 and 15 (22) 17 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (263) 18 surg*.ti,ab. (1088) 19 16 and 18 (10) 20 17 and 19 (0) 21 (surg* and measure* and quality and readmission*).ti. (0) 22 20 or 21 (0) 23 limit 22 to english language (0) 24 remove duplicates from 23 (0) **********
CINAHL Date: 3/15/17	Database: EBSCOhost CINAHL Plus with Full Text Search Strategy: --- S1 (MH "Readmission") (7499) S2 TI Readmission$ OR AB Readmission$ OR MW Readmission$ (10419) S3 S1 OR S2 (10419) S4 (MH "Clinical Indicators") (9413) S5 (MH "Outcome Assessment") OR (MH "Process Assessment (Health Care)+"))"/ (34719) S6 TI (Quality OR ACS NSQIP) OR AB (Quality OR ACS NSQIP) (200910) S7 S4 OR S5 OR S6 (234270) S8 (MH "Thoracic Surgery+") (44891) S9 (MH "Surgery, Cardiovascular+") (46637) S10 (MH "Orthopedic Surgery+") (74399) S11 (MH "Orthopedics") (8756) S12 TI (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) OR AB (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) (125150) S13 S8 OR S9 OR S10 OR S11 OR S12 (231496) S14 S3 and S7 and S13 (279) S15 TI (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) OR AB (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) (503422) S16 TI surg* OR AB surg* (220124) S17 S14 AND S16 (191) S18 S15 AND S17 (117) S19 TI (surg$ AND measure$ AND quality AND readmission$) OR AB (surg$ AND measure$ AND quality AND readmission$) (0) S20 S18 AND S19 (117) S21 limit S20 to english language (115) **********

2. Mortality Rates	
A. Required sources:	**Evidence:**
Medline Date: 3/22/17 Updated: 4/4/17	Database: Ovid MEDLINE(R) <1946 to March Week 4 2017>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <April 03, 2017> Search Strategy: --- 1 exp Quality Indicators, Health Care/ (17040) 2 exp "Outcome and Process Assessment (Health Care)"/ (911588) 3 (Quality or ACS NSQIP).ti,ab. (743554) 4 1 or 2 or 3 (1584625) 5 exp Thoracic Surgery/ (11990)

	6 Thorax/su [Surgery] (2527) 7 exp Cardiovascular Surgical Procedures/ (338850) 8 exp Thoracic Surgical Procedures/ (298602) 9 Orthopedics/su [Surgery] (152) 10 exp Orthopedic Procedures/ (251714) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1939359) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (2376877) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (7160734) 14 surg*.ti,ab. (1586814) 15 (surg* and measure* and quality and mortality).ti. (3) 16 (30 day mortality or 60 day mortality or 90 day mortality).ti,ab,kw. (11751) 17 Postoperative Mortality.mp. (6323) 18 16 or 17 (17701) 19 4 and 12 and 18 (4124) 20 13 and 19 (1858) 21 14 and 20 (1244) 22 15 or 21 (1247) 23 remove duplicates from 22 (1205) 24 limit 23 to english language (1137) **********
Cochrane Database of Systematic Reviews & Methodology Register Date: 3/24/17	Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to March 22, 2017> Search Strategy: --- 1 (Quality or ACS NSQIP).ti,ab. (5034) 2 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1077) 3 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (3135) 4 surg*.ti,ab. (1519) 5 (surg* and measure* and quality and mortality).ti. (0) 6 (30 day mortality or 60 day mortality or 90 day mortality).ti,ab,kw. (21) 7 Postoperative Mortality.mp. (73) 8 6 or 7 (89) 9 1 and 2 and 8 (17) 10 4 and 9 (16) 11 3 and 10 (7) **********
CCRCT Date: 4/4/17	Database: EBM Reviews - Cochrane Central Register of Controlled Trials <February 2017> Search Strategy: --- 1 exp Quality Indicators, Health Care/ (295) 2 exp "Outcome and Process Assessment (Health Care)"/ (113624) 3 (Quality or ACS NSQIP).ti,ab. (63313) 4 1 or 2 or 3 (164168) 5 exp Thoracic Surgery/ (151) 6 Thorax/su [Surgery] (2) 7 exp Cardiovascular Surgical Procedures/ (16505) 8 exp Thoracic Surgical Procedures/ (13683) 9 Orthopedics/su [Surgery] (0) 10 exp Orthopedic Procedures/ (9539) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (118774) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (131844) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (355878) 14 surg*.ti,ab. (103574)

	15 (surg* and measure* and quality and mortality).ti. (0) 16 (30 day mortality or 60 day mortality or 90 day mortality).ti,ab,kw. (1289) 17 Postoperative Mortality.mp. (316) 18 16 or 17 (1586) 19 4 and 12 and 18 (267) 20 13 and 19 (123) 21 14 and 20 (70) 22 15 or 21 (70) 23 remove duplicates from 22 (68) 24 limit 23 to english language (67) **********
NHS Economic Evaluation Date: 4/4/17	Database: EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016> Search Strategy: --- 1 exp Quality Indicators, Health Care/ (27) 2 exp "Outcome and Process Assessment (Health Care)"/ (4159) 3 (Quality or ACS NSQIP).ti,ab. (302) 4 1 or 2 or 3 (4372) 5 exp Thoracic Surgery/ (10) 6 Thorax/su [Surgery] (0) 7 exp Cardiovascular Surgical Procedures/ (710) 8 exp Thoracic Surgical Procedures/ (629) 9 Orthopedics/su [Surgery] (0) 10 exp Orthopedic Procedures/ (547) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1026) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (2004) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (263) 14 surg*.ti,ab. (1088) 15 (surg* and measure* and quality and mortality).ti. (0) 16 (30 day mortality or 60 day mortality or 90 day mortality).ti,ab,kw. (0) 17 Postoperative Mortality.mp. (5) 18 16 or 17 (5) 19 4 and 12 and 18 (0) 20 13 and 19 (0) 21 14 and 20 (0) 22 15 or 21 (0) 23 remove duplicates from 22 (0) 24 limit 23 to english language (0) **********
CINAHL Date: 4/4/17	Database: EBSCOhost CINAHL Plus with Full Text Search Strategy: --- S1 (MH "Clinical Indicators") (9431) S2 (MH "Outcome Assessment") OR (MH "Process Assessment (Health Care)+"))"/ (34859) S3 TI (Quality OR ACS NSQIP) OR AB (Quality OR ACS NSQIP) (201663) S4 S1 OR S2 OR S3 (235154) S5 (MH "Thoracic Surgery+") (45131) S6 (MH "Surgery, Cardiovascular+") (46846) S7 (MH "Orthopedic Surgery+") (74809) S8 (MH "Orthopedics") (8797) S9 TI (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) OR AB (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) (126064) S10 S5 OR S6 OR S7 OR S8 OR S9 (232937)

	S11 TI (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) OR AB (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) (505470) S12 TI surg* OR AB surg* (221304) S13 TI (surg$ AND measure$ AND quality AND readmission$) OR AB (surg$ AND measure$ AND quality AND mortality) (3) S14 TI ((30 day mortality OR 60 day mortality OR 90 day mortality)) OR AB ((30 day mortality OR 60 day mortality OR 90 day mortality)) (2466) S15 (MH "Mortality") (19322) S16 Postoperative Mortality (512) S17 S14 OR S15 OR S16 (22018) S18 S4 AND S10 AND S17 (234) S19 S11 AND S18 (93) S20 S12 AND S19 (69) S21 S13 OR S20 (72) **********

3. Post-op Care Plan	
A. Required sources:	**Evidence:**
Medline Date: 3/22/17 Updated: 4/4/17	Database: Ovid MEDLINE(R) <1946 to March Week 4 2017>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <April 03, 2017> Search Strategy: ---------- 1 exp Quality Indicators, Health Care/ (17040) 2 exp "Outcome and Process Assessment (Health Care)"/ (911588) 3 (Quality or ACS NSQIP).ti,ab. (743554) 4 1 or 2 or 3 (1584625) 5 exp Thoracic Surgery/ (11990) 6 Thorax/su [Surgery] (2527) 7 exp Cardiovascular Surgical Procedures/ (338850) 8 exp Thoracic Surgical Procedures/ (298602) 9 Orthopedics/su [Surgery] (152) 10 exp Orthopedic Procedures/ (251714) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1939359) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (2376877) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (7160734) 14 surg*.ti,ab. (1586814) 15 (surg* and measure* and quality and mortality).ti. (3) 16 patient care planning.mp. or exp Patient Care Planning/ (59227) 17 (care pathway* or clinical pathway*).ti,ab,kw. (5171) 18 16 or 17 (62380) 19 (home care or nursing home or assisted living).ti,ab. (34207) 20 18 and 19 (1255) 21 4 and 12 and 20 (32) **********
Cochrane Database of Systematic Reviews & Methodology Register Date: 3/24/17	Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to March 22, 2017> Search Strategy: ---------- 1 (Quality or ACS NSQIP).ti,ab. (5034) 2 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1077) 3 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (3135) 4 surg*.ti,ab. (1519)

	5 (surg* and measure* and quality and care).ti. (0) 6 patient care planning.mp. (33) 7 (care pathway* or clinical pathway*).ti,ab,kw. (14) 8 (home care or nursing home or assisted living).ti,ab. (26) 9 6 or 7 or 8 (70) 10 1 and 2 and 9 (5) 11 3 and 10 (4) 12 4 and 11 (0) **********
CCRCT Date: 4/4/17	Database: EBM Reviews - Cochrane Central Register of Controlled Trials <February 2017> Search Strategy: --- 1 exp Quality Indicators, Health Care/ (295) 2 exp "Outcome and Process Assessment (Health Care)"/ (113624) 3 (Quality or ACS NSQIP).ti,ab. (63313) 4 1 or 2 or 3 (164168) 5 exp Thoracic Surgery/ (151) 6 Thorax/su [Surgery] (2) 7 exp Cardiovascular Surgical Procedures/ (16505) 8 exp Thoracic Surgical Procedures/ (13683) 9 Orthopedics/su [Surgery] (0) 10 exp Orthopedic Procedures/ (9539) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (118774) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (131844) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (355878) 14 surg*.ti,ab. (103574) 15 (surg* and measure* and quality and mortality).ti. (0) 16 patient care planning.mp. or exp Patient Care Planning/ (1361) 17 (care pathway* or clinical pathway*).ti,ab,kw. (429) 18 16 or 17 (1697) 19 (home care or nursing home or assisted living).ti,ab. (2423) 20 18 and 19 (55) 21 4 and 12 and 20 (1) **********
NHS Economic Evaluation Date: 4/4/17	Database: EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016> Search Strategy: --- 1 exp Quality Indicators, Health Care/ (27) 2 exp "Outcome and Process Assessment (Health Care)"/ (4159) 3 (Quality or ACS NSQIP).ti,ab. (302) 4 1 or 2 or 3 (4372) 5 exp Thoracic Surgery/ (10) 6 Thorax/su [Surgery] (0) 7 exp Cardiovascular Surgical Procedures/ (710) 8 exp Thoracic Surgical Procedures/ (629) 9 Orthopedics/su [Surgery] (0) 10 exp Orthopedic Procedures/ (547) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1026) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (2004) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (263) 14 surg*.ti,ab. (1088) 15 (surg* and measure* and quality and mortality).ti. (0) 16 patient care planning.mp. or exp Patient Care Planning/ (212)

	17 (care pathway* or clinical pathway*).ti,ab,kw. (66) 18 16 or 17 (219) 19 (home care or nursing home or assisted living).ti,ab. (49) 20 18 and 19 (2) 21 4 and 12 and 20 (0) **********
CINAHL Date: 4/4/17	Database: EBSCOhost CINAHL Plus with Full Text Search Strategy: ---------- S1 (MH "Clinical Indicators") (9431) S2 (MH "Outcome Assessment") OR (MH "Process Assessment (Health Care)+"))"/ (34859) S3 TI (Quality OR ACS NSQIP) OR AB (Quality OR ACS NSQIP) (201663) S4 S1 OR S2 OR S3 (235154) S5 (MH "Thoracic Surgery+") (45131) S6 (MH "Surgery, Cardiovascular+") (46846) S7 (MH "Orthopedic Surgery+") (74809) S8 (MH "Orthopedics") (8797) S9 TI (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) OR AB (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) (126064) S10 S5 OR S6 OR S7 OR S8 OR S9 (232937) S11 TI (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) OR AB (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) (505470) S12 TI surg* OR AB surg* (221304) S13 TI (surg$ AND measure$ AND quality AND readmission$) OR AB (surg$ AND measure$ AND quality AND readmission$) (0) S14 (MH "Patient Care Plans+") (8763) S15 patient care plan$ (4730) S16 TI (care pathway$ OR clinical pathway$) OR AB (care pathway$ OR clinical pathway$) (2546) S17 TI (home care OR nursing home OR assisted living) OR AB (home care OR nursing home OR assisted living) (26014) S18 S14 OR S15 OR S16 OR S17 (37049) S19 S4 AND S10 AND S18 (196) S20 S11 AND S19 (65) S21 S12 AND S20 (21) **********

4. Wait Times	
A. Required sources:	**Evidence:**
Medline Date: 4/4/17 Updated: 6/13/17	Database: Ovid MEDLINE(R) <1946 to June Week 1 2017>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <June 12, 2017> Search Strategy: ---------- 1 exp Thoracic Surgery/ (12160) 2 Thorax/su [Surgery] (2531) 3 exp Cardiovascular Surgical Procedures/ (345848) 4 exp Thoracic Surgical Procedures/ (303795) 5 Orthopedics/su [Surgery] (153) 6 exp Orthopedic Procedures/ (256205) 7 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1982456) 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (2426823) 9 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (7306744)

	10 surg*.ti,ab. (1617175) 11 (target time* or waiting time or Waiting List).mp. or exp Waiting Lists/ (19131) 12 8 and 9 and 10 and 11 (540) 13 limit 12 to english language (486) 14 remove duplicates from 13 (469) **********
Cochrane Database of Systematic Reviews & Methodology Register Date: 3/24/17 Updated: 6/13/17	Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to June 9, 2017> Search Strategy: ---------- 1 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1087) 2 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (3168) 3 surg*.ti,ab. (1535) 4 (target time* or waiting time or Waiting List).mp. or exp Waiting Lists/ (381) 5 1 and 4 (29) 6 2 and 4 (173) 7 5 or 6 (182) **********
CCRCT Date: 4/4/17 Updated: 6/13/17	Database: EBM Reviews - Cochrane Central Register of Controlled Trials <April 2017> Search Strategy: ---------- 1 exp Thoracic Surgery/ (151) 2 Thorax/su [Surgery] (2) 3 exp Cardiovascular Surgical Procedures/ (16674) 4 exp Thoracic Surgical Procedures/ (13799) 5 Orthopedics/su [Surgery] (0) 6 exp Orthopedic Procedures/ (9656) 7 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (122041) 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (135244) 9 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (365411) 10 surg*.ti,ab. (106681) 11 (target time* or waiting time or Waiting List).mp. or exp Waiting Lists/ (2398) 12 8 and 9 and 10 and 11 (47) 13 limit 12 to english language (41) 14 remove duplicates from 13 (41) **********
NHS Economic Evaluation Date: 4/4/17 Updated: 6/13/17	Database: EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016> Search Strategy: ---------- 1 exp Thoracic Surgery/ (10) 2 Thorax/su [Surgery] (0) 3 exp Cardiovascular Surgical Procedures/ (710) 4 exp Thoracic Surgical Procedures/ (629) 5 Orthopedics/su [Surgery] (0) 6 exp Orthopedic Procedures/ (547) 7 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1026) 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (2004) 9 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (263) 10 surg*.ti,ab. (1088)

	11 (target time* or waiting time or Waiting List).mp. or exp Waiting Lists/ (133) 12 8 and 11 (32) **********
CINAHL Date: 4/4/17 Updated: 6/13/17	Database: EBSCOhost CINAHL Plus with Full Text Search Strategy: --- S1 (MH "Thoracic Surgery+") (45864) S2 (MH "Surgery, Cardiovascular+") (47712) S3 (MH "Orthopedic Surgery+") (76552) S4 (MH "Orthopedics") (8891) S5 TI (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) OR AB (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) (137985) S6 S1 OR S2 OR S3 OR S4 OR S5 (244533) S7 TI (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) OR AB (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) (572399) S8 TI surg* OR AB surg* (245763) S9 (MH "Waiting Lists") (4169) S10 TX wait$ list$ (2222) S11 TX target time$ (245) S12 S9 OR S10 OR S11 (6453) S13 S6 AND S7 AND S8 AND S12 (52) **********

5. Guideline Compliance	
A. Required sources:	**Evidence:**
Medline Date: 3/22/17 Updated 6/19/17	Database: Ovid MEDLINE(R) <1946 to June Week 2 2017>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <June 16, 2017> Search Strategy: --- 1 exp Thoracic Surgery/ (12160) 2 Thorax/su [Surgery] (2531) 3 exp Cardiovascular Surgical Procedures/ (346098) 4 exp Thoracic Surgical Procedures/ (303967) 5 Orthopedics/su [Surgery] (153) 6 exp Orthopedic Procedures/ (256401) 7 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1984057) 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (2428677) 9 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (7313030) 10 surg*.ti,ab. (1618459) 11 exp Guideline Adherence/ (27274) 12 (guidleine Compliance or policy Compliance or protocol Compliance or institutional Compliance).ti,ab,kw. (380) 13 (guidleine Adherence or policy Adherence or protocol Adherence or institutional Adherence).ti,ab,kw. (352) 14 11 or 12 or 13 (27847) 15 ((guideline or policy or protocol or institutional) adj3 (compliance or adherence)).mp. (29858) 16 14 or 15 (29858) 17 8 and 9 and 10 and 16 (397) 18 limit 17 to english language (363) 19 remove duplicates from 18 (346)

	**********
Cochrane Database of Systematic Reviews & Methodology Register Date: 3/24/17 Updated 6/19/17	Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to June 14, 2017> Search Strategy: --- 1 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1089) 2 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (3172) 3 surg*.ti,ab. (1536) 4 [exp Guideline Adherence/] (0) 5 (guidleine Compliance or policy Compliance or protocol Compliance or institutional Compliance).ti,ab,kw. (1) 6 (guidleine Adherence or policy Adherence or protocol Adherence or institutional Adherence).ti,ab,kw. (1) 7 4 or 5 or 6 (2) 8 ((guideline or policy or protocol or institutional) adj3 (compliance or adherence)).mp. (289) 9 7 or 8 (289) 10 1 and 2 and 3 and 9 (1) **********
CCRCT Date: 4/4/17 Updated 6/19/17	Database: EBM Reviews - Cochrane Central Register of Controlled Trials <May 2017> Search Strategy: --- 1 exp Thoracic Surgery/ (151) 2 Thorax/su [Surgery] (2) 3 exp Cardiovascular Surgical Procedures/ (16764) 4 exp Thoracic Surgical Procedures/ (13835) 5 Orthopedics/su [Surgery] (0) 6 exp Orthopedic Procedures/ (9715) 7 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (123336) 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (136599) 9 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (370114) 10 surg*.ti,ab. (108072) 11 exp Guideline Adherence/ (830) 12 (guidleine Compliance or policy Compliance or protocol Compliance or institutional Compliance).ti,ab,kw. (334) 13 (guidleine Adherence or policy Adherence or protocol Adherence or institutional Adherence).ti,ab,kw. (149) 14 11 or 12 or 13 (1252) 15 ((guideline or policy or protocol or institutional) adj3 (compliance or adherence)).mp. (2166) 16 14 or 15 (2166) 17 8 and 9 and 10 and 16 (31) 18 limit 17 to english language (24) 19 remove duplicates from 18 (24) **********
NHS Economic Evaluation Date: 4/4/17 Updated 6/19/17	Database: EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016> Search Strategy: --- 1 exp Thoracic Surgery/ (10) 2 Thorax/su [Surgery] (0) 3 exp Cardiovascular Surgical Procedures/ (710)

	4 exp Thoracic Surgical Procedures/ (629) 5 Orthopedics/su [Surgery] (0) 6 exp Orthopedic Procedures/ (547) 7 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1026) 8 1 or 2 or 3 or 4 or 5 or 6 or 7 (2004) 9 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (263) 10 surg*.ti,ab. (1088) 11 exp Guideline Adherence/ (75) 12 (guidleine Compliance or policy Compliance or protocol Compliance or institutional Compliance).ti,ab,kw. (0) 13 (guidleine Adherence or policy Adherence or protocol Adherence or institutional Adherence).ti,ab,kw. (0) 14 11 or 12 or 13 (75) 15 ((guideline or policy or protocol or institutional) adj3 (compliance or adherence)).mp. (94) 16 14 or 15 (94) 17 8 and 9 and 10 and 16 (1) 18 limit 17 to english language (1) 19 remove duplicates from 18 (1) **********
CINAHL Date: 4/4/17 Updated 6/19/17	Database: EBSCOhost CINAHL Plus with Full Text Search Strategy: --- S1 (MH "Thoracic Surgery+") (45900) S2 (MH "Surgery, Cardiovascular+") (47756) S3 (MH "Orthopedic Surgery+") (76677) S4 (MH "Orthopedics") (8896) S5 TI (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) OR AB (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) (138274) S16 S1 OR S2 OR S3 OR S4 OR S5 (232937) S7 TI (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) OR AB (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) (574043) S8 TI surg* OR AB surg* (246392) S9 (MH "Guideline Adherence") (9724) S10 TI ((guideline Adherence OR policy Adherence OR protocol Adherence OR institutional Adherence)) OR AB ((guideline Adherence OR policy Adherence OR protocol Adherence OR institutional Adherence)) (662) S11 TI ((guideline Compliance OR policy Compliance OR protocol Compliance OR institutional Compliance)) OR AB ((guideline Compliance OR policy Compliance OR protocol Compliance OR institutional Compliance)) (293) S12 TI ((guideline or policy or protocol or institutional) N3 (compliance or adherence)) OR AB ((guideline or policy or protocol or institutional) N3 (compliance or adherence)) (4404) S13 S9 OR S10 OR S11 OR S12 (13179) S14 S6 AND S7 AND S8 AND S13 (52) **********

6. Infections	
A. Required sources:	**Evidence:**
Medline Date: 3/22/17	Database: Ovid MEDLINE(R) <1946 to March Week 4 2017>, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <April 03, 2017> Search Strategy:

Updated: 4/4/17	---------- 1 exp Quality Indicators, Health Care/ (17040) 2 exp "Outcome and Process Assessment (Health Care)"/ (911588) 3 (Quality or ACS NSQIP).ti,ab. (743554) 4 1 or 2 or 3 (1584625) 5 exp Thoracic Surgery/ (11990) 6 Thorax/su [Surgery] (2527) 7 exp Cardiovascular Surgical Procedures/ (338850) 8 exp Thoracic Surgical Procedures/ (298602) 9 Orthopedics/su [Surgery] (152) 10 exp Orthopedic Procedures/ (251714) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1939359) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (2376877) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (7160734) 14 surg*.ti,ab. (1586814) 15 (surg* and measure* and quality and infection).ti. (6) 16 Surgical Wound Infection.mp. or exp Surgical Wound Infection/ (32402) 17 Prophyla* Antibiotic*.ti,ab. (5418) 18 16 or 17 (36555) 19 4 and 12 and 18 (2310) 20 13 and 19 (914) 21 14 and 20 (749) 22 15 or 21 (754) 23 remove duplicates from 22 (732) 24 limit 23 to english language (682) **********
Cochrane Database of Systematic Reviews & Methodology Register Date: 3/24/17	Database: EBM Reviews - Cochrane Database of Systematic Reviews <2005 to March 22, 2017> Search Strategy: ---------- 1 (Quality or ACS NSQIP).ti,ab. (5034) 2 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1077) 3 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (3135) 4 surg*.ti,ab. (1519) 5 (surg* and measure* and quality and infection*).ti. (0) 6 (surgical site infection* or Surgical Wound Infection*).mp. (136) 7 Prophyla* Antibiotic*.ti,ab. (61) 8 6 or 7 (181) 9 1 and 2 and 8 (15) 10 4 and 9 (14) 11 3 and 10 (8) **********
CCRCT Date: 4/4/17	Database: EBM Reviews - Cochrane Central Register of Controlled Trials <February 2017> Search Strategy: ---------- 1 exp Quality Indicators, Health Care/ (295) 2 exp "Outcome and Process Assessment (Health Care)"/ (113624) 3 (Quality or ACS NSQIP).ti,ab. (63313) 4 1 or 2 or 3 (164168) 5 exp Thoracic Surgery/ (151) 6 Thorax/su [Surgery] (2) 7 exp Cardiovascular Surgical Procedures/ (16505) 8 exp Thoracic Surgical Procedures/ (13683) 9 Orthopedics/su [Surgery] (0)

	10 exp Orthopedic Procedures/ (9539) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (118774) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (131844) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (355878) 14 surg*.ti,ab. (103574) 15 (surg* and measure* and quality and infection).ti. (0) 16 Surgical Wound Infection.mp. or exp Surgical Wound Infection/ (2784) 17 Prophyla* Antibiotic*.ti,ab. (1083) 18 16 or 17 (3585) 19 4 and 12 and 18 (173) 20 13 and 19 (68) 21 14 and 20 (54) 22 15 or 21 (54) 23 remove duplicates from 22 (54) 24 limit 23 to english language (51) **********
NHS Economic Evaluation Date: 4/4/17	Database: EBM Reviews - NHS Economic Evaluation Database <1st Quarter 2016> Search Strategy: --- 1 exp Quality Indicators, Health Care/ (27) 2 exp "Outcome and Process Assessment (Health Care)"/ (4159) 3 (Quality or ACS NSQIP).ti,ab. (302) 4 1 or 2 or 3 (4372) 5 exp Thoracic Surgery/ (10) 6 Thorax/su [Surgery] (0) 7 exp Cardiovascular Surgical Procedures/ (710) 8 exp Thoracic Surgical Procedures/ (629) 9 Orthopedics/su [Surgery] (0) 10 exp Orthopedic Procedures/ (547) 11 (cardi* or ortho* or arthroplasty or vascular or aortic or hip or knee).ti,ab. (1026) 12 5 or 6 or 7 or 8 or 9 or 10 or 11 (2004) 13 (measure* or factor* or indicat* or marker* or metric*).ti,ab. (263) 14 surg*.ti,ab. (1088) 15 (surg* and measure* and quality and infection).ti. (0) 16 Surgical Wound Infection.mp. or exp Surgical Wound Infection/ (121) 17 Prophyla* Antibiotic*.ti,ab. (14) 18 16 or 17 (128) 19 4 and 12 and 18 (9) 20 13 and 19 (0) 21 14 and 20 (0) 22 15 or 21 (0) 23 remove duplicates from 22 (0) 24 limit 23 to english language (0) **********
CINAHL Date: 4/4/17	Database: EBSCOhost CINAHL Plus with Full Text Search Strategy: --- S1 (MH "Clinical Indicators") (9431) S2 (MH "Outcome Assessment") OR (MH "Process Assessment (Health Care)+"))"/ (34859) S3 TI (Quality OR ACS NSQIP) OR AB (Quality OR ACS NSQIP) (201663) S4 S1 OR S2 OR S3 (235154) S5 (MH "Thoracic Surgery+") (45131) S6 (MH "Surgery, Cardiovascular+") (46846)

	S7 (MH "Orthopedic Surgery+") (74809) S8 (MH "Orthopedics") (8797) S9 TI (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) OR AB (cardi$ OR ortho$ OR arthroplasty OR vascular OR aortic OR hip OR knee) (126064) S10 S5 OR S6 OR S7 OR S8 OR S9 (232937) S11 TI (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) OR AB (measure$ OR factor$ OR indicat$ OR marker$ OR metric$) (505470) S12 TI surg* OR AB surg* (221304) S13 TI (surg$ AND measure$ AND quality AND infection$) OR AB (surg$ AND measure$ AND quality AND infection$) (0) S14 Surgical Wound Infection$ (7342) S15 TI Prophyla$ Antibiotic$ OR AB Prophyla$ Antibiotic$ (0) S16 (MH "Surgical Wound Infection") (7282) S17 S14 OR S15 OR S16 (7342) S18 S4 AND S10 AND S17 (154) S19 S11 AND S18 (57) S20 S12 AND S19 (55) **********

7. Grey Literature	
A. Required sources:	**Evidence:**
AHRQ: evidence reports, technology assessments, U.S Preventative Services Task Force Evidence Synthesis Date: 3/20/17 Updated: 3/28/17	http://www.ahrq.gov/research/findings/evidence-based-reports/search.html Search: readmission; readmit; mortality; post-operative care; wait time; delay; guideline compliance; infection Relevant Results: *None*
CADTH Date: 3/20/17 Updated: 3/28/17	https://www.cadth.ca Search: readmission; readmit; mortality; post-operative care; wait time; delay; guideline compliance; infection Relevant Results: Post-Operative Follow-Up for Elderly Hip Fracture Surgery Patients: Clinical Effectiveness and Guidelines - *Abstract-based rapid review product; specific to follow-up care* Post-operative Pain Management for Patients After Elective Knee or Hip Replacement Surgery: Guidelines - *Specific to pain management, not related to quality measure* Timing of Hip Fracture Surgery for Non-Elderly Adults: Clinical Effectiveness and Guidelines - *Abstract-based rapid review product; potentially relevant* Cancelation of Hip and Knee Replacement Surgeries: Guidelines - *Specific to comorbidities associated with surgery cancellation* Preoperative Skin Antiseptic Preparations and Application Techniques for Preventing Surgical Site Infections: A Systematic Review of the Clinical Evidence and Guidelines - *SSI prevention specific to antiseptic application—peripheral information in the review is possibly useful for background on SSI; appendix 11 provides data by surgery type*
ECRI Institute	https://www.ecri.org/Pages/default.aspx

Date: 3/20/17 Updated: 3/28/17	Search: readmission; readmit; mortality and surgery; post-operative care; wait time; delay; guideline compliance; infection Relevant Results: *None*
NHS Evidence Date: 3/20/17	http://www.evidence.nhs.uk/default.aspx Search: readmission; readmit; mortality; post-operative care; wait time; delay; guideline compliance; infection Relevant Results: Thirty-day readmission rates in spine surgery: systematic review and meta-analysis - *KQ2 is relevant - What study factors impact the rate of 30-day readmissions? Includes time from enrollment as a factor* Effect of early surgery after hip fracture on mortality and complications: systematic review and meta-analysis - *KQ1-Supports wait time as a valid quality metric – relevant* Meta-analysis of studies on mortality of early surgery vs delayed surgery for patients with femoral neck fractures - *Chinese language only* Pre-operative indicators for mortality following hip fracture surgery: a systematic review and meta-analysis - *Background- patient-level characteristics only – may be useful as citation for number of studies looking at patient level characteristics* Morbidity and mortality related to odontoid fracture surgery in the elderly population - *Outcomes after fracture surgery. Study supports discussion on outcomes based on factors other than hospital/physician performance.* Timing matters in hip fracture surgery: patients operated within 48 hours have better outcomes - a meta-analysis and meta-regression of over 190,000 patients - *Relevant KQ1-Supports wait times as valid quality metric.* Timing of surgery for hip fractures: a systematic review of 52 published studies involving 291,413 patients - *Relevant KQ1-Supports wait times as valid quality metric.*
NQF Date: 3/23/17	http://www.qualityforum.org/ProjectListing.aspx Search: readmission; readmit; mortality and surgery; post-operative care; wait time; delay; guideline compliance; infection Relevant Results: Surgery *These refer to ongoing projects, not complete data. See comments below for potentially relevant projects.* All-Cause Admissions and Readmissions Project 2015-2017 - Relevant measures: #1789, #2879, #2514, #2502, #2504 - Relevant for discussion of NQF activities All-Cause Admissions & Readmissions Project 2017 - Relevant measures: #2515 - Relevant for discussion of NQF activities – not sure how it differs from above Care Coordination Endorsement Maintenance Project 2016-2017 - Relevant measures: #0326, #0646, #0647, #0648, #0649 - Relevant for discussion of NQF activities Surgery Project 2015-2017 - Relevant measures: #1550, #1551, #2998, #3030, #3031, #3032 - Relevant for discussion of NQF activities
VA Products - VATAP, PBM and HSR&D publications	A. http://www.hsrd.research.va.gov/research/default.cfm Search: readmission; readmit; mortality and surgery; post-operative care; wait time; delay; guideline compliance; infection

Date: 3/29/17	Relevant Results: Differences in Quality, Cost, and Access between VA and Fee Basis CABG and PCI - *Background of potential effects of outsourced, non-VA care identified by annual volume of procedures and hospital performance reported to Medicare-- performance measured in 30-day risk-adjusted mortality following acute myocardial infarction in the Hospital Compare database* Improving Surgical Quality: Risks and Impact of Readmission - *Background-On-going study-considers multiple patient-, procedure- and complication-based factors in 30-day readmission for the purposes of validating a risk prediction tool- specifically aimed at exposing data not currently reflected in VASQIP* B. http://www.research.va.gov/research_topics/ Relevant Results: Access and Quality Tool www.accesstocare.va.gov - *Background - provide Veterans with useful information related to such things as new and established patient wait times, satisfaction scores for access to primary and specialty care, and timeliness of urgent appointments.* C. https://www.hsrd.research.va.gov/publications/esp Relevant Results: Joint replacement disparities https://www.hsrd.research.va.gov/publications/esp/joint-replacement.cfm - *Focuses on racial disparities – VA and non-VA* Public reporting of quality and safety data https://www.hsrd.research.va.gov/publications/esp/transparency.cfm - *Background - Focuses on best way to present performance data to the public and if public reporting influences quality improvement programs or clinical measures. May be relevant context for discussion around KQ2.* Readmission risk prediction https://www.hsrd.research.va.gov/publications/esp/readmission.cfm - *Background-Useful to cite in discussion about existing models. The review finds risk prediction models for hospital readmission still not validated in the evidence.* VA vs non-VA quality https://www.hsrd.research.va.gov/publications/esp/quality.cfm - *Background – VA vs non-VA quality of care*
CMS Policies Date: 3/29/17	https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityMeasures/CMS-Measures-Inventory.html Search: quality measures Relevant Results: Cardiovascular Measures - *Background - Useful for background discussion of CMS measures.* Orthopedic Measures - *Background - Useful for background discussion of CMS measures.* Statistical Issues In Assessing Hospital Performance - *Background- CMS statistical guidance*
Google scholar	http://scholar.google.com/

Date: 3/29/17	Search: readmission; readmit; mortality and surgery; post-operative care; wait time; delay; guideline compliance; infection Relevant Results: Lucas, Donald J., and Timothy M. Pawlik. "Readmission after surgery." Advances in surgery 48 (2013): 185-199. - *Background Focuses on problems with the 30-day standard. Data on rates of readmission after surgery by surgery type* Karhade, Aditya V., et al. "Thirty-day readmission and reoperation after surgery for spinal tumors: a National Surgical Quality Improvement Program analysis." Neurosurgical Focus 41.2 (2016): E5. - *Rate of and reasons for readmission after surgery, focus on determining incidence for readmittance post-spinal tumor surgery, mortality and predictors of complications* Li, Zhongmin, et al. "Hospital variation in readmission after coronary artery bypass surgery in California." Circulation: Cardiovascular Quality and Outcomes (2012): CIRCOUTCOMES-112. - *Background- Focuses on disparity between hospital readmission rates, evidence for patient characteristics and hospital practices as key indicators of readmission risk (top 2 reasons for readmission failure or infection)*

8. Search for systematic reviews currently under development (includes forthcoming reviews & protocols) **Date Searched:**	
A. Required sources:	**Evidence:**
PROSPERO *(SR registry)* *Date: 3/29/17*	*http://www.crd.york.ac.uk/PROSPERO/* Search: readmission; readmit; mortality; post-operative care; wait time; delay; guideline compliance; infection Relevant Results: Stein Ove Danielsen, Irene Lie, Philip Moons, Iren Sandven. Incidence and causes of thirty-day readmission after surgical aortic valve replacement and transcatheter aortic valve implantation: a systematic review and meta-analysis. PROSPERO 2016:CRD42016032670 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42016032670 - *Discussion – review in progress - Rate of and reasons for readmission after surgery, focus on determining incidence for readmittance, mortality and predictors of complications, unclear if patient level factors only* James Bernatz. Thirty-day readmission rates in orthopedic and neurosurgical spinal surgeries: a systematic review and meta-analysis. PROSPERO 2014:CRD42014015319 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42014015319 - *KQ1 -identifies patient level causes for and rate of 30-day readmission for spinal surgery (focused on cost-reduction).* James Bernatz, Paul Anderson. Thirty-day readmission rates in orthopedics: a systematic review. PROSPERO 2014:CRD42014010293 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42014010293 - *KQ1-identifies rate of and 22 risk factors for 30-day readmission; focused on reducing rate of 30-day readmission. Patient level only* Maria Peer, Andrea Bailey, Peter Gallacher, Fiona Coutts, Nigel Gleeson. The effect of waiting time on physical function in patients undergoing total knee arthroplasty surgery: a systematic review of the literature. PROSPERO 2016:CRD42016037093 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42016037093 - *NA-focused on functionality during wait time before knee surgery*

	Christoph Röder, Thomas Klestil, Birgit Winkler, Christoph Stotter, Martin Lutz, Stefan Nehrer, Gerald Gartlehner, Barbara Nussbaumer-Streit, Gernot Wagner, Irma Klerings. Immediate versus delayed surgery for hip fractures in the geriatric population. PROSPERO 2017:CRD42017058216 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42017058216 - *Completion 28 February 2018- focused on geriatric hip surgery and wait times* James Masters. A systematic review of the epidemiology of surgical site infection in hip fracture surgery. PROSPERO 2017:CRD42017050685 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42017050685 - *Completion 30 September 2017- focused on SSI in hip fracture surgery*
DoPHER (SR Protocols) Date: 3/29/17	http://eppi.ioe.ac.uk/webdatabases4/Intro.aspx?ID=9 Search: readmission; readmit; mortality and surgery; post-operative care; wait time; delay; guideline compliance; infection Relevant Results: *None*
Cochrane Database of Systematic Reviews: Protocols Date: 3/29/17	Database: EBM Reviews - Cochrane Methodology Register <3rd Quarter 2012> Search Strategy: ---------- 1 quality measure*.mp. [mp=title, abstract, subject heading word] (22) 2 performance measure*.mp. [mp=title, abstract, subject heading word] (13) 3 outcome measure*.mp. [mp=title, abstract, subject heading word] (766) 4 quality indicator*.mp. [mp=title, abstract, subject heading word] (25) 5 performance indicator*.mp. [mp=title, abstract, subject heading word] (6) 6 outcome indicator*.mp. [mp=title, abstract, subject heading word] (2) 7 1 or 2 or 3 or 4 or 5 or 6 (825) 8 surg*.mp. [mp=title, abstract, subject heading word] (805) 9 7 and 8 (65) ********** Relevant Results: *None*

APPENDIX C: LIST OF EXCLUDED STUDIES

Exclude reasons: B=Relevant for background information only, 1=Ineligible population, 2=Ineligible intervention, 3=Ineligible comparator, 4=Ineligible outcome, 5=Ineligible timing, 6=Ineligible study design, 7=Ineligible publication type 8=Outdated or ineligible systematic review, 9=Non-English language

#	Citation	Exclude reason
1	Agabiti N, Cesaroni G, Picciotto S, et al. The association of socioeconomic disadvantage with postoperative complications after major elective cardiovascular surgery. *J Epidemiol Community Health.* Oct 2008;62(10):882-889.	B
2	Agha R. Towards national surgical surveillance in the UK--a pilot study. *PLoS ONE [Electronic Resource].* 2012;7(12):e47969.	1
3	Albright JM, Panzer RJ, Black ER, Mays RA, Lush-Ehmann CM. Reporting tools for clinical quality improvement. *Clinical Performance & Quality Health Care.* 1993;1(4):227-232.	4
4	Al-Khatib SM, Hellkamp A, Curtis J, et al. Non-evidence-based ICD implantations in the United States. *JAMA.* Jan 05 2011;305(1):43-49.	4
5	Al-Momany NH, Al-Bakri AG, Makahleh ZM, Wazaify MM. Adherence to international antimicrobial prophylaxis guidelines in cardiac surgery: a Jordanian study demonstrates need for quality improvement. *J Manage Care Pharm.* Apr 2009;15(3):262-271.	4
6	Alverson BK, O'Callaghan J. Hospital readmission: quality indicator or statistical inevitability? *Pediatrics.* Sep 2013;132(3):569-570.	1
7	Amato L, Colais P, Davoli M, et al. [Volume and health outcomes: evidence from systematic reviews and from evaluation of Italian hospital data]. *Epidemiologia e Prevenzione.* 2013;37(2-3 Suppl 2):1-100.	9
8	Anderson DJ, Chen LF, Sexton DJ, Kaye KS. Complex surgical site infections and the devilish details of risk adjustment: important implications for public reporting. *Infection Control & Hospital Epidemiology.* Oct 2008;29(10):941-946.	4
9	Andreasen JJ, Korsager B, Alstrup P, Jepsen OB. Postoperative wound infection: indicator of clinical quality? *Dan Med Bull.* Aug 2002;49(3):242-244.	4
10	Andruszkow H, Scharff B, Zapf A, et al. [Influence of comorbidities and delay in surgical treatment on mortality following femoral neck fracture]. *Z Orthop Unfall.* Aug 2013;151(4):338-342.	9
11	Angus DC. Grappling with intensive care unit quality--does the readmission rate tell us anything? *Critical Care Medicine.* Nov 1998;26(11):1779-1780.	1
12	Anonymous. Rewarding quality--the highest- and lowest-scored hospitals. Combined penalty/reward based on FY 2016 readmissions penalty, value-based purchasing reward/penalty and hospital-acquired conditions (HAC) score. *Mod Healthc.* Dec 21-28 2015;45(51):34.	7
13	Ashby E, Haddad FS, O'Donnell E, Wilson AP. How will surgical site infection be measured to ensure "high quality care for all"? *Journal of Bone & Joint Surgery - British Volume.* Sep 2010;92(9):1294-1299.	B
14	Ashton CM, Del Junco DJ, Souchek J, Wray NP, Mansyur CL. The association between the quality of inpatient care and early readmission: a meta-analysis of the evidence. *Medical Care.* Oct 1997;35(10):1044-1059.	B
15	Ashton CM, Wray NP. A conceptual framework for the study of early readmission as an indicator of quality of care. *Soc Sci Med.* Dec 1996;43(11):1533-1541.	B
16	Ashton HA, Buxton MJ, Day NE, et al. The Multicentre Aneurysm	B

	Screening Study (MASS) into the effect of abdominal aortic aneurysm screening on mortality in men: a randomised controlled trial. *Lancet.* Nov 16 2002;360(9345):1531-1539.	
17	Atkinson G, Giovanis T. Conceptual errors in the CMS refusal to make socioeconomic adjustments in readmission and other quality measures. *J Ambulatory Care Manage.* Jul-Sep 2014;37(3):269-272.	7
18	Awad N, Caputo FJ, Carpenter JP, Alexander JB, Trani JL, Lombardi JV. Relative value unit-based compensation incentivization in an academic vascular practice improves productivity with no early adverse impact on quality. *Journal of Vascular Surgery.* 2017;65(2):579-582.	2
19	Axon RN, Cole L, Moonan A, et al. Evolution and Initial Experience of a Statewide Care Transitions Quality Improvement Collaborative: Preventing Avoidable Readmissions Together. *Popul Health Manag.* Feb 2016;19(1):4-10.	1
20	Babaev A, Frederick PD, Pasta DJ, et al. Trends in management and outcomes of patients with acute myocardial infarction complicated by cardiogenic shock. JAMA: Journal of the American Medical Association. 2005;294(4):448-454.	2
21	Balla U, Malnick S, Schattner A. Early readmissions to the department of medicine as a screening tool for monitoring quality of care problems. *Medicine (Baltimore).* Sep 2008;87(5):294-300.	1
22	Basta MN, Bauder AR, Kovach SJ, Fischer JP. Assessing the predictive accuracy of the American College of Surgeons National Surgical Quality Improvement Project Surgical Risk Calculator in open ventral hernia repair. *American Journal of Surgery.* Aug 2016;212(2):272-281.	1
23	Bates OL, O'Connor N, Dunn D, Hasenau SM. Applying STAAR interventions in incremental bundles: improving post-CABG surgical patient care. *Worldviews on Evidence-Based Nursing.* 2014;11(2):89-97.	B
24	Bautista M, Llinas A, Bonilla G, et al. Thromboprophylaxis after major orthopedic surgery: Improving compliance with clinical practice guidelines. *Thromb Res.* Jan 2016;137:113-118.	4
25	Benbassat J, Taragin M. Hospital readmissions as a measure of quality of health care: advantages and limitations. *Archives of Internal Medicine.* Apr 24 2000;160(8):1074-1081.	B
26	Bernatz JT, Anderson PA. Thirty-day readmission rates in spine surgery: systematic review and meta-analysis. *Neurosurg Focus.* Oct 2015;39(4):E7.	4
27	Bernatz JT, Tueting JL, Hetzel S, Anderson PA. What Are the 30-day Readmission Rates Across Orthopaedic Subspecialties? *Clinical Orthopaedics & Related Research.* 2016;474(3):838-847.	B
28	Bernheim SM. Measuring quality and enacting policy: readmission rates and socioeconomic factors. *Circulation. Cardiovascular Quality & Outcomes.* May 2014;7(3):350-352.	7
29	Bernstein SJ, Rigter H, Brorsson B, et al. Waiting for coronary revascularization: a comparison between New York State, The Netherlands and Sweden. *Health Policy.* Oct 1997;42(1):15-27.	4
30	Bertholf L. Clinical pathways from conception to outcome. *Top Health Inf Manage.* Nov 1998;19(2):30-34.	4
31	Borgi J, Rubinfeld I, Ritz J, Jordan J, Velanovich V. The differential effects of intermediate complications with postoperative mortality. *American Surgeon.* Mar 2013;79(3):261-266.	B
32	Bottorff MB, Nutescu EA, Spinler S. Antiplatelet therapy in patients with unstable angina and non-ST-segment-elevation myocardial infarction: findings from the CRUSADE national quality improvement initiative. *Pharmacotherapy.* Aug 2007;27(8):1145-1162.	B
33	Bougioukakis P, Kluegl SJ, Babin-Ebell J, et al. Presentation of a quality management program in off-pump coronary bypass surgery. *Innovations.*	4

	Jul-Aug 2014;9(4):317-321.	
34	Bradley EH, Sipsma H, Curry L, Mehrotra D, Horwitz LI, Krumholz H. Quality collaboratives and campaigns to reduce readmissions: what strategies are hospitals using? *J Hosp Med.* Nov 2013;8(11):601-608.	1
35	Braybrooke J, Ahn H, Gallant A, et al. The impact of surgical wait time on patient-based outcomes in posterior lumbar spinal surgery. *European Spine Journal.* Nov 2007;16(11):1832-1839.	4
36	Brekke A, Elfenbein DM, Madkhali T, et al. When patients call their surgeon's office: an opportunity to improve the quality of surgical care and prevent readmissions. *American Journal of Surgery.* Mar 2016;211(3):599-604.	1
37	Brown EG, Burgess D, Li CS, Canter RJ, Bold RJ. Hospital readmissions: necessary evil or preventable target for quality improvement. *Annals of Surgery.* Oct 2014;260(4):583-589; discussion 589-591.	1
38	Brown SE, Ratcliffe SJ, Halpern SD. Assessing the utility of ICU readmissions as a quality metric: an analysis of changes mediated by residency work-hour reforms. *Chest.* Mar 2015;147(3):626-636.	1
39	Bruce J, Russell EM, Mollison J, Krukowski ZH. The quality of measurement of surgical wound infection as the basis for monitoring: a systematic review. *Journal of Hospital Infection.* 2001;49(2):99-108.	4
40	Burgess JF, Hockenberry JM. Can all cause readmission policy improve quality or lower expenditures? A historical perspective on current initiatives. *Health Econ Policy Law.* Apr 2014;9(2):193-213.	B
41	Calderwood MS, Kleinman K, Bratzler DW, et al. Medicare Claims Can Be Used to Identify US Hospitals With Higher Rates of Surgical Site Infection Following Vascular Surgery. *Medical Care.* 2014;52(10):918-925.	1
42	Carrier M, Pineault R, Tremblay N, Pelletier LC. Outcome of rationing access to open-heart surgery: effect of the wait for elective surgery on patient outcome. CMAJ Canadian Medical Association Journal. Oct 15 1993;149(8):1117-1122.	3
43	Cebul RD, Snow RJ, Pine R, Hertzer NR, Norris DG. Indications, outcomes, and provider volumes for carotid endarterectomy. *JAMA.* 1998;279(16):1282-1287.	4
44	Cesena FH, Favarato D, Cesar LA, de Oliveira SA, da Luz PL. Cardiac complications during waiting for elective coronary artery bypass graft surgery: incidence, temporal distribution and predictive factors. European Journal of Cardio-Thoracic Surgery. Feb 2004;25(2):196-202.	3
45	Chambers M, Clarke A. Measuring readmission rates. *BMJ.* 1990;301(6761):1134-1136.	1
46	Chen J, Radford MJ, Wang Y, Marciniak TA, Krumholz HM. Do "America's Best Hospitals" perform better for acute myocardial infarction? *New England Journal of Medicine.* Jan 28 1999;340(4):286-292.	1
47	Chen JY, Ma Q, Chen H, Yermilov I. New bundled world: quality of care and readmission in diabetes patients. *J Diabetes Sci Technol.* May 01 2012;6(3):563-571.	1
48	Chen LM, Jha AK, Guterman S, Ridgway AB, Orav EJ, Epstein AM. Hospital cost of care, quality of care, and readmission rates: penny wise and pound foolish? *Archives of Internal Medicine.* Feb 22 2010;170(4):340-346.	1
49	Chen Q, Mull HJ, Rosen AK, Borzecki AM, Pilver C, Itani KM. Measuring readmissions after surgery: do different methods tell the same story? *American Journal of Surgery.* 2016;212(1):24-33.	B
50	Chen Q, Tsai TC, Mull HJ, Rosen AK, Itani KM. Using a composite readmission measure to assess surgical quality in the Veterans Health Administration: how well does it correlate with established surgical measures? JAMA Surgery. Nov 2014;149(11):1206-1207.	4
51	Chiasson PM, Roy PD, Mitchell MJ, Chiasson AM, Alexander DI. Hip	4

	fracture surgery in Nova Scotia: a comparison of treatment provided by "generalist" general surgeons and orthopedic surgeons. *Canadian Journal of Surgery.* 1997;40(5):383-389.	
52	Clancy CM. Commentary: reducing hospital readmissions: aligning financial and quality incentives. *American Journal of Medical Quality.* Sep-Oct 2012;27(5):441-443.	7
53	Clancy CM. New hospital readmission policy links financial and quality incentives. *J Nurs Care Qual.* Jan-Mar 2013;28(1):1-4.	7
54	Clarke A. Readmission to hospital: a measure of quality or outcome? *Quality & Safety in Health Care.* Feb 2004;13(1):10-11.	7
55	Cohn A. Readmission rates are a poor marker of quality. *BMJ.* Jan 29 2014;348:g1148.	7
56	Copeland LA, Graham LA, Richman JS, et al. A study to reduce readmissions after surgery in the Veterans Health Administration: design and methodology. *BMC Health Services Research.* 2017;17(1):198.	7
57	Croft AM, Lynch P, Smellie JS, Dickinson CJ. Outpatient waiting times: indicators of hospital performance? *J R Army Med Corps.* Oct 1998;144(3):131-137.	B
58	Curran T, Zhang JQ, Lo RC, et al. Risk factors and indications for readmission after lower extremity amputation in the American College of Surgeons National Surgical Quality Improvement Program. *Journal of Vascular Surgery.* Nov 2014;60(5):1315-1324.	4
59	Dardick KR, Stein JA. Hospital readmissions and measures of quality. *JAMA.* Jan 25 2012;307(4):361; author reply 361-362.	7
60	Davenport DL, Zwischenberger BA, Xenos ES. Analysis of 30-day readmission after aortoiliac and infrainguinal revascularization using the American College of Surgeons National Surgical Quality Improvement Program data set. *Journal of Vascular Surgery.* Nov 2014;60(5):1266-1274.	4
61	Davies SM, Saynina O, McDonald KM, Baker LC. Limitations of using same-hospital readmission metrics. *International Journal for Quality in Health Care.* 2013;25(6):633-639.	B
62	D'Errigo P, Tosti ME, Fusco D, Perucci CA, Seccareccia F, Research group ICOS. Use of hierarchical models to evaluate performance of cardiac surgery centres in the Italian CABG outcome study. *BMC Med Res Methodol.* Jul 03 2007;7:29.	B
63	DesHarnais SI, Forthman MT, Homa-Lowry JM, Wooster LD. Risk-adjusted clinical quality indicators: indices for measuring and monitoring rates of mortality, complications, and readmissions.[Erratum appears in Qual Manag Health Care. 2001 Winter;9(2):ix]. *Qual Manag Health Care.* Fall 2000;9(1):14-22.	7
64	DesHarnais SI, Forthman MT, Homa-Lowry JM, Wooster LD. Risk-adjusted quality outcome measures: indexes for benchmarking rates of mortality, complications, and readmissions. *Qual Manag Health Care.* Winter 1997;5(2):80-87.	B
65	Dimick JB, Ghaferi AA. Hospital readmission as a quality measure in surgery. *JAMA.* Feb 03 2015;313(5):512-513.	B
66	Dixon JL, Papaconstantinou HT, Hodges B, et al. Redundancy and variability in quality and outcome reporting for cardiac and thoracic surgery. *Baylor University Medical Center Proceedings.* 2015;28(1):14-17.	B
67	Dua A, Desai SS, Seabrook GR, et al. The effect of Surgical Care Improvement Project measures on national trends on surgical site infections in open vascular procedures. *Journal of Vascular Surgery.* Dec 2014;60(6):1635-1639.	B
68	Dummit LA, Kahvecioglu D, Marrufo G, et al. Association Between Hospital Participation in a Medicare Bundled Payment Initiative and Payments and Quality Outcomes for Lower Extremity Joint Replacement Episodes.	4

	JAMA. 2016;316(12):1267-1278.	
69	Edelstein AI, Lovecchio FC, Saha S, Hsu WK, Kim JY. Impact of Resident Involvement on Orthopaedic Surgery Outcomes: An Analysis of 30,628 Patients from the American College of Surgeons National Surgical Quality Improvement Program Database. *Journal of Bone & Joint Surgery - American Volume.* 2014;96(15):e131.	4
70	Edmiston CE, Spencer M, Lewis BD, et al. Reducing the risk of surgical site infections: did we really think SCIP was going to lead us to the promised land? *Surg Infect (Larchmt).* Jun 2011;12(3):169-177.	B
71	Every NR, Fihn SD, Sales AE, Keane A, Ritchie JR. Quality Enhancement Research Initiative in ischemic heart disease: a quality initiative from the Department of Veterans Affairs. QUERI IHD Executive Committee. *Medical Care.* Jun 2000;38(6 Suppl 1):I49-59.	B
72	Falcone RA, Nass C, Jermyn R, et al. The value of preoperative pharmacologic stress testing before vascular surgery using ACC/AHA guidelines: a prospective, randomized trial. Journal of Cardiothoracic & Vascular Anesthesia. Dec 2003;17(6):694-698.	1
73	Fielden JM, Cumming JM, Horne JG, Devane PA, Slack A, Gallagher LM. Waiting for hip arthroplasty: economic costs and health outcomes. *Journal of Arthroplasty.* Dec 2005;20(8):990-997.	4
74	Fink AS, Campbell DA, Jr., Mentzer RM, Jr., et al. The National Surgical Quality Improvement Program in non-veterans administration hospitals: initial demonstration of feasibility. *Annals of Surgery.* Sep 2002;236(3):344-353; discussion 353-344.	B
75	Fischer C, Anema HA, Klazinga NS. The validity of indicators for assessing quality of care: a review of the European literature on hospital readmission rate. *Eur J Public Health.* Aug 2012;22(4):484-491.	1
76	Fischer C, Lingsma HF, Marang-van de Mheen PJ, Kringos DS, Klazinga NS, Steyerberg EW. Is the readmission rate a valid quality indicator? A review of the evidence. *PLoS ONE [Electronic Resource].* 2014;9(11):e112282.	B
77	Fischer C, Steyerberg EW, Fonarow GC, Ganiats TG, Lingsma HF. A systematic review and meta-analysis on the association between quality of hospital care and readmission rates in patients with heart failure. *American Heart Journal.* Nov 2015;170(5):1005-1017.e1002.	1
78	Folbert E, Smit R, van der Velde D, Regtuijt M, Klaren H, Hegeman JH. [Multidisciplinary integrated care pathway for elderly patients with hip fractures: implementation results from Centre for Geriatric Traumatology, Almelo, The Netherlands]. *Ned Tijdschr Geneeskd.* 2011;155(26):A3197.	9
79	Fortuna GR, Jr., Perlick A, DuBose JJ, et al. Injury grade is a predictor of aortic-related death among patients with blunt thoracic aortic injury. Journal of Vascular Surgery. May 2016;63(5):1225-1231.	2
80	Franzo A, Francescutti C, Simon G. Risk factors correlated with post-operative mortality for hip fracture surgery in the elderly: a population-based approach. *Eur J Epidemiol.* 2005;20(12):985-991.	10
81	Fry DE. Surgical site infections and the surgical care improvement project (SCIP): evolution of national quality measures. *Surgical Infections.* Dec 2008;9(6):579-584.	B
82	Gani F, Lucas DJ, Kim Y, Schneider EB, Pawlik TM. Understanding Variation in 30-Day Surgical Readmission in the Era of Accountable Care: Effect of the Patient, Surgeon, and Surgical Subspecialties. *JAMA Surgery.* 2015;150(11):1042-1049.	4
83	Gao Y, Long A, Xie Z, et al. The compliance of thromboprophylaxis affects the risk of venous thromboembolism in patients undergoing hip fracture surgery. Springerplus. 2016;5(1):1362.	3
84	Garbuz DS, Xu M, Duncan CP, Masri BA, Sobolev B. Delays worsen quality of life outcome of primary total hip arthroplasty. *Clinical*	4

	Orthopaedics & Related Research. Jun 2006;447:79-84.	
85	Gharacholou SM, Alexander KP, Chen AY, et al. Implications and reasons for the lack of use of reperfusion therapy in patients with ST-segment elevation myocardial infarction: findings from the CRUSADE initiative. *American Heart Journal.* May 2010;159(5):757-763.	1
86	Gholson JJ, Pugely AJ, Bedard NA, Duchman KR, Anthony CA, Callaghan JJ. Can We Predict Discharge Status After Total Joint Arthroplasty? A Calculator to Predict Home Discharge. *Journal of Arthroplasty.* 2016;31(12):2705-2709.	4
87	Gholve PA, Kosygan KP, Sturdee SW, Faraj AA. Multidisciplinary integrated care pathway for fractured neck of femur. A prospective trial with improved outcome. *Injury.* Jan 2005;36(1):93-98; discussion 99.	4
88	Gibbons C, Bruce J, Carpenter J, et al. Identification of risk factors by systematic review and development of risk-adjusted models for surgical site infection. *Health Technology Assessment (Winchester, England).* 2011;15(30):1-156, iii-iv.	4
89	Gibson A, Tevis S, Kennedy G. Readmission after delayed diagnosis of surgical site infection: a focus on prevention using the American College of Surgeons National Surgical Quality Improvement Program. *American Journal of Surgery.* Jun 2014;207(6):832-839.	1
90	Gibson PH, Croal BL, Cuthbertson BH, et al. Socio-economic status and early outcome from coronary artery bypass grafting. *Heart.* May 2009;95(10):793-798.	4
91	Girotti ME, Shih T, Dimick JB. Health policy update: rethinking hospital readmission as a surgical quality measure. *JAMA Surgery.* Aug 2014;149(8):757-758.	B
92	Gjertsson P, Caidahl K, Oden A, Bech-Hanssen O. Diagnostic and referral delay in patients with aortic stenosis is common and negatively affects outcome. Scandinavian Cardiovascular Journal. Jan 2007;41(1):12-18.	3
93	Glebova NO, Bronsert M, Hammermeister KE, et al. Drivers of readmissions in vascular surgery patients. *Journal of Vascular Surgery.* 2016;64(1):185-194.e183.	4
94	Glebova NO, Bronsert M, Hicks CW, et al. Contributions of planned readmissions and patient comorbidities to high readmission rates in vascular surgery patients. *Journal of Vascular Surgery.* 2016;63(3):746-755.e742.	4
95	Gonzalez AA, Girotti ME, Shih T, Wakefield TW, Dimick JB. Reliability of hospital readmission rates in vascular surgery. *Journal of Vascular Surgery.* 2014;59(6):1638-1643.	B
96	Grover FL. The Society of Thoracic Surgeons National Database: current status and future directions. *Annals of Thoracic Surgery.* Aug 1999;68(2):367-373; discussion 374-366.	B
97	Grumbach K, Anderson GM, Luft HS, Roos LL, Brook R. Regionalization of cardiac surgery in the United States and Canada. Geographic access, choice, and outcomes. *JAMA.* Oct 25 1995;274(16):1282-1288.	4
98	Gupta PK, Fernandes-Taylor S, Ramanan B, Engelbert TL, Kent KC. Unplanned readmissions after vascular surgery. *Journal of Vascular Surgery.* 2014;59(2):473-482.	4
99	Guru V, Anderson GM, Fremes SE, et al. The identification and development of Canadian coronary artery bypass graft surgery quality indicators. *Journal of Thoracic & Cardiovascular Surgery.* 2005;130(5):1257.	B
100	Hajat S, Fitzpatrick R, Morris R, et al. Does waiting for total hip replacement matter? Prospective cohort study. *Journal of Health Services & Research Policy.* Jan 2002;7(1):19-25.	4
101	Halfon P, Eggli Y, Pretre-Rohrbach I, Meylan D, Marazzi A, Burnand B. Validation of the potentially avoidable hospital readmission rate as a	B

	routine indicator of the quality of hospital care. *Medical Care.* Nov 2006;44(11):972-981.	
102	Han S, Smith TS, Gunnar W. Descriptive analysis of 30-day readmission after inpatient surgery discharge in the Veterans Health Administration. *JAMA Surgery.* 2014;149(11):1162-1168.	B
103	Hannan EL, Kilburn H, Jr., Racz M, et al. Improving the outcomes of coronary artery bypass surgery in New York State. *JAMA: Journal of the American Medical Association.* 1994;271(10):761-766.	B
104	Hannan EL, Sarrazin MS, Doran DR, Rosenthal GE. Provider profiling and quality improvement efforts in coronary artery bypass graft surgery: the effect on short-term mortality among Medicare beneficiaries. *Medical Care.* Oct 2003;41(10):1164-1172.	B
105	Hansen LS, Hjortdal VE, Andreasen JJ, Mortensen PE, Jakobsen CJ. 30-day mortality after coronary artery bypass grafting and valve surgery has greatly improved over the last decade, but the 1-year mortality remains constant. *Annals of Cardiac Anaesthesia.* Apr-Jun 2015;18(2):138-142.	B
106	Harpole DH, Jr., DeCamp MM, Jr., Daley J, et al. Prognostic models of thirty-day mortality and morbidity after major pulmonary resection. *Journal of Thoracic & Cardiovascular Surgery.* May 1999;117(5):969-979.	1
107	Hawn MT, Vick CC, Richman J, et al. Surgical site infection prevention: time to move beyond the surgical care improvement program. *Annals of Surgery.* Sep 2011;254(3):494-499; discussion 499-501.	4
108	Head SJ, da Costa BR, Beumer B, et al. Adverse events while awaiting myocardial revascularization: a systematic review and meta-analysis. Eur J Cardiothorac Surg. May 02 2017.	3
109	Hollenbeak CS, Bowman AR, Harbaugh RE, Casale PN, Han D. The impact of surgical specialty on outcomes for carotid endarterectomy. *Journal of Surgical Research.* 2010;159(1):595-602.	4
110	Holt PJ, Poloniecki JD, Hofman D, Hinchliffe RJ, Loftus IM, Thompson MM. Re-interventions, readmissions and discharge destination: modern metrics for the assessment of the quality of care. *Eur J Vasc Endovasc Surg.* Jan 2010;39(1):49-54.	4
111	Horwitz LI, Lin Z, Herrin J, et al. Association of hospital volume with readmission rates: a retrospective cross-sectional study.[Erratum appears in BMJ. 2015;350:h895 Note: Hines, Harold J Jr [added]; PMID: 25689984]. *BMJ.* 2015;350:h447.	1
112	Horwitz LI, Partovian C, Lin Z, et al. Development and use of an administrative claims measure for profiling hospital-wide performance on 30-day unplanned readmission. *Annals of Internal Medicine.* 2014;161(10 Suppl):S66-75.	B
113	Hsu RB, Lin CH. Surgical proficiency and quality indicators in off-pump coronary artery bypass. *Annals of Thoracic Surgery.* Dec 2013;96(6):2069-2074.	4
114	Huesch MD. Provider-hospital "fit" and patient outcomes: evidence from Massachusetts cardiac surgeons, 2002-2004.[Erratum appears in Health Serv Res. 2011 Apr;46(2):690]. *Health Services Research.* 2011;46(1 Pt 1):1-26.	4
115	Hughes JS, Eisenhandler J, Goldfield N, Weinberg PG, Averill R. Postadmission sepsis as a screen for quality problems: a case-control study. *American Journal of Medical Quality.* Nov-Dec 2014;29(6):499-507.	1
116	Husni ME, Losina E, Fossel AH, Solomon DH, Mahomed NN, Katz JN. Decreasing medical complications for total knee arthroplasty: effect of critical pathways on outcomes. *BMC Musculoskeletal Disorders.* Jul 14 2010;11:160.	4
117	Hyder JA, Roy N, Wakeam E, et al. Performance measurement in surgery through the National Quality Forum. *Journal of the American College of Surgeons.* 2014;219(5):1037-1046.	B

118	Iddriss A. Surgical-readmission rates and quality of care. *New England Journal of Medicine.* Dec 19 2013;369(25):2460.	B
119	Improta G, Balato G, Romano M, et al. Lean Six Sigma: a new approach to the management of patients undergoing prosthetic hip replacement surgery. *Journal of Evaluation in Clinical Practice.* 2015;21(4):662-672.	4
120	Ingraham AM, Cohen ME, Bilimoria KY, et al. Association of surgical care improvement project infection-related process measure compliance with risk-adjusted outcomes: implications for quality measurement. *Journal of the American College of Surgeons.* Dec 2010;211(6):705-714.	B
121	Jackson NW, Doogue MP, Elliott JM. Priority points and cardiac events while waiting for coronary bypass surgery. Heart. Apr 1999;81(4):367-373.	3
122	Johnson ML, Gordon HS, Petersen NJ, et al. Effect of definition of mortality on hospital profiles. *Medical Care.* Jan 2002;40(1):7-16.	B
123	Johnston LE, Robinson WP, Tracci MC, et al. Vascular Quality Initiative and National Surgical Quality Improvement Program registries capture different populations and outcomes in open infrainguinal bypass. *Journal of Vascular Surgery.* Sep 2016;64(3):629-637.	1
124	Judge A, Chard J, Learmonth I, Dieppe P. The effects of surgical volumes and training centre status on outcomes following total joint replacement: analysis of the Hospital Episode Statistics for England. *Journal of Public Health.* 2006;28(2):116-124.	4
125	Kangovi S, Grande D. Hospital readmissions--not just a measure of quality. *JAMA.* Oct 26 2011;306(16):1796-1797.	7
126	Kao LS, Lew DF, Doyle PD, et al. A tale of 2 hospitals: a staggered cohort study of targeted interventions to improve compliance with antibiotic prophylaxis guidelines. *Surgery.* Aug 2010;148(2):255-262.	1
127	Kelly-Pettersson P, Samuelsson B, Muren O, et al. Waiting time to surgery is correlated with an increased risk of serious adverse events during hospital stay in patients with hip-fracture: A cohort study. Int J Nurs Stud. Apr 2017;69:91-97.	3
128	Keswani A, Tasi MC, Fields A, Lovy AJ, Moucha CS, Bozic KJ. Discharge Destination After Total Joint Arthroplasty: An Analysis of Postdischarge Outcomes, Placement Risk Factors, and Recent Trends. *Journal of Arthroplasty.* 2016;31(6):1155-1162.	4
129	Keswani A, Weiser MC, Shin J, Lovy AJ, Moucha CS. Discharge Destination After Revision Total Joint Arthroplasty: An Analysis of Postdischarge Outcomes and Placement Risk Factors. *Journal of Arthroplasty.* 2016;31(9):1866-1872.e1861.	4
130	Khanna R, McDevitt JL, McClendon J, Jr., Smith ZA, Dahdaleh NS, Fessler RG. Utility of Readmission Rates as a Quality of Care Measure and Predictors of Readmission Within 30 Days After Spinal Surgery: a Single-Center, Multivariate Analysis. *Spine.* Nov 2015;40(22):1769-1774.	B
131	Khuri SF, Daley J, Henderson WG. The comparative assessment and improvement of quality of surgical care in the Department of Veterans Affairs. *Archives of Surgery.* Jan 2002;137(1):20-27.	B
132	Khuri SF, Henderson WG, Daley J, et al. Successful implementation of the Department of Veterans Affairs' National Surgical Quality Improvement Program in the private sector: the Patient Safety in Surgery study. *Annals of Surgery.* Aug 2008;248(2):329-336.	B
133	Khuri SF, Henderson WG, Daley J, et al. The patient safety in surgery study: background, study design, and patient populations. *Journal of the American College of Surgeons.* Jun 2007;204(6):1089-1102.	B
134	Kisloff B. Surgical-readmission rates and quality of care. *New England Journal of Medicine.* Dec 19 2013;369(25):2460.	B
135	Knudtson ML, Beanlands R, Brophy JM, et al. Treating the right patient at the right time: access to specialist consultation and non-invasive testing. *Canadian Journal of Cardiology.* Aug 2006;22(10):819-824.	1

136	Kocher RP, Adashi EY. Hospital readmissions and the Affordable Care Act: paying for coordinated quality care. *JAMA.* Oct 26 2011;306(16):1794-1795.	7
137	Konstantinidis A, Fogel S, Jones J, Gilliam B, Kundzins J, Baker C. Use of the national surgical quality improvement program to reduce surgical mortality: implementation of intensive preoperative screening and intervention. *American Surgeon.* Sep 2014;80(9):896-900.	1
138	Kristensen PK, Thillemann TM, Soballe K, Johnsen SP. Can improved quality of care explain the success of orthogeriatric units? A population-based cohort study. *Age & Ageing.* Jan 2016;45(1):66-71.	4
139	Kumar G. Protocol-guided hip fracture management reduces length of hospital stay. *Br J Hosp Med (Lond).* Nov 2012;73(11):645-648	2
140	Kurki TS. Prediction of outcome in cardiac surgery. *Mt Sinai J Med.* Jan-Mar 2002;69(1-2):68-72.	4
141	Kurtz SM, Lau EC, Ong KL, Adler EM, Kolisek FR, Manley MT. Which Clinical and Patient Factors Influence the National Economic Burden of Hospital Readmissions After Total Joint Arthroplasty? *Clinical orthopaedics and related research.* 2017.	4
142	Lancey R, Kurlansky P, Argenziano M, et al. Uniform standards do not apply to readmission following coronary artery bypass surgery: a multi-institutional study. *Journal of Thoracic & Cardiovascular Surgery.* 2015;149(3):850-857.e851; discussion 857.	4
143	Lau RL, Perruccio AV, Gandhi R, Mahomed NN. The role of surgeon volume on patient outcome in total knee arthroplasty: a systematic review of the literature. *BMC Musculoskeletal Disorders.* 2012;13:250.	4
144	Lavernia CJ, Villa JM, Iacobelli DA. Readmission rates in the state of Florida: a reflection of quality? *Clinical Orthopaedics & Related Research.* Dec 2013;471(12):3856-3862.	4
145	Lawson EH, Hall BL, Louie R, et al. Association between occurrence of a postoperative complication and readmission: implications for quality improvement and cost savings. *Annals of Surgery.* Jul 2013;258(1):10-18.	4
146	Lee JD, Bonaros N, Hong PT, et al. Factors influencing hospital length of stay after robotic totally endoscopic coronary artery bypass grafting. *Annals of Thoracic Surgery.* Mar 2013;95(3):813-818.	4
147	Lim R, Kreidieh I, Dymond D, et al. Is the waiting list a safe place for outpatients awaiting coronary bypass surgery? Health Trends. 1991;23(4):149-152.	3
148	Lingard EA, Berven S, Katz JN, Kinemax Outcomes G. Management and care of patients undergoing total knee arthroplasty: variations across different health care settings. *Arthritis Care & Research.* Jun 2000;13(3):129-136.	4
149	Lucas DJ, Haut ER, Hechenbleikner EM, Wick EC, Pawlik TM. Avoiding immortal time bias in the American College of Surgeons National Surgical Quality Improvement Program readmission measure. *JAMA Surgery.* Aug 2014;149(8):875-877.	B
150	Makela KT, Hakkinen U, Peltola M, Linna M, Kroger H, Remes V. The effect of hospital volume on length of stay, re-admissions, and complications of total hip arthroplasty. *Acta Orthopaedica.* 2011;82(1):20-26.	4
151	Maniar HS, Bell JM, Moon MR, et al. Prospective evaluation of patients readmitted after cardiac surgery: analysis of outcomes and identification of risk factors. Journal of Thoracic & Cardiovascular Surgery. 2014;147(3):1013-1018.	2
152	Manoharan SR, Baker DK, Pasara SM, Ponce B, Deinlein D, Theiss SM. Thirty-day readmissions following adult spinal deformity surgery: an analysis of the National Surgical Quality Improvement Program (NSQIP) database. *Spine Journal: Official Journal of the North American Spine*	4

	Society. 2016;16(7):862-866.	
153	March LM, Cameron ID, Cumming RG, et al. Mortality and morbidity after hip fracture: can evidence based clinical pathways make a difference? *Journal of Rheumatology.* Sep 2000;27(9):2227-2231.	2
154	Markley J, Sabharwal K, Wang Z, Bigbee C, Whitmire L. A community-wide quality improvement project on patient care transitions reduces 30-day hospital readmissions from home health agencies. *Home Healthc Nurse.* Mar 2012;30(3):E1-E11.	1
155	Marshall DA, Christiansen T, Smith C, et al. Continuous quality improvement program for hip and knee replacement. *American Journal of Medical Quality.* 2015;30(5):425-431.	B
156	Martin CT, Gao Y, Pugely AJ. Incidence And Risk Factors For 30-Day Readmissions After Hip Fracture Surgery. *Iowa Orthopaedic Journal.* 2016;36:155-160.	4
157	Marufu TC, White SM, Griffiths R, Moonesinghe SR, Moppett IK. Prediction of 30-day mortality after hip fracture surgery by the Nottingham Hip Fracture Score and the Surgical Outcome Risk Tool. *Anaesthesia.* May 2016;71(5):515-521.	4
158	Maslow J, Hutzler L, Slover J, Bosco J, 3rd. Etiology of Readmissions Following Orthopaedic Procedures and Medical Admissions. A Comparative Analysis. *Bulletin of the Hospital for Joint Disease (2013).* 2015;73(4):269-275.	B
159	Matsen FA, 3rd, Li N, Gao H, Yuan S, Russ SM, Sampson PD. Factors Affecting Length of Stay, Readmission, and Revision After Shoulder Arthroplasty: A Population-Based Study.[Erratum appears in J Bone Joint Surg Am. 2015 Sep 2;97(17):e60; PMID: 26333745]. *Journal of Bone & Joint Surgery - American Volume.* 2015;97(15):1255-1263.	4
160	Maxwell BG, Wong JK, Miller DC, Lobato RL. Temporal changes in survival after cardiac surgery are associated with the thirty-day mortality benchmark. *Health Services Research.* 2014;49(5):1659-1669.	B
161	Mazzeffi M, Lin HM, Flynn BC. Socioeconomic position is not associated with 30-day or 1-year mortality in demographically diverse vascular surgery patients. *Journal of Cardiothoracic & Vascular Anesthesia.* Jun 2012;26(3):420-426.	1
162	Mazzocato P, Unbeck M, Elg M, Skoldenberg OG, Thor J. Unpacking the key components of a programme to improve the timeliness of hip-fracture care: a mixed-methods case study. *Scand J Trauma Resusc Emerg Med.* Nov 09 2015;23:93.	4
163	McCormack R, Michels R, Ramos N, Hutzler L, Slover JD, Bosco JA. Thirty-day readmission rates as a measure of quality: causes of readmission after orthopedic surgeries and accuracy of administrative data. *Journal of Healthcare Management.* Jan-Feb 2013;58(1):64-76; discussion 76-67.	B
164	McCutcheon BA, Ciacci JD, Marcus LP, et al. Thirty-Day Perioperative Outcomes in Spinal Fusion by Specialty Within the NSQIP Database. *Spine.* 2015;40(14):1122-1131.	4
165	McKinney M. Laying the groundwork for quality: Hospital engagement networks--call them HENs--tasked with ambitious goals for reducing readmissions and hospital-acquired conditions. *Mod Healthc.* May 21 2012;42(21):28-30.	7
166	Meehan TP, Sr., Qazi DJ, Van Hoof TJ, et al. Process Evaluation of a Quality Improvement Project to Decrease Hospital Readmissions From Skilled Nursing Facilities. *Journal of the American Medical Directors Association.* Aug 01 2015;16(8):648-653.	1
167	Merkow RP, Ju MH, Chung JW, et al. Underlying reasons associated with hospital readmission following surgery in the United States. *JAMA.* 2015;313(5):483-495.	4

168	Metcalfe D, Salim A, Olufajo O, et al. Hospital case volume and outcomes for proximal femoral fractures in the USA: an observational study. *BMJ Open.* 2016;6(4):e010743.	4
169	Miliani K, L'Heriteau F, Astagneau P, Group INS. Non-compliance with recommendations for the practice of antibiotic prophylaxis and risk of surgical site infection: results of a multilevel analysis from the INCISO Surveillance Network. Journal of Antimicrobial Chemotherapy. Dec 2009;64(6):1307-1315.	4
170	Miller DC, Ye Z, Gust C, Birkmeyer JD. Anticipating the effects of accountable care organizations for inpatient surgery. *JAMA Surgery.* 2013;148(6):549-554.	4
171	Minhas SV, Kester BS, Lovecchio FC, Bosco JA. Nationwide 30-Day Readmissions After Elective Orthopedic Surgery: Reasons and Implications. *Journal for Healthcare Quality.* 2017;39(1):34-42.	4
172	Mitchell PM, Gavrilova SA, Dodd AC, Attum B, Obremskey WT, Sethi MK. The impact of resident involvement on outcomes in orthopedic trauma: An analysis of 20,090 cases. *Journal of Clinical Orthopaedics & Trauma.* 2016;7(4):229-233.	4
173	Miyata H, Motomura N, Ueda Y, Matsuda H, Takamoto S. Effect of procedural volume on outcome of coronary artery bypass graft surgery in Japan: implication toward public reporting and minimal volume standards. *Journal of Thoracic & Cardiovascular Surgery.* 2008;135(6):1306-1312.	4
174	Miyata H, Motomura N, Ueda Y, Tsukihara H, Tabayashi K, Takamoto S. Toward quality improvement of thoracic aortic surgery: estimating volume-outcome effect from nationwide survey. *European Journal of Cardio-Thoracic Surgery.* 2009;36(3):517-521.	4
175	Montin L, Leino-Kilpi H, Suominen T, Lepisto J. A systematic review of empirical studies between 1966 and 2005 of patient outcomes of total hip arthroplasty and related factors. J Clin Nurs. Jan 2008;17(1):40-45.	4
176	Moro ML, Sommella L, Gialli M, et al. Surgical infections surveillance: results of a six-month incidence study in two Italian hospitals.[Erratum appears in Eur J Epidemiol 1992 May;8(3):484 Note: Masini R [corrected to Masetti R]]. *Eur J Epidemiol.* Nov 1991;7(6):641-648.	4
177	Morris MS, Deierhoi RJ, Richman JS, Altom LK, Hawn MT. The relationship between timing of surgical complications and hospital readmission. *JAMA surgery.* 2014;149(4):348-354.	4
178	Morris MS, Graham LA, Richman JS, et al. Postoperative 30-day Readmission: Time to Focus on What Happens Outside the Hospital. *Annals of Surgery.* 2016;264(4):621-631.	4
179	Moscelli G, Siciliani L, Tonei V. Do waiting times affect health outcomes? Evidence from coronary bypass. Soc Sci Med. 2016;161:151-159.	3
180	Muntz J. Duration of deep vein thrombosis prophylaxis in the surgical patient and its relation to quality issues. *American Journal of Surgery.* 2010;200(3):413-421.	4
181	Nakazawa KR, Egorova NN, Power JR, Faries PL, Vouyouka AG. The Impact of Surgical Care Improvement Project Measures on In-Hospital Outcomes following Elective Vascular Procedures. *Annals of Vascular Surgery.* Jan 2017;38:17-28.	1
182	Neuman MD, Archan S, Karlawish JH, Schwartz JS, Fleisher LA. The relationship between short-term mortality and quality of care for hip fracture: a meta-analysis of clinical pathways for hip fracture. *Journal of the American Geriatrics Society.* 2009;57(11):2046-2054.	2
183	Neuman MD, Wirtalla C, Werner RM. Association between skilled nursing facility quality indicators and hospital readmissions. *JAMA.* Oct 15 2014;312(15):1542-1551.	1
184	O'Brien SM, Shahian DM, DeLong ER, et al. Quality measurement in adult cardiac surgery: part 2--Statistical considerations in composite measure	4

	scoring and provider rating. *Annals of Thoracic Surgery.* Apr 2007;83(4 Suppl):S13-26.	
185	Okike K, Peter-Bibb TK, Xie KC, Okike ON. Association Between Physician Online Rating and Quality of Care. *J Med Internet Res.* Dec 13 2016;18(12):e324.	4
186	Osborne NH, Nicholas LH, Ryan AM, Thumma JR, Dimick JB. Association of hospital participation in a quality reporting program with surgical outcomes and expenditures for Medicare beneficiaries. *JAMA.* 2015;313(5):496-504.	1
187	Osswald BR, Tochtermann U, Schweiger P, et al. Minimal early mortality in CABG--simply a question of surgical quality? *Thoracic & Cardiovascular Surgeon.* Oct 2002;50(5):276-280.	B
188	Owen RM, Perez SD, Bornstein WA, Sweeney JF. Impact of surgical care improvement project inf-9 on postoperative urinary tract infections: do exemptions interfere with quality patient care? *Archives of Surgery.* Oct 2012;147(10):946-953.	1
189	Paxton EW, Inacio MC, Singh JA, Love R, Bini SA, Namba RS. Are There Modifiable Risk Factors for Hospital Readmission After Total Hip Arthroplasty in a US Healthcare System? *Clinical Orthopaedics & Related Research.* 2015;473(11):3446-3455.	4
190	Penson DF. Re: variation in surgical-readmission rates and quality of hospital care. *Journal of Urology.* May 2014;191(5):1363-1364.	B
191	Pollock FH, Bethea A, Samanta D, Modak A, Maurer JP, Chumbe JT. Readmission within 30 days of discharge after hip fracture care. *Orthopedics.* 2015;38(1):e7-13.	4
192	Ponce B, Raines BT, Reed RD, Vick C, Richman J, Hawn M. Surgical Site Infection After Arthroplasty: Comparative Effectiveness of Prophylactic Antibiotics: Do Surgical Care Improvement Project Guidelines Need to Be Updated? *Journal of Bone & Joint Surgery - American Volume.* 2014;96(12):970-977.	4
193	Press MJ, Scanlon DP, Ryan AM, et al. Limits of readmission rates in measuring hospital quality suggest the need for added metrics. *Health Aff (Millwood).* Jun 2013;32(6):1083-1091.	1
194	Pujol N, Merrer J, Lemaire B, et al. Unplanned return to theater: A quality of care and risk management index? *Orthopaedics & traumatology, surgery & research.* 2015;101(4):399-403.	4
195	Pull ter Gunne AF, Hosman AJ, Cohen DB, et al. A methodological systematic review on surgical site infections following spinal surgery: part 1: risk factors. *Spine.* 2012;37(24):2017-2033.	4
196	Rice S. Readmission penalties have experts queasy about quality measures. *Mod Healthc.* Aug 10 2015;45(32):8.	1
197	Riegel B, Gates DM, Gocka I, et al. Effectiveness of a program of early hospital discharge of cardiac surgery patients.[Erratum appears in J Cardiovasc Nurs 1997 Apr;11(3):1]. *Journal of Cardiovascular Nursing.* Oct 1996;11(1):63-75.	2
198	Rolfson O, Wissig S, van Maasakkers L, et al. Defining an International Standard Set of Outcome Measures for Patients With Hip or Knee Osteoarthritis: Consensus of the International Consortium for Health Outcomes Measurement Hip and Knee Osteoarthritis Working Group. *Arthritis care & research.* 2016;68(11):1631-1639.	B
199	Rumball-Smith J, Blakely T, Sarfati D, Hider P. The mismeasurement of quality by readmission rate: how blunt is too blunt an instrument?: a quantitative bias analysis. *Medical Care.* May 2013;51(5):418-424.	1
200	Rumball-Smith J, Hider P, Graham P. The readmission rate as an indicator of the quality of elective surgical inpatient care for the elderly in New Zealand. *New Zealand Medical Journal.* Feb 13 2009;122(1289):32-39.	4
201	Rumball-Smith J, Hider P. The validity of readmission rate as a marker of	1

	the quality of hospital care, and a recommendation for its definition. *New Zealand Medical Journal.* Feb 13 2009;122(1289):63-70.	
202	Rumball-Smith J, Sarfati D, Hider P, Blakely T. Ethnic disparities in the quality of hospital care in New Zealand, as measured by 30-day rate of unplanned readmission/death. *International Journal for Quality in Health Care.* Jul 2013;25(3):248-254.	1
203	Saleh KJ, Bozic KJ, Graham DB, et al. Quality in orthopaedic surgery--an international perspective: AOA critical issues. *Journal of Bone & Joint Surgery - American Volume.* 2013;95(1):e3.	B
204	Saleh KJ, Wood KC, Gafni A, Gross AE. Immediate surgery versus waiting list policy in revision total hip arthroplasty. An economic evaluation. J Arthroplasty. Jan 1997;12(1):1-10.	4
205	Sampalis J, Boukas S, Liberman M, Reid T, Dupuis G. Impact of waiting time on the quality of life of patients awaiting coronary artery bypass grafting. *CMAJ Canadian Medical Association Journal.* Aug 21 2001;165(4):429-433.	4
206	Samuel AM, Fu MC, Toy JO, et al. Most 30-day Readmissions After Anterior Cervical Discectomy and Fusion Are Not Due to Surgical Site-Related Issues: An Analysis of 17,088 Patients. *Spine.* 2016;41(23):1801-1807.	B
207	Sanagou M, Wolfe R, Forbes A, Reid CM. Hospital-level associations with 30-day patient mortality after cardiac surgery: a tutorial on the application and interpretation of marginal and multilevel logistic regression. *BMC Med Res Methodol.* Mar 12 2012;12:28.	4
208	Sandvik D, Bade P, Dunham A, Hendrickson S. A hospital-to-nursing home transfer process associated with low hospital readmission rates while targeting quality of care, patient safety, and convenience: a 20-year perspective. *Journal of the American Medical Directors Association.* May 2013;14(5):367-374.	1
209	Sari I, Acar Z, Nurkalem Z, et al. Preoperative clinical status but not waiting time predicts in-hospital outcomes of surgery in patients with left main coronary artery stenosis. Tohoku J Exp Med. Oct 2007;213(2):173-180.	3
210	Saucedo J, Marecek GS, Lee J, Huminiak L, Stulberg SD, Puri L. How accurately are we coding readmission diagnoses after total joint arthroplasty? *Journal of Arthroplasty.* 2013;28(7):1076-1079.	B
211	Schattner A. Thirty-day readmission rates and hospital quality. *Int J Clin Pract.* Jan 2014;68(1):139.	1
212	Seabrook GR. Does rigorous quality process reporting guarantee superior-quality health care? *JAMA: Journal of the American Medical Association.* 2013;310(3):316-317.	7
213	Sechriest 2nd VF, Carney JR, Kuskowski MA, et al. Incidence of knee sepsis after ACL reconstruction at one institution: the impact of a clinical pathway. *Journal of Bone & Joint Surgery, American Volume.* 2013;95(9):843-849.	4
214	Sellers MM, Merkow RP, Halverson A, et al. Validation of new readmission data in the American College of Surgeons National Surgical Quality Improvement Program. *Journal of the American College of Surgeons.* Mar 2013;216(3):420-427.	B
215	Shahian DM, Meyer GS, Mort E, et al. Association of National Hospital Quality Measure adherence with long-term mortality and readmissions. *BMJ Quality & Safety.* Apr 2012;21(4):325-336.	B
216	Sherman SL, Lyman S, Koulouvaris P, Willis A, Marx RG. Risk factors for readmission and revision surgery following rotator cuff repair. *Clinical Orthopaedics & Related Research.* 2008;466(3):608-613.	4
217	Shih T, Dimick JB. Reliability of readmission rates as a hospital quality measure in cardiac surgery. *Annals of Thoracic Surgery.* Apr 2014;97(4):1214-1218.	B

218	Sibley RA, Charubhumi V, Hutzler LH, Paoli AR, Bosco JA. Joint Replacement Volume Positively Correlates With Improved Hospital Performance on Centers for Medicare and Medicaid Services Quality Metrics. *Journal of arthroplasty.* 2016;24.	4
219	Silber S, Muhling H, Dorr R, Zindler G, Preuss A, Stumpfl A. [Waiting times and death on the waiting list for coronary artery bypass operation. Experiences in Munich with over 1,000 patients]. *Herz.* Dec 1996;21(6):389-396.	9
220	Slamowicz R, Erbas B, Sundararajan V, Dharmage S. Predictors of readmission after elective coronary artery bypass graft surgery. Australian Health Review. Nov 2008;32(4):677-683.	3
221	Suhm N, Kaelin R, Studer P, et al. Orthogeriatric care pathway: a prospective survey of impact on length of stay, mortality and institutionalisation. *Arch Orthop Trauma Surg.* Sep 2014;134(9):1261-1269.	4
222	Sund R, Liski A. Quality effects of operative delay on mortality in hip fracture treatment. *Quality & Safety in Health Care.* Oct 2005;14(5):371-377.	
223	Takaro T, Ankeney JL, Laning RC, Peduzzi PN. Quality control for cardiac surgery in the Veterans Administration. *Annals of Thoracic Surgery.* Jul 1986;42(1):37-44.	4
224	Tepas JJ, 3rd, Kerwin AJ, deVilla J, Nussbaum MS. Macro vs micro level surgical quality improvement: a regional collaborative demonstrates the case for a national NSQIP initiative. *Journal of the American College of Surgeons.* Apr 2014;218(4):599-604.	1
225	Thakur NM. Readmission as an indicator of quality of care. *Am J Psychiatry.* Mar 1998;155(3):449-450.	7
226	Thalji NM, Suri RM, Greason KL, Schaff HV. Risk assessment methods for cardiac surgery and intervention. *Nat Rev Cardiol.* Dec 2014;11(12):704-714.	7
227	Toy JO, Basques BA, Grauer JN. Morbidity, mortality, and readmission after vertebral augmentation: analysis of 850 patients from the American College of Surgeons National Surgical Quality Improvement Program database. *Spine.* Nov 01 2014;39(23):1943-1949.	4
228	Travis J, Carr JB, Saylor D, et al. Coronary artery bypass graft surgery: surgical site infection prevention. *Journal for Healthcare Quality: Promoting Excellence in Healthcare.* 2009;31(4):16-23.	2
229	Troeng T, Janzon L. Are in-hospital deaths and long stay markers for errors in surgery? *Qual Assur Health Care.* 1990;2(2):149-159.	1
230	Tsai TC, Jha AK. Surgical-readmission rates and quality of care. *New England Journal of Medicine.* Dec 19 2013;369(25):2460-2461.	B
231	Tully PJ, Baumeister H, Bennetts JS, Rice GD, Baker RA. Depression screening after cardiac surgery: A six month longitudinal follow up for cardiac events, hospital readmissions, quality of life and mental health. *Int J Cardiol.* Mar 01 2016;206:44-50.	4
232	Tuominen U, Sintonen H, Hirvonen J, et al. Is longer waiting time for total knee replacement associated with health outcomes and medication costs? Randomized clinical trial (Structured abstract). *Value In Health.* 2010 2015;13(8).	4
233	Tuominen U, Sintonen H, Aronen P, et al. Cost-utility of waiting time in total joint replacements: a randomized clinical trial. Int J Technol Assess Health Care. Jan 2013;29(1):27-34.	4
234	Turnbull RG, Taylor DC, Hsiang YN, et al. Assessment of patient waiting times for vascular surgery. *Canadian Journal of Surgery.* Apr 2000;43(2):105-111.	1
235	van der Boon RM, Nuis RJ, Benitez LM, et al. Frequency, determinants and prognostic implications of infectious complications after transcatheter	4

	aortic valve implantation. *American Journal of Cardiology.* Jul 01 2013;112(1):104-110.	
236	Van Herck P, Vanhaecht K, Deneckere S, et al. Key interventions and outcomes in joint arthroplasty clinical pathways: a systematic review. *Journal of Evaluation in Clinical Practice.* 2010;16(1):39-49.	4
237	van Walraven C. The Utility of Unplanned Early Hospital Readmissions as a Health Care Quality Indicator. *JAMA Intern Med.* Nov 2015;175(11):1812-1814.	B
238	Vaughan-Sarrazin M, Bayman L, Rosenthal G, Henderson W, Hendricks A, Cullen JJ. The business case for the reduction of surgical complications in VA hospitals. *Surgery.* 2011;149(4):474-483.	4
239	Veeravagu A, Patil CG, Lad SP, Boakye M. Risk factors for postoperative spinal wound infections after spinal decompression and fusion surgeries. *Spine.* Aug 01 2009;34(17):1869-1872.	4
240	Vest JR, Gamm LD, Oxford BA, Gonzalez MI, Slawson KM. Determinants of preventable readmissions in the United States: a systematic review. *Implementation Science.* 2010;5:88.	B
241	Wakeam E, Hyder JA, Tsai TC, Lipsitz SR, Orgill DP, Finlayson SR. Complication timing and association with mortality in the American College of Surgeons' National Surgical Quality Improvement Program database. *Journal of Surgical Research.* Jan 2015;193(1):77-87.	1
242	Wang R, Cheng N, Xiao CS, et al. Optimal Timing of Surgical Revascularization for Myocardial Infarction and Left Ventricular Dysfunction. Chinese Medical Journal. 20th Feb 2017;130(4):392-397.	3
243	Weissman JS, Ayanian JZ, Chasan-Taber S, Sherwood MJ, Roth C, Epstein AM. Hospital readmissions and quality of care. *Medical Care.* May 1999;37(5):490-501.	1
244	Wennberg DE, Lucas FL, Birkmeyer JD, Bredenberg CE, Fisher ES. Variation in carotid endarterectomy mortality in the Medicare population: trial hospitals, volume, and patient characteristics. *JAMA.* 1998;279(16):1278-1281.	4
245	Williams SC, Koss RG, Morton DJ, Loeb JM. Performance of top-ranked heart care hospitals on evidence-based process measures. *Circulation.* Aug 08 2006;114(6):558-564.	1
246	Wilson GC, Cutler Quillin R, 3rd, Sutton JM, et al. Factors related to readmission after major elective surgery. *Digestive Diseases & Sciences.* 2015;60(1):47-53.	4
247	Wilson J, Charlett A, Leong G, McDougall C, Duckworth G. Rates of surgical site infection after hip replacement as a hospital performance indicator: analysis of data from the English mandatory surveillance system. *Infection Control & Hospital Epidemiology.* Mar 2008;29(3):219-226.	4
248	Wish JB. The role of 30-day readmission as a measure of quality. *Clin J Am Soc Nephrol.* Mar 2014;9(3):440-442.	1
249	Wojkowska-Mach J, Bulanda M, Jaje E, et al. The risk related to surgical site infections after hip endoarthroplasty--surveillance outcome analysis in two Polish orthopaedic centres. *Ortop.* May-Jun 2009;11(3):253-263.	4
250	Woldhek AL, Rijkenberg S, Bosman RJ, van der Voort PH. Readmission of ICU patients: A quality indicator? *Journal of Critical Care.* 2017;38:328-334.	1
251	Wong DR, Ali IS, Torchiana DF, Agnihotri AK, Bohmer RM, Vander Salm TJ. Learning in a new cardiac surgical center: an analysis of precursor events. *Surgery.* Feb 2009;145(2):131-137.	4
252	Worth LJ, Bull AL, Thorpe SM, Richards MJ. Meeting national recommendations for surgical site infection surveillance: examples and lessons from the Victorian Healthcare-associated Infection Surveillance System. *Healthcare Infection.* 2009;14(3):119-122.	4
253	Wortman PM, Smyth JM, Langenbrunner JC, Yeaton WH. Consensus	3

	among experts and research synthesis. A comparison of methods. *International Journal of Technology Assessment in Health Care.* 1998;14(1):109-122.	
254	Xing D, Ma JX, Ma XL, et al. A methodological, systematic review of evidence-based independent risk factors for surgical site infections after spinal surgery. *European Spine Journal.* 2013;22(3):605-615.	4
255	Yanamadala S, Morrison D, Curtin C, McDonald K, Hernandez-Boussard T. Electronic Health Records and Quality of Care: An Observational Study Modeling Impact on Mortality, Readmissions, and Complications. *Medicine (Baltimore).* May 2016;95(19):e3332.	B
256	Young B, Ng TM, Teng C, Ang B, Tai HY, Lye DC. Nonconcordance with surgical site infection prevention guidelines and rates of surgical site infections for general surgical, neurological, and orthopedic procedures. Antimicrob Agents Chemother. Oct 2011;55(10):4659-4663.	4
257	Yu S, Garvin KL, Healy WL, Pellegrini Jr VD, Iorio R. Preventing hospital readmissions and limiting the complications associated with total joint arthroplasty. *Journal of the American Academy of Orthopaedic Surgeons.* 2015;23(11):e60-e71.	4
258	Zhang JQ, Curran T, McCallum JC, et al. Risk factors for readmission after lower extremity bypass in the American College of Surgeons National Surgery Quality Improvement Program. *Journal of Vascular Surgery.* 2014;59(5):1331-1339.	1

APPENDIX D: EVIDENCE TABLES

Table Abbreviations: CABG=coronary artery bypass grafting; CMS=Centers for Medicare & Medicaid Services; DRG=diagnosis-related group; DVT=deep vein thrombosis; EUROSCORE= European system for cardiac operative risk evaluation; HQA=Hospital Quality Alliance; HCFA=Health Care Financing Administration; HIQR=Hospital Inpatient Quality Reporting Program; LOS=length of stay; MI=myocardial infarction; MRSA=methicillin-resistant *Staphylococcus aureus;* NQF=National Quality Forum; NR=not reported; O/E=observed to expected; SCIP=Surgical Care Improvement Project; SSI=surgical site infection; STS=Society of Thoracic Surgeons; TJA=total joint arthroplasty; TKR=total knee replacement; THR=total hip replacement; VASQIP=Veterans Affairs Surgical Quality Improvement Program; VHA=Veterans Health Administration; VTE=venous thromboembolism

DATA ABSTRACTION: WAIT TIME (SYSTEMATIC REVIEWS)

Author Year Study Design	Population	Measure Details	Analytic Details	Findings	Setting; Timeframe
Hip fractures (elderly)					
Leung 2010[10] Systematic Review	Hip fracture in the elderly N= 42 observational studies	Comparison between no-delay vs delay to surgery (cut-off for wait time, mortality, and complications varied by study)	Adjustment between studies varied	*Mortality:* Mixed conclusions between studies *Complications:* Most studies show an association between increased wait time and complications *Readmissions:* NR	1984-2009
Moja 2012[11] Systematic Review	Hip fracture in the elderly N= 191,873 within 35 observational studies	Comparison between no-delay vs surgical delay (cut-off for wait time and mortality varied by study)	Adjusted for age, sex, year, study design, data source, study quality, location, baseline risk	*Mortality:* Association between decreased wait time and decreased all-cause mortality rate (combined unadjusted and adjusted) OR 0.74 (95% CI 0.67 to 0.81) Stratified by surgical delay (combined unadjusted and adjusted): ≤12 hours: OR 0.84 (95% CI 0.57 to 1.23) ≤24 hours: OR 0.74 (95% CI 0.62 to 0.87) ≤48 hours: OR 0.75 (95% CI 0.68 to 0.81) >96 hours: OR 0.67 (95% CI 0.39 to 1.13) *Complications:* NR *Readmissions:* NR	1986-2011
Shiga 2008[12] Systematic Review	Hip fracture in the elderly N= 257,367 within 16	Comparison between wait time of ≤48-hours vs >48-hours	Adjustment between studies varied	*Mortality:* Association between increased wait time and increased 30-day mortality (unadjusted) OR 1.41 (95% CI 1.29 to1.54) Association between increased wait time and	NR

	observational studies			increased 1-year mortality (unadjusted) OR 1.32 (95% CI 1.21 to 1.43) *Complications:* NR *Readmissions:* NR	
Simunovic 2010[13] Systematic Review	Hip fracture in the elderly N= 13,478 within 16 observational studies	Comparison between no-delay vs surgical delay (cut-off for wait time and complications varied by study)	Adjustment between studies was varied	*Mortality:* Association between decreased wait time and decreased all-cause mortality (adjusted) RR 0.81 (95% CI 0.68 to 0.96) Stratified by mortality cut-off point: 30-day mortality (unadjusted) RR 0.90 (95% CI 0.71 to 1.13) 3 to 6-month mortality (unadjusted) RR 0.87 (95% CI 0.44 to 1.72) 1-year mortality (unadjusted) RR 0.55 (95% CI 0.40 to 0.75) *Complications:* Pneumonia (unadjusted) RR 0.59 (95% CI 0.37 to 0.93) Pressure sores (unadjusted) RR 0.48 (95% CI 0.34 to 0.69) Deep vein thrombosis (unadjusted) RR 0.97 (95% CI 0.56 to 1.68) Pulmonary embolism (unadjusted) RR 0.66 (95% CI 0.17 to 2.58) *Readmissions:* NR	NR
Hip fracture (non-elderly)					
Khan 2009[14] Systematic Review	Hip fracture N= 291,413 within 52 observational studies	Comparison between no-delay vs delay to surgery (cut-off for wait time, mortality, and complications varied by study)	Adjustment between studies varied	*Mortality:* 10/24 studies showed an association between decreased wait time and decreased mortality (adjusted) 14/24 studies showed no association (adjusted) *Complications:* 6/11 studies showed an association between decreased wait time and decreased complications (adjusted) 5/11 studies showed no association (adjusted) *Readmissions:* NR	1970-2007
Ankle fracture					

Schepers 2013[15] Systematic Review	Ankle fracture N= 11 observational studies	Comparison between no-delay vs surgical delay (cut-off for wait time and complications varied by study)	None	*Mortality:* NR *Complications:* Association between increased wait time and increased complications (unadjusted) OR 1.60 (95% CI 1.44 to 1.77) *Readmissions:* NR	1988-2013

DATA ABSTRACTION: WAIT TIME (PRIMARY STUDIES)

Author Year Study Design	Population	Measure Details	Analytic Details	Findings	Setting; Timeframe
Cardiovascular surgery					
Légaré 2005[16] Prospective Cohort	CABG among patients with stenosis of the left main coronary artery N= 561	Comparison between wait time within standard time or longer than standard time established for each triage level (emergent=0 days, in-hospital urgent=7 days, out-of-hospital semi-urgent A=21 days, out-of-hospital semi-urgent B=56 days)	Adjusted for propensity score, myocardial infarction within 7 days before surgery, preoperative renal failure, ejection fraction <40%, age >70 years, stenosis of left main coronary artery >70%	No statistically significant association between waiting longer than standard waiting time and composite score of in-hospital mortality, mechanical ventilation ≥ 24 hours postoperatively and postoperative length of stay > 9 days (adjusted) OR 0.7 (95% CI 0.4 to 1.2) No statistically significant association between queue assignment and out-of-hospital semi-urgent B for composite score Emergent: OR 2.5 (95% CI 0.95 to 6.5) In-hospital urgent: OR 0.9 (95% CI 0.4 to 1.9) Out-of-hospital semi-urgent A: OR 0.7 (95% 0.3 to 1.6) *Complications:* NR *Readmissions:* NR	1 hospital in Halifax, Nova Scotia 1999-2003
Sobolev 2012[17] Retrospective Cohort	CABG N= 9,593	Comparison between wait time of short delay**,prolonged delay***, and excessive delay****	Adjusted for risk score algorithm considering patient, clinical and surgical factors	*Mortality:* Statistically significant association between short delay and excessive delay for in-hospital mortality, but no association between prolonged delay and excessive delay (adjusted) Excessive delay (Reference) Prolonged delay OR 0.78 (95% CI 0.38 to 1.63) Short delay OR 0.32 (95% CI 0.20 to 0.51) *Complications:* NR *Readmissions:* NR	4 cardiac centers in British Columbia 1992-2006
Hip fractures (elderly)					

Meessen 2014[18] Retrospective Cohort	Hip fracture in the elderly N= 828	Comparison between wait time of ≤48 hours vs >48 hours	Adjusted for sex, age, Charlson comorbidity index	*Mortality:* No statistically significant association between wait time and 2-year all-cause mortality rate (Cox hazards analysis, adjusted) P>0.05 *Complications:* NR *Readmissions:* NR	Varese, Italy 2009
Holvik 2010[19] Retrospective Cohort	Hip fracture in the elderly N= 567	Comparison between wait time of ≤24 hours vs >24 hours	Adjusted for age, gender, pre-fracture residence (community or institution), number of comorbid conditions, severity of comorbidity, and number of medical complications observed during the stay	*Mortality:* No statistically significant association between wait time and 1-year all-cause mortality rate (adjusted) RR= 0.48 (95% CI 0.21 to 1.10) *Complications:* NR *Readmissions:* NR	Oslo, Norway 2007-2008
Karademir 2015[20] Retrospective Cohort	Hip fracture in the elderly N= 115	Comparison between wait time of ≤5 days vs >5 days	None	*Mortality:* No statistically significant association between wait time and 1-year all-cause mortality rate (unadjusted) P=0.5 *Complications:* NR *Readmissions:* NR	Istanbul, Turkey Timeframe NR
Hip fracture (non-elderly)					
Clague 2002[21] Retrospective Cohort	Hip fracture N= 462	Comparison between wait time of ≤24-hours vs >24-hours	None	*Mortality:* No statistically significant association between wait time and in-hospital mortality rate (unadjusted) P>0.05 No statistically significant association between wait time and 90-day mortality rate (unadjusted) P> 0.05 *Complications:* NR *Readmissions:* NR	1 UK hospital, 1996-1999
Griffiths 2013[22] Retrospective Cohort	Hip fracture N= 60	Comparison between wait time of ≤72-hours vs >72-hours	None	*Mortality:* No statistically significant association between wait time and 30-day mortality (unadjusted) P=0.2 *Complications:*	1 UK hospital Timeframe NR

				Association between increased wait time and increased 30-day complications (unadjusted) P=0.008 *Readmissions:* NR	
Lund 2014[23] Retrospective Cohort	Hip fracture N= 6,143	Stratified by wait time	None	*Mortality:* No statistically significant association between wait time and 1-year all-cause mortality rate (unadjusted) 0-12h: HR 1.00 (Reference) 12-24 hours: HR 0.89 (95% CI 0.78 to 1.01) 24-48 hours: HR 1.03 (95% CI 0.91 to 1.17) 48-72 hours: HR 1.02 (95% CI 0.84 to 1.24) 72-96 hours: HR 1.10 (95% CI 0.83 to 1.44) >96 hours: HR 1.05 (95% CI 0.81 to 1.36) *Complications:* NR *Readmissions:* NR	Danish Anaesthesia Database 2005-2007
Lurati-Buse 2014[24] RCT	Hip fracture N= 60	Comparison between accelerated care (medical clearance within 2 hrs of diagnosis) and standard care	None	*Mortality:* No statistically significant association between increased wait time and increased 30-day mortality (unadjusted) OR 0.22 (95% CI 0.02 to 2.14)* *Complications:* NR *Readmissions:* NR	2 hospitals in Canada and 1 in India 2011-2012
Ryan 2015[25] Retrospective Cohort	Hip fracture N= 2,121,215	Stratified by wait time	Adjusted for age, gender, race, comorbidity burden, insurance status, day of admission, hospital factors size, teaching status, and region	*Mortality:* Association between increased wait time and increased in-hospital mortality (adjusted) 0-day: OR 1 (reference) 2-day: OR 1.14 (95% CI 1.06 to 1.23) ≥3-days: OR 1.34 (95% CI 1.23 to 1.46) *Complications:* Association between increased wait time and increased in-hospital complications (adjusted) 0-day: OR 1 (reference) 1-day: OR 1.09 (95% CI 1.06 to 1.12) 2-day: OR 1.33 (95% CI 1.29 to 1.39) ≥3-days: OR 2.08 (95% CI 2.00 to 2.16) *Readmissions:* NR	US National Inpatient Sample, 2000-2009
Ankle fracture					
Tennent 2001[26] Retrospective Cohort	Ankle fracture N= 47	Comparison between wait time of ≤14-days vs >14-days	None	*Mortality: NR* *Complications:* Association between increased wait time and increased infection rate (unadjusted)	2 UK hospitals

				≤14-days < 50% >14-days = 50% *Readmissions:* NR	
Other fractures					
Vallier 2013[27] Retrospective Cohort	Pelvis, acetabulum, femur, or spine fractures N= 1005	Comparison between wait time of ≤24-hours vs >24-hours	Adjusted for age, injury severity, and the presence/severity of chest and/or abdominal injury	*Mortality:* NR *Complications:* Association between decreased wait time and decreased complication rate (adjusted) OR 0.731 (95% CI 0.546 to 0.986) *Readmissions:* NR	1 US hospital, 2005-2013

Abbreviations: *= ESP Calculated; **= within 2 weeks for semiurgent and 6 weeks for nonurgent procedures; ***= within 6 for semi-urgent and 12 weeks for non-urgent procedures; ****= longer than 6 weeks for semi-urgent and 12 weeks for non-urgent procedures; CCS= Canadian Cardiac Society

DATA ABSTRACTION: READMISSIONS

Author Year Study Design	Population	Measure Details	Analytic Details	Findings	Setting; Timeframe
Hannan 2011[28] Retrospective Cohort	CABG N= 33,936	Risk-adjusted hospital 30-day readmissions	Stepwise logistic regression, adjusted for patient, procedure, and hospital factors.	*Process Measures:* NR *Mortality:* Association with risk-adjusted 30-day hospital mortality rates (r=0.32, P=0.047), and with hospital risk-adjusted mortality rate in highest tertile (r=0.38, P=0.03) *Complications:* NR	NY State Cardiac Surgery Reporting System, 2005-2007
Hannan 2003[29] Retrospective Cohort	CABG N= 16,325	Risk adjusted hospital 30-day readmissions	Stepwise logistic regression, adjusted for patient, procedure, and hospital factors.	*Process Measures:* NR *Mortality:* No statistically significant association with overall hospital risk-adjusted mortality rate (r=0.09, P=0.64), but association with hospital RAMR in highest tertile, OR 1.14 (95% CI 1.03 to 1.25) *Complications:* NR	NY State Cardiac Surgery Reporting System, 1999
Parina 2015[30] Retrospective Cohort	CABG N= 296,063	Risk-adjusted 30-day readmission Considered high or low outliers if 95% CIs of O/E ratio excluded 1; classified 'discordant' if readmission and	Risk-adjustment for age, race, sex, LOS, Charlson index	*Process Measures:* NR *Mortality:* No association with overall mortality, among outliers 85% were discordant (CABG discordance rate: 78.3%) *Complications:* NR	299 hospitals in CA, 1995-2009

Author Year Study Design	Population	Measure Details	Analytic Details	Findings	Setting; Timeframe
		mortality rates were not both high or both low.			
Stefan 2013[31] Retrospective Cohort	Cardiac and Vascular N= 73,573 Orthopedic N= 205,526	30-day risk standardized readmission rate	Predicted/expected ratio, standardized by overall mean; predicted calculated using hierarchical generalized linear models, adjusted for patient-level factors	*Process Measures:* Orthopedic: association for overall measure (*r*=-0.06; P=0.003) and appropriate care measure (*r*=-0.05, P=0.03) (care measures made up of SCIP measures) Cardiac + vascular: no association with overall or appropriate care measure *Mortality:* NR *Complications:* NR	CMS HIQR program, 2007
Thomas 1996[32] Retrospective Cohort	CABG N= 4,261	Risk-adjusted, O/E unplanned, 30-, 60-, and 90-day readmissions	Stepwise logistic regression adjusted for patient age, sex, severity, complexity, LOS, and clinical variables	*Process Measures:* No relationship between CABG 30-day O/E readmissions and poor quality; Charts peer-reviewed based on set of HCFA-specified generic quality screens to evaluate care provided as acceptable or problematic *Mortality:* NR *Complications:* NR	Medicare data from Michigan hospitals, 1989-1991
Tsai 2013[33] Retrospective Cohort	CABG N= 153,496 Hip replacement N= 206,175	Hospital-level Composite of procedure-specific risk-adjusted 30-day readmission rates	Multivariate adjustment for patient and hospital characteristics	*Mortality:* CABG: Readmission rate in highest mortality quartile=18.1% vs the group of lowest quartile-third quartile=17.3%-17.4% (P=0.013) Hip replacement: Readmission rate in highest mortality quartile=11.7% vs the group of lowest quartile-third quartile=10.2-10.9% (P<0.001) *Process Measures:* HQA surgical score - based on SCIP process measures CABG: No statistically significant difference in readmission with HQA surgical score quartile (P=0.751) Hip replacement: No statistically significant difference in readmission with HQA surgical score quartile (P=0.193) *Complications:* NR	National Medicare data, 2009-2010
Zitser-Gurevich	CABG	First readmission within 100 days of CABG	Hospital mortality rank based on risk-adjusted 30-	*Process Measures:* NR *Mortality:*	National study of 14 hospitals: Israel 1994

Author Year Study Design	Population	Measure Details	Analytic Details	Findings	Setting; Timeframe
1999[34] Prospective Cohort	N=4,835	operation	day mortality rates. Logistic modeling with 61 explanatory variables including patient characteristics, operative factors, and post-operative variables	High mortality ranked hospitals had higher rates of readmission (OR=1.34, P=0.003) *Complications:* NR	

DATA ABSTRACTION: ADHERENCE TO SURGICAL STANDARDS

Author Year Study Design	Population	Measure Details	Analytic Details	Findings	Setting; Timeframe
Auerbach 2009[35] Retrospective Cohort	CABG N= 81,289	Proportion of patients who failed to receive recommended SCIP measures (# of missed measures).	30-day mortality adjusted for age, gender, DRG, comorbidities, hospital volume).	*Mortality:* 3 missed measures vs none missed OR 1.54 (95% CI 1.20 to 1.98), 4 or more missed measures vs none missed OR 1.63 (95% CI 1.24 to 2.15). *Complications:* NR *Readmissions:* No statistically significant association between # of missed measures and adjusted readmission (4 or more missed vs none OR 1.02 (95% CI 0.93 to 1.13).	164 US hospitals participating in Perspective database, 2003-2005
Bhattacharyya 2009[36] Retrospective Cohort	Hip or knee replacement N= NR	Composite score of 3 measures of surgical process quality and 3 measures of surgical outcome per CMS guidelines (based on NQF). Performance tiers calculated by deciles of hospital performance.	Inpatient mortality (no information on risk adjustment). Iatrogenic complications and urinary tract infection risk-adjusted. Readmissions (no information on risk adjustment)	*Mortality:* No statistically significant difference in mortality across hospital tiers, but trend toward higher rate of mortality in tier 4 (lowest quality) hospitals (r=0.116, P=0.088) *Complications:* No significant association of complications with hospital tier (data NR). *Readmissions:* Readmission avoidance index did not differ between top 20% hospitals and other hospitals (P=0.488).	CMS Hospital Quality Initiative Demonstration, 2003
Brinkman 2014[37] Retrospective	CABG N= 506,110	Adherence to use of preoperative beta-blocker within 24 hours preceding surgery	Operative mortality (during procedure or within 30 days of procedure) adjusted for	*Mortality:* No statistically significant association with operative mortality: OR 0.96 (95% CI 0.88 to 1.04). *Complications:*	1,107 centers from STS database, 2008-2012

Cohort		(NQF).	age, body surface area, race, sex, comorbidities, prior operations, year of surgery, hospital effects.	Association of beta-blocker use with increased atrial fibrillation: OR 1.09 (95% CI 1.06 to 1.12). No association with other complications (stroke, prolonged ventilation, reoperation, renal failure). *Readmissions:* NR	
Cotogni 2017[38] Prospective Cohort	Cardiac surgery N= 741	Adherence to prophylactic vancomycin administration timing protocol	Operative mortality or infection (during procedure or within 30 days of procedure) adjusted for age, EuroSCORE logistic, intensive care unit LOS, mechanical ventilation timing	*Mortality:* Association of increased mortality with protocol violation: OR 10.16 (95% CI 2.48 to 41.58) *Complications:* Association of increased SSI with protocol violation: OR 7.03 (95% CI 3.41 to 14.52) *Readmissions:* NR	1 hospital in Turin, Italy, Time NR
Kim 2012[39] Retrospective Cohort	Hip or knee arthroplasty N= 356 Spine surgery N= 537	Adherence to national guideline recommended surgical antibiotic prophylaxis (SAP) (antibiotic selection, timing and duration).	Before after implementation (2007 - 2nd phase) of national hospital evaluation program. No information on adjustment for confounders.	*Mortality:* NR *Complications:* Improved adherence to SAP guidelines (P<0.01) but no statistically significant changes in SSI rate, arthroplasty (P=0.44), spine surgery (P=0.28). *Readmissions:* NR	6 hospitals in Korea, 2006-2008
Kurlansky 2012[40] Retrospective Cohort	CABG N= 2,218	Total quality score (0 to 5) based on number of NQF process measures achieved. A score of 5=high-quality care.	Major morbidity (stroke, renal failure, reoperation, sternal infection, and prolonged ventilation) adjusted for hospital volume and STS risk score.	*Mortality:* NR *Complications:* Low quality score associated with increased stroke OR 1.51 (95% CI 1.18 to 1.93), reoperation OR 1.65 (95% CI 1.25 to 2.16), prolonged ventilation OR 1.54 (95% CI 1.21 to 1.96), and renal failure OR 1.91 (95% CI 1.09 to 3.35). No association with sternal infection. *Readmissions:* NR	5 cardiac surgery programs associated with Columbia University, 2007-2009
LaPar 2014[41] Retrospective Cohort	Cardiac N= 1,703	Adherence to SCIP measure of maintenance of 6am blood glucose levels on post-operative days 1 and 2	STS risk-adjusted operative mortality (during procedure or within 30 days of procedure), composite major morbidity and complications.	*Mortality:* No statistically significant association with SCIP measure failure vs no failure: OR 1.49 (95% CI 0.54 to 4.09). *Complications:* No statistically significant association with SCIP measure failure vs no failure for major morbidity (OR 1.51, 95% CI 0.86 to 2.67), and major sternal complications (OR 1.58, 95% CI 0.18 to 13.7). *Readmissions:* NR	University of Virginia Hospital, 2010-2012
McDonnell 2013[42]	Cardiac	SCIP outliers (non-control of blood glucose	30-day mortality, complications (MI,	*Mortality:* SCIP measure failure=1.8% vs compliant=1.7%;	Boston University Medical Center,

Retrospective Cohort	N= 832 66% CABG	at 6am on post-operative days 1 and 2)	infections), adjusted for serum creatinine level	P=0.55 *Complications:* No statistically significant association with SCIP measure failure and complications: MI (1.8% vs 1.4%, p=0.52), stroke (1.8% vs 0.9%, p=0.39), deep sternal infection (0% vs 0.4%, p=1.00), multisystem failure (1.8% vs 0.9%, p=0.43), atrial fibrillation (16.3% vs 30.3%, p=0.05). *Readmissions:* NR	2008-2011
Rasouli 2013[43] Retrospective Cohort	TJA N= 23,907	Before and after implementation of SCIP (adherence > 98% post implementation)	SSI rates within 1 year of index surgery. Adjusted for type of surgery, location, SCIP measures.	*Mortality:* NR *Complications:* After implementation, superficial SSI increased (P=0.05) and rate of deep SSI decreased (P=0.46). No change in DVT (P=0.51) and rate of PE increased (P=0.002). *Readmissions:* NR	Rothman Institute of Orthopedics, 2000-2009
Schelenz 2005[44] Retrospective Cohort	Cardiac N= 3,988	Before and after implementation of the 1998 UK national guidelines for the control of MRSA in hospitals and US guidelines on the control of SSI and infections in theatres.	MRSA rates 16 months before and after the intervention. Unadjusted.	*Mortality:* NR *Complications:* After implementation, there was a decrease in patients acquiring MRSA on ward (RR 0.41, 95% CI 0.23 to 0.76) *Readmissions:* NR	1 London hospital, 1999-2002
Wang 2012[45] Retrospective Cohort	Hip arthroplasty N= 17,714	Highly compliant hospitals (> median level of compliance) vs less compliant hospitals (≤ median level of compliance) to SCIP measures	Hospital-level SS rates and patient level postoperative infection. Adjusted for patient, hospital and surgery variables	*Mortality:* NR *Complications:* Increased post-operative infection rates (OR 1.50, 95% CI 1.07 to 2.12) and hospital-level SSIs (OR 1.91, 95%CI 1.31 to 2.79) with higher adherence to SCIP VTE-2 prevention measure. No association with other SCIP adherence measures *Readmissions:* NR	128 New York state hospitals, 2008

DATA ABSTRACTION: MORTALITY

Author Year Study Design	Population	Measure Details	Findings	Setting; Timeframe
Guru	CABG	All-cause, risk-adjusted,	No statistically significant correlation between all-cause-risk	Cardiac Care Network

2008[46] Retrospective Cohort	N= 347	in-hospital mortality and proportion of preventable deaths	adjusted mortality rates and proportion of preventable deaths at hospital level (Spearman coefficient=-0.42, P=0.26)	of Ontario, 1998-2003
Smith 2016[47] Retrospective Cohort	Multiple N= 236,125	Risk-adjusted 30-day mortality risk deciles	Distinct early survival risk pattern in highest risk decile for cardiac and orthopedic surgery with separation from all other deciles (eFigure, data NR)	VASQIP, 2011-2013

DATA ABSTRACTION: MEASUREMENT BURDEN AND UNINTENDED EFFECTS

Author Year	Performance Measure	Measurement Burden	Unintended Effects
Auerbach 2009[35]	Adherence to surgical standard	Lack of documentation of measures may be a concern. Electronic billing systems have not been validated for measure collection. Mortality and readmissions only at index hospital. Measures inpatient adherence only and cannot account for post-discharge factors	NR
Bhattacharyya 2009[36]	Adherence to surgical standard	Limited distribution of the composite measure scores required calculation to 4th decimal place to separate hospitals into deciles Numerous steps in performance of surgery difficult to evaluate and centrally report Administrative costs of collecting, analyzing and reporting these measures have not been reported Some deviation from standards may be clinically appropriate - not captured in measure Unknown whether individual measures have good distribution and ceiling effects to be able to distinguish between high and low performance	NR
Brinkman 2014[37]	Adherence to surgical standard	STS database collects perioperative beta-blocker use as "yes/no" field - cannot ascertain timing, dose, or other related covariates Adherence is low - some surgeons disagree with use in specific patients (*ie*, some cases of off-pump revascularization) May only be clinically beneficially in specific patients - measure does not specify which patients	Giving beta-blockers to patients who might not benefit, might have harms
Clague 2002[21]	Wait time	Presumably easily modifiable process measure Shorter and longer admission time may be beneficial to different subgroups - different measures would need to be applied to different subgroups of patients	NR
Griffiths 2013[22]	Wait time	Difficult to determine whether delay to surgery was due to necessary medical optimization or due to non-patient factors such as surgeon or implant availability	NR

Guru 2008[46]	Mortality	Reporting all-cause mortality does not account for the proportion that were not preventable Preventable deaths identified by chart reviews and adverse event audits - not a normally publicly reported measure (all-cause mortality reported on quality report card) All-cause mortality does not provide the level of detail required for quality improvement Preventable deaths measure is subjective - made by experts or hospital reviewers	NR
Hannan 2011[28]	Readmission	Patient vs system measures are more predictive of 30-day readmissions. Comorbidities, preoperative and other risk factors should be considered in readmission predictors - *ie*, BMI was not previously considered, but is significant in this study – indicates rise in obesity.	NR
Hannan 2003[29]	Readmission	Insufficient investigation of 30-day readmission outcome measure in the CABG literature, mortality is most commonly researched measure. Readmission=delayed complication, therefore risk-adjusted complication measure would complement, risk-adjusted mortality	Insurers may not reimburse early readmissions Hospitals may game the system and delay readmittance beyond 30 days.
Kim 2012[39]	Adherence to surgical standard	NR	NR
Khan 2009[14]	Wait time	Frailer patients may be more likely to be delayed (more time for assessment, correction of physiologic imbalances, *etc*) and may induce confounding which is difficult to account for (centrally collected database may have limited information on confounding variables) There may be different definitions of "delayed surgery" - substandard care not well defined	NR
Kurlansky 2012[40]	Adherence to surgical standard	Surgical standards need to be surgery-specific (CABG)	NR
LaPar 2014[41]	Adherence to surgical standard	SCIP measures fail to identify patients for whom improved outcomes and surgical quality might be achieved	NR
Leung 2010[10]	Wait time	Can be difficult to ascertain cause of delay - which can influence outcomes	NR
Lund 2014[23]	Wait time	Databases may lack information on guidelines and reasons for surgical delay Cut-off definitions of "early" or "late" surgery are variable	Requiring short surgical delay may influence timing of surgery (towards other shifts with less experienced surgeons and staff)
McDonnell 2013[42]	Adherence to surgical standard	Single SCIP glucose measure not accurate depiction of glucose over time Hospital or program level committee required to implement and track SCIP measures Measure (blood glucose) is only a factor in outcomes for specific patients (with diabetes)	NR
Meessen 2014[18]	Wait time	NR	NR
Moja	Wait time	Using administrative databases may not be able to account for important	NR

2012[11]		confounding factors (comorbidities, etc) Difficult to ascertain reasons for surgical delay Different cut-off times used	
Parina 2015[30]	Readmission	Quality indicators, like 30-day readmissions, are not well-defined or validated; no consensus on the definition of "quality". 30-day readmission rates do not correlate closely with mortality and are therefore poor indicators of quality. New quality metric should be validated against a "gold standard", hospital mortality rate. May be important to compare 30-day readmission to other quality outcomes (length of stay, patient safety indicators, various process measures).	NR
Rasouli 2013[43]	Adherence to surgical standard	NR	NR
Ryan 2015[25]	Wait time	Database may only have dates of admission and surgery - not possible to determine timing by hour	NR
Schepers 2013[15]	Wait time	No information on reasons for postponing surgery	NR
Shiga 2008[12]	Wait time	Causes of delay can be system or medically related - can't distinguish between them	NR
Simunovic 2010[13]	Wait time	NR	NR
Smith 2016[47]	Mortality	NR	Delay of intensive care management and end-of-life care to delay death beyond 30 days but not improving life expectancy or quality of care - unfounded claim in this study
Stefan 2013[31]	Readmission	Statistically significant differences in risk-standardized 30-day readmission rate measures do not correspond to meaningful differences between high- and low-performing hospitals.	NR
Tennent 2001	Wait time	NR	NR
Thomas 1996[32]	Readmission	Readmission rate information is easily obtainable--bias toward using this as a quality measure. Readmission as a quality measure relies on assumptions: patients receiving good care will be stable before being discharged and patients who are not stabilized are more likely to be readmitted.	NR
Tsai 2013[33]	Readmission	Readmission rates generally uncorrelated with other measures of hospital quality (ie, volume, mortality) Administrative data used to capture readmission may not capture other factors - need to do risk-adjustment	NR
Vallier 2013	Wait time	Other injuries may influence timing or surgery	NR
Zitser-	Readmission	Readmission can be difficult to predict in models - making it difficult to	NR

Gurevich 1999[34]	identify high-risk patients and risk-adjust May be difficult to determine related and unrelated readmissions to index operation

QUALITY ASSESSMENT: PRIMARY STUDIES

Author Year	Risk of selection bias? (yes/no/unclear)	Risk of performance bias? (yes/no/unclear)	Risk of detection bias? (yes/no/unclear)	Risk of bias due to confounding? (yes/no/unclear)	Risk of Attrition bias? (yes/no/ unclear)	Risk of reporting bias? (yes/no/unclear)	Overall Quality (Good/Fair/Poor)
Auerbach 2009[35]	No Perspective database. Regular auditing. Included all patients undergoing CABG during timeframe	No	No Regularly collected and maintained hospital data	No Analyses adjusted for patient and hospital level confounders	Unclear No comment on any missing data, but well-maintained database	No	Good
Bhattacharyya 2009[36]	Unclear Data from CMS demonstration project, voluntary database; lacking data from lower 50% of hospitals	No	No Hospital collected and reported data	Unclear UTI risk-adjusted. Hematoma and readmissions not severity adjusted.	Unclear Hospitals in lowest tier were more likely to have missing data	No	Fair
Brinkman 2014[37]	No Participation in STS database voluntary but covers almost all CABGs in US. Regular auditing.	No	No STS database	No Analysis adjusted for patient and hospital level confounders	No Excluded 0.08% for missing variables	No	Good
Cotogni 2017[38]	No Eligibility criteria applied to all consecutive patients undergoing cardiac surgery for 1-year period	No	Unclear No information on how information was collected or outcome assessment	No Analyses adjusted for patient and surgical confounders	Unclear No patients lost to follow-up but no comment on any missing data	No	Fair

Guru 2008[46]	No Randomly sampled deaths for 8 hospitals plus consecutive deaths for new hospital	No	Unclear Blinded reviewers, subjective outcome assessed by surgeon	Unclear Adjusted for patient characteristics only	Unclear No information on missing data or completeness of database	No	Fair
Hannan 2011[28]	No New York administrative database (SPARCS). Regular auditing.	No	No Reasons for readmission were determined by ICD-9-CM	No Risk-adjusted for patient, surgical and hospital level variables	Unclear No comment on any missing data, but well-maintained database	No	Good
Hannan 2003[29]	No New York administrative database (SPARCS). Regular auditing.	No	No Reasons for readmission were determined by ICD-9-CM	No Risk-adjusted for patient, surgical and hospital level variables	Unclear No comment on any missing data, but well-maintained database	No	Good
Kim 2012[39]	Yes Mandatory reporting database for hospitals with more than 100 beds. Only 6 hospitals included, no data on #s or reasons for exclusions for lack of reliable data or for infections other than SSI	No	No Nationally recorded hospital database	Yes No adjustment for confounding variables	Unclear Patients with missing data excluded, no information on number excluded	No	Poor
Kurlansky 2012[40]	No All surgical cases at 5 centers in program with validated data – STS compliant – validated data.	No	No	No Adjustment by predicted risk score	No Imputation guidelines from STS followed for any missing data	No	Good

LaPar 2014[41]	No STS institutional database. included all patients undergoing cardiac surgery during timeframe	No	No STS institutional data	No Propensity score matching and STS risk-adjusted variables	No No information on missing data but well-maintained database	No	Good
Légaré 2005[16]	Yes Convenience sample of consecutive patients	No	No	No Adjusted for propensity score, myocardial infarction within 7 days before surgery, preoperative renal failure, ejection fraction <40%, age >70 years, stenosis of left main coronary artery >70%	No	No	Fair
McDonnell 2013[42]	No Hospital database, no info on auditing/ validation. All patients undergoing cardiac surgery during timeframe	No	No Institutional database	Yes Only discuss controlling for serum creatinine level, but no other confounding factors	Unclear No information on missing data or completeness of database	No	Poor
Parina 2015[30]	Unclear California (OSHPD) database, excluded data from low-volume hospitals	No	No Outcomes were objective	No Risk-adjusted for patient, surgical and hospital level variables	Unclear Some patients missing sex and ethnoracial data. No information on other missing data.	No	Fair

Rasouli 2013[43]	No Institutional database, no info on auditing/ validation. All patients with primary or revision TJA	No	No Institutional database	Unclear Only adjusted for SCIP and surgery factors	Unclear No information on missing data or completeness of database	No	Poor
Schelenz 2005[44]	No All patients undergoing elective cardiac surgery during pre and post time periods	No	Unclear Minimal information on how data was collected and outcome assessors	Yes No adjustment for any patient factors which may have differed between time periods and no data on patient characteristics	Unclear No comment on missing data	No	Poor
Smith 2016[47]	No VASQIP validated and maintained database	No	No	No VASQIP risk-adjustment models	No Missing data limited, SAS macro used for imputation of missing information	No	Good
Sobolev 2012[17]	No Population-based patient registry. Inclusion/exclusion criteria applied uniformly	No	No	No Adjusted for patient, clinical, and surgical factors	Unclear Unclear handling missing data. Excluded 8.5% for missing data or “other reasons”	No	Fair
Stefan 2013[31]	No QIO CDW database	No	No Reasons for readmission were determined by ICD-9-CM	No Risk-adjusted for patient, surgical, and hospital level variables	Unclear No mention of the proportion with missing data	No	Good

Thomas 1996[32]	No Medicare UB-82 claims data	No	No Reasons for readmission were determined by ICD-9-CM	Unclear Risk-adjusted for patient level factors only	Unclear No mention of missing of data	No	Fair
Tsai 2013[33]	No Medicare Inpatient 100% file and 2010 MEDPAR File	No	No Measures were objective	No Risk-adjusted using validated tool	Unclear No mention of missing of data	No	Good
Wang 2012[45]	Unclear No information on patient-level eligibility criteria for selection. Data from state-level linked databases	No	No Regularly collected and maintained hospital data	No Adjusted for patient, hospital, and surgical confounders	Unclear Missing data excluded, varying numbers of missing data for covariates	No	Fair
Zitser-Gurevich 1999[34]	No National Hospital Admission Registry	No	No Measures were objective	No Risk-adjusted for patient, surgical and hospital level variables	Unclear Mention missing values for left ventricular dysfunction but no mention of handling of missing data	No	Good

Abbreviations: SPARCS= Statewide Planning and Research Cooperative System; OSHPD= Office of Statewide Health Planning and Development; MEDPAR= Medicare Provider Analysis and Review; CDW=Clinical Data Warehouse; QIO=Quality Improvement Organization; VASQIP=VA surgical quality improvement program; SCIP=surgical care improvement program; TJA=total joint arthroplasty; STS=society of thoracic surgeons; SSI=surgical site infection; CABG=coronary artery bypass graft

APPENDIX E: PEER REVIEW

Comment #	Reviewer number	Comment	Author response
1. Are the objectives, scope, and methods for this review clearly described?			
1	1	Yes	*NA*
2	2	Yes	*NA*
3	3	No - I will confine my comments to cardiac surgery, which is my clinical and performance measurement area of expertise. The nominal objective of this paper is stated in its title: "Use of Performance Measures as Criteria for Selecting Community Cardiac and Orthopedic Surgical Providers for the Veterans Choice Program". In order to mitigate accessibility issues in the VA for cardiac and orthopedic services, the VA Choice program was established to contract for such services with selected community providers, when needed. These providers must "maintain the same or similar credentials and licenses as VA providers". The logical flow and inferences of this evidence paper are a mystery to me. The authors demean 30-day CABG mortality as a quality metric, seemingly because one study they identified showed poor correlation between this measure and clinician assessment of preventability. Yet the precedent for this metric is overwhelming. For nearly three decades, virtually every state (e.g., NY, MA, PA, NJ, CA) and national CABG quality assessment program of which I am aware has used this metric as the primary, and often sole method for assessing surgical quality. CABG surgery is actually one of the few procedures where both typical volumes and mortality rates are adequate to justify using risk adjusted mortality as a valid metric to differentiate quality (Dimick et al, JAMA 2004. 292:847). Short term perioperative morbidity and mortality have always been the mainstays of CABG performance measurement, and they are outcomes of great importance to patients. If you do not survive 30 days postop, preferably without serious short term complications such as stroke or renal failure, all other measures are irrelevant. These data are collected and available in state	*We appreciate these comments and below have organized our responses below into separate themes:* *1) 30-day mortality: We agree that we were coming across as dismissing 30-day mortality as a less valid performance metric than mortality. We clarified that our focus was to identify which measures meant as indirect indicators of health outcomes (eg, readmissions, process measures, etc.) are associated with health outcomes (e.g., mortality, quality of life, or function) and that our conclusion that readmission is the strongest measure of quality was relative to other indirect indicators. We agree that any performance measures that directly measure mortality, quality of life and function generally take precedence over other measures given their intrinsic importance to patients and have clarified this in the report. As for the studies that evaluate the association between 30-day mortality and preventable mortality and long-term mortality, we saw them as being in response to published criticisms about the singular use of 30-day mortality and have reframed them as such. We better emphasized that we are encouraged that the usefulness of 30-day mortality as a surrogate for long-term outcomes was reinforced in a recent VHA study, which also found no evidence of gaming to meet a 30-day metric. However, we do stand by our conclusion that the evidence linking readmission to 30-day mortality is stronger than the evidence linking process measures to 30-day mortality. The link between readmission and 30-day mortality is supported by multiple consistent studies; whereas, the link between each specific composite process measure and mortality is only supported by a single study.*

Comment #	Reviewer number	Comment	Author response
		(e.g., NY Cardiac Surgery Reporting System) and national clinical registries (e.g., STS National Database, discussed in response to the next question), and in claims data. Other measures discussed but dismissed by the authors are similarly perplexing. The main medication process measure described in this evidence paper is beta blocker use, whose efficacy is challenged by the particular study they cite. Yet use of this medication is an ACC/AHA Class 1 recommended practice (Circulation 2011; 124: 2610 –2642) for CABG to reduce the occurrence of postoperative atrial fibrillation, based on dozens of studies (randomized and observational). Strikingly, in their discussion of process standards related to CABG, the authors do not specifically mention what is arguably the single most important CABG process measures—use of the internal mammary artery conduit—which has a well-documented association with short and long term survival, graft patency, freedom from recurrent angina, and freedom from reoperation. Ironically, at the same time the authors seem to dismiss 30-day mortality as a valid metric for selecting VA contractors for CABG, they repeatedly use this same measure as the reference upon which to establish the validity, or lack thereof, of other proposed quality metrics, such as readmissions or adherence to process of care measures. With regard to thirty day readmission, this would be low on my list of available CABG performance metrics. Thus, it was quite surprising for me to see this suddenly appear in the evidence document as the authors' most highly recommended quality measure. Readmissions are a problematic measure of CABG performance. While surgical readmissions often result from delayed occurrence or recognition of postoperative complications, the ability to risk adjust this endpoint is problematic. Typical readmission risk model c-indices are 0.60-0.65 rather than the 0.75-0.85 range of most mortality or morbidity risk models. Notably, one of the largest registry-based studies of CABG readmission showed minimal association	2) *Shahian 2014 Circulation study: We added this to the report: "Lower readmission rates were weakly correlated (Spearman rank correlation was –0.154) with higher composite scores (including mortality, major morbidity, internal mammary artery graft and NQF-endorsed perioperative meds) in a secondary subgroup analysis of 827 CMS CABG providers from the 2010 STS database.[Shahian 2014] However, we have insufficient information to determine the strength of this evidence as this finding was only very briefly noted in the Discussion section of the main study, which was devoted to the development of the readmission measure. No other information about the methodology were provided in the publication or via author request."* 3) *Beta Blocker: Yes, we are aware that the findings of Brinkman 2014 suggesting no significant association between preoperative beta blocker use and mortality may seem counterintuitive as preoperative beta blocker use is an ACC/AHA Class 1 recommended practice for CABG to reduce the occurrence of postoperative atrial fibrillation. However, it is not uncommon for studies of patient health outcomes to contradict studies of surrogate endpoints such as atrial fibrillation.* 4) *Internal mammary artery conduit: The only studies we identified that link internal mammary artery conduit use to survival, such as Boylan et. al. 1994 in the Journal of Thoracic and Cardiovascular Surgery v107, Issue 3, Pages 657-662, were those initial studies that led to its adoption as a quality standard. We did not find any studies in our search or in your list below that evaluated the link between satisfactory routine adherence to the internal mammary artery conduit use standard and health outcomes.* 5) *Limitations of readmission: We agree that use of readmission is potentially limited by lack of consensus about risk adjustment, including how to handle SES and*

Comment #	Reviewer number	Comment	Author response
		between readmission rates and performance on a robust, multidimensional, NQF-endorsed composite measure of CABG performance (Shahian et al, Circulation. 2014; 130: 399-409). Readmissions may also be highly influenced by local and patient level socioeconomic factors that are completely out of the control of the discharging hospital, especially for hospitals serving vulnerable populations. And finally, readmissions for cardiac surgery are often to hospitals other than the index hospital (D'Agostino et al, J Thorac Cardiovasc Surg 1999; 118: 823-32. Patient's operated upon at a regional tertiary center may be subsequently readmitted to their local community hospital, perhaps unnecessarily, for problems that could have been treated as an outpatient. The index hospital may not have even been notified that the patient was being considered for readmission to another hospital. In summary, I believe the authors have wrongly concluded that mortality, morbidity and process measures are less valid indicators of CABG quality than 30-day readmission; I regard the latter as a second or third tier indicator of quality for the purposes of VA Choice selective contracting.	*the potential for underestimating rates due to difficulties capturing readmissions to another hospital. We had already included in our Discussion a lengthy discussion of these and other limitations. We added to the Executive Summary and Conclusions a reminder of such limitations and that they must be considered in determining the usefulness of Readmissions.* .
4	4	Yes	*NA*
2. Is there any indication of bias in our synthesis of the evidence?			
5	1	No	*NA*
6	2	No	*NA*
7	3	Yes - I believe the authors have systematically excluded from consideration the most widely used and respected source of clinical cardiothoracic surgery performance data in the US—the STS National Database, which is barely mentioned as an afterthought on page 7 ("...the Society for Thoracic Surgeons (STS) use NQF measures..."). The STS National Database (full disclosure—I have been a volunteer member of various STS Database working groups) was initiated in 1989 and today has over 6 million patient records. As of 2012, it had 90-95% national penetration among adult cardiac surgery programs, and that number is undoubtedly higher today. STS uses trained data managers to collect extremely granular clinical data on	*We have already recommended that VHA decision-makers require Choice community providers to participate in a public reporting program that involves periodic auditing. We state that this could ensure the reliability of Choice community providers' performance measures, and the participation in public reporting itself may also be a strong motivator for quality improvement. This recommendation encompasses STS participation.* *The fact that STS measures are "based on audited, clinically granular data, they incorporate robust risk models, they are reliable, they are used by virtually every cardiac program in the US, and they are all peer-review published and NQF-endorsed"*

Comment #	Reviewer number	Comment	Author response
		every patient, and case completeness rates near 100% have been demonstrated. Annual external audit by a Medicare QIN-QIO have consistently shown accuracy rates of 96-97%. The STS National Database serves as the basis of a robust portfolio of NQF-endorsed performance measures that are publicly reported by a majority of US cardiac programs and used by Consumer Reports and US News and World Report in their performance ratings. Benchmarked performance reports for a myriad of process and risk adjusted outcomes measures are provided quarterly to each participant, and beginning in 2010 a public reporting program was instituted. As of early 2017, 60% of all STS adult cardiac surgery database participants (and thus about the same percentage of all non-federal US cardiac surgery programs) are voluntarily publicly reporting their STS results on the STS or Consumer Reports websites. STS does have risk models for both 30-day all cause readmission and long-term survival. However, although components of the broad STS portfolio of performance metrics, in my opinion they are much less robust measures of CABG performance than the family of composite quality metrics that STS developed beginning a decade ago, all of which have been endorsed through the rigorous NQF process. For CABG, this composite measure encompasses four domains—risk adjusted mortality, risk adjusted morbidity (avoidance of all 5 of the most serious and common complications of CABG), use of the internal mammary artery (the demonstrably superior conduit for long-term graft patency, avoidance of recurrent angina and reoperation, and survival), and use of all 4 NQF endorsed perioperative medications. This is a much broader assessment of quality than could be provided by any individual performance measure, including mortality alone, and measure reliability and ability to discriminate performance are greatly enhanced because of the larger number of endpoints. Importantly, the STS mortality endpoint avoids the gaming issues noted by the authors of the VA study. It includes not only all deaths occurring	*is informative. But, as a formal comparison of the strengths and weaknesses of the various available performance improvement programs was outside of the scope of this report, we cannot recommend one over another at this time. Also, reliance on STS measures alone may exclude our national network of university hospitals that are often partnered with and an important source of referrals for VA hospitals, but which are participants of other performance improvement organizations. Therefore, leaving our recommendation open to participation in any public reporting program that involves periodic auditing may better ensure Choice network provider adequacy.* *We agree that use of a rigorously developed and validated and widely accepted and used composite measure of direct and indirect indicators of health outcomes may also be a highly feasible and comprehensive approach to determining eligibility of Choice providers - assuming its potential advantages outweighed identified potential challenges. We have added this recommendation and a paragraph to the 'Implications for Policy and Implementation' section of the Discussion that defines, provides rationale for, outlines potential challenges of and ideal characteristics of composite measures based on some of the reference material you provided.*

Comment #	Reviewer number	Comment	Author response
		in hospital, regardless of timing, but also all deaths within 30-days, regardless of where they occurred. Thus, there is no incentive for keeping a hopelessly ill patient alive till day 31 and then withdrawing support, as that patient's death would still be captured. It is extremely rare for a non-federal cardiac surgery provider in the US to not participate in the STS Database. I would personally be reluctant to allow a non-VA program to contract to provide VA CABG services if it did not participate in the STS Database and receive regular feedback reports. Given the near universal participation of US non-federal cardiac surgery programs in the STS Database, it would be exceptionally easy for the VA to use STS quality metrics to assess the quality of programs they are considering. STS composite CABG measures seem to optimally satisfy all the criteria one would want in a performance metric. These multidimensional, comprehensive measures are based on audited, clinically granular data, they incorporate robust risk models, they are reliable, they are used by virtually every cardiac program in the US, and they are all peer-review published and NQF-endorsed. That the possibility of using these measures to evaluate CABG performance for the VA Choice program is not even mentioned in this review is inexplicable to me. I have listed a sampling of the many peer reviewed papers describing these STS quality measurement activities in my answer to the next question.	
8	4	No	*NA*
3. Are there any published or unpublished studies that we may have overlooked?			
9	1	No	*NA*
10	2	No	*NA*
11	3	Yes - Selected peer-reviewed articles relevant to CABG performance measurement and the STS National Database 1. Shahian DM, Jacobs JP. Health services information: Lessons learned from the society of thoracic surgeons national database. In: Sobolev B, Levy A, Goring S, eds. Data and	*We thank the reviewer for this comprehensive list of papers that provide detailed information about the STS national database, development and validation of STS performance measure risk prediction models, linking of STS databases to social security and CMS data, and issues in quality measurement. After dual review, we did not identify any additional studies that evaluated*

Comment #	Reviewer number	Comment	Author response
		measures in health services research. Boston, MA: Springer US;2016: p. 1-24. 2. D'Agostino RS, Jacobs JP, Badhwar V et al. The society of thoracic surgeons adult cardiac surgery database: 2016 update on outcomes and quality. Ann Thorac Surg 2016;101(1):24-32. 3. Jacobs JP, Shahian DM, He X et al. Penetration, completeness, and representativeness of the society of thoracic surgeons adult cardiac surgery database. Ann Thorac Surg 2016;101(1):33-41. 4. D'Agostino RS, Jacobs JP, Badhwar V et al. The society of thoracic surgeons adult cardiac surgery database: 2017 update on outcomes and quality. Ann Thorac Surg 2016. 5. Afilalo J, Kim S, O'Brien S et al. Gait speed and operative mortality in older adults following cardiac surgery. JAMA cardiology 2016;1(3):314-321. 6. Edwards FH, Ferraris VA, Kurlansky PA et al. Failure to rescue rates after coronary artery bypass grafting: An analysis from the society of thoracic surgeons adult cardiac surgery database. Ann Thorac Surg 2016;102(2):458-464. 7. Shahian DM. The society of thoracic surgeons national database: "What's past is prologue". Ann Thorac Surg 2016;101(3):841-845. 8. Badhwar V, Rankin JS, He X et al. The society of thoracic surgeons mitral repair/replacement composite score: A report of the society of thoracic surgeons quality measurement task force. Ann Thorac Surg 2016;101(6):2265-2271. 9. Rankin JS, Badhwar V, He X et al. The society of thoracic surgeons mitral valve repair/replacement plus coronary artery bypass grafting composite score: A report of the society of thoracic surgeons quality measurement task force. Ann Thorac Surg 2016. 10. Bhatt DL, Drozda JP, Jr., Shahian DM et al. Acc/aha/sts statement on the future of registries and the performance measurement enterprise: A report of the american college of cardiology/american heart association task force on performance measures and the society of thoracic surgeons. J Am Coll Cardiol 2015;66(20):2230-2245. 11. Englum BR, Saha-Chaudhuri P, Shahian DM et al. The impact of high-risk cases on hospitals' risk-adjusted coronary	*the association between a performance measure meant as an indirect indicator of a health outcome and actual health outcomes. We did add the following articles to the Background section:* - *Shahian DM, Blackstone EH, Edwards FH et al. Cardiac surgery risk models: A position article. Ann Thorac Surg 2004;78(5):1868-1877.* - *Shahian DM, O'Brien SM, Filardo G et al. The society of thoracic surgeons 2008 cardiac surgery risk models: Part 3--valve plus coronary artery bypass grafting surgery. Ann Thorac Surg 2009;88(1 Suppl):S43-S62.* - *Shahian DM, O'Brien SM, Filardo G et al. The society of thoracic surgeons 2008 cardiac surgery risk models: Part 1--coronary artery bypass grafting surgery. Ann Thorac Surg 2009;88(1 Suppl):S2-22.* - *D'Agostino RS, Jacobs JP, Badhwar V et al. The society of thoracic surgeons adult cardiac surgery database: 2017 update on outcomes and quality. Ann Thorac Surg 2016.* - *Jacobs JP, Shahian DM, He X et al. Penetration, completeness, and representativeness of the society of thoracic surgeons adult cardiac surgery database. Ann Thorac Surg 2016;101(1):33-41.* - *Shahian DM, Jacobs JP, Edwards FH et al. The society of thoracic surgeons national database. Heart 2013;99(20):1494-1501.* - *Peterson ED, Delong ER, Masoudi FA et al. Accf/aha 2010 position statement on composite measures for healthcare performance assessment: A report of american college of cardiology foundation/american heart association task force on performance measures (writing committee to develop a position statement on composite measures). J Am Coll Cardiol 2010;55(16):1755-1766.*

Comment #	Reviewer number	Comment	Author response
		artery bypass grafting mortality rankings. Ann Thorac Surg 2015. 12. Jacobs JP, Shahian DM, Prager RL et al. Introduction to the sts national database series: Outcomes analysis, quality improvement, and patient safety. Ann Thorac Surg 2015;100(6):1992-2000. 13. Shahian DM, Grover FL, Prager RL et al. The society of thoracic surgeons voluntary public reporting initiative: The first 4 years. Ann Surg 2015;262(3):526-535. 14. Shahian DM, He X, Jacobs JP et al. The society of thoracic surgeons composite measure of individual surgeon performance for adult cardiac surgery: A report of the society of thoracic surgeons quality measurement task force. Ann Thorac Surg 2015;100(4):1315-1325. 15. Winkley Shroyer AL, Bakaeen F, Shahian DM et al. The society of thoracic surgeons adult cardiac surgery database: The driving force for improvement in cardiac surgery. Seminars in thoracic and cardiovascular surgery 2015;27(2):144-151. 16. Grover FL, Shahian DM, Clark RE, Edwards FH. The sts national database. Ann Thorac Surg 2014;97(1 Suppl):S48-S54. 17. Shahian DM. Preoperative beta-blockade in coronary artery bypass grafting surgery. JAMA Intern Med 2014;174(8):1328-1329. 18. Shahian DM, He X, Jacobs JP et al. The sts avr + cabg composite score: A report of the sts quality measurement task force. Ann Thorac Surg 2014;97(5):1604-1609. 19. Shahian DM, He X, O'Brien SM et al. Development of a clinical registry-based 30-day readmission measure for coronary artery bypass grafting surgery. Circulation 2014;130(5):399-409. 20. Shahian DM, Jacobs JP, Edwards FH et al. The society of thoracic surgeons national database. Heart 2013;99(20):1494-1501. 21. Jacobs JP, O'Brien SM, Shahian DM et al. Successful linking of the society of thoracic surgeons database to social security data to examine the accuracy of society of thoracic surgeons mortality data. J Thorac Cardiovasc Surg 2013;145(4):976-983.	

Comment #	Reviewer number	Comment	Author response
		22. Overman DM, Jacobs JP, Prager RL et al. Report from the society of thoracic surgeons national database workforce: Clarifying the definition of operative mortality. World J Pediatr Congenit Heart Surg 2013;4(1):10-12. 23. Rankin JS, He X, O'Brien SM et al. The society of thoracic surgeons risk model for operative mortality after multiple valve surgery. Ann Thorac Surg 2013;95(4):1484-1490. 24. Afilalo J, Mottillo S, Eisenberg MJ et al. Addition of frailty and disability to cardiac surgery risk scores identifies elderly patients at high risk of mortality or major morbidity. Circ Cardiovasc Qual Outcomes 2012. 25. Shahian DM, O'Brien SM, Sheng S et al. Predictors of long-term survival following coronary artery bypass grafting surgery: Results from the society of thoracic surgeons adult cardiac surgery database (the ascert study). Circulation 2012. 26. Shahian DM, He X, Jacobs JP et al. The society of thoracic surgeons isolated aortic valve replacement (avr) composite score: A report of the sts quality measurement task force. Ann Thorac Surg 2012;94(6):2166-2171. 27. Shahian DM, Edwards FH, Jacobs JP et al. Public reporting of cardiac surgery performance: Part 1--history, rationale, consequences. Ann Thorac Surg 2011;92(3 Suppl):S2-11. 28. Shahian DM, Edwards FH, Jacobs JP et al. Public reporting of cardiac surgery performance: Part 2--implementation. Ann Thorac Surg 2011;92(3 Suppl):S12-S23. 29. Hillis LD, Smith PK, Anderson JL et al. 2011 accf/aha guideline for coronary artery bypass graft surgery: Executive summary: A report of the american college of cardiology foundation/american heart association task force on practice guidelines. Circulation 2011;124(23):2610-2642. 30. Jacobs JP, Edwards FH, Shahian DM et al. Successful linking of the society of thoracic surgeons database to social security data to examine survival after cardiac operations. Ann Thorac Surg 2011;92(1):32-37. 31. Bufalino VJ, Masoudi FA, Stranne SK et al. The american heart association's recommendations for expanding the applications of existing and future clinical registries: A policy statement from the american heart association. Circulation 2011;123(19):2167-2179.	

Comment #	Reviewer number	Comment	Author response
		32. Jacobs JP, Edwards FH, Shahian DM et al. Successful linking of the society of thoracic surgeons adult cardiac surgery database to centers for medicare and medicaid services medicare data. Ann Thorac Surg 2010;90(4):1150-1156. 33. Peterson ED, Delong ER, Masoudi FA et al. Accf/aha 2010 position statement on composite measures for healthcare performance assessment: A report of american college of cardiology foundation/american heart association task force on performance measures (writing committee to develop a position statement on composite measures). J Am Coll Cardiol 2010;55(16):1755-1766. 34. Shahian DM, Edwards F, Grover FL et al. The society of thoracic surgeons national adult cardiac database: A continuing commitment to excellence. J Thorac Cardiovasc Surg 2010;140(5):955-959. 35. Shahian DM, O'Brien SM, Normand SL, Peterson ED, Edwards FH. Association of hospital coronary artery bypass volume with processes of care, mortality, morbidity, and the society of thoracic surgeons composite quality score. J Thorac Cardiovasc Surg 2010;139(2):273-282. 36. O'Brien SM, Shahian DM, Filardo G et al. The society of thoracic surgeons 2008 cardiac surgery risk models: Part 2--isolated valve surgery. Ann Thorac Surg 2009;88(1 Suppl):S23-S42. 37. Shahian DM, O'Brien SM, Filardo G et al. The society of thoracic surgeons 2008 cardiac surgery risk models: Part 3--valve plus coronary artery bypass grafting surgery. Ann Thorac Surg 2009;88(1 Suppl):S43-S62. 38. Shahian DM, O'Brien SM, Filardo G et al. The society of thoracic surgeons 2008 cardiac surgery risk models: Part 1--coronary artery bypass grafting surgery. Ann Thorac Surg 2009;88(1 Suppl):S2-22. 39. O'Brien SM, Shahian DM, Delong ER et al. Quality measurement in adult cardiac surgery: Part 2--statistical considerations in composite measure scoring and provider rating. Ann Thorac Surg 2007;83(4 Suppl):S13-S26. 40. Shahian DM, Edwards FH, Ferraris VA et al. Quality measurement in adult cardiac surgery: Part 1--conceptual framework and measure selection. Ann Thorac Surg 2007;83(4	

Comment #	Reviewer number	Comment	Author response
		Suppl):S3-12. 41. Shahian D, Silverstein T, Lovett A, Wolf R, Normand S-L. Comparison of clinical and administrative data sources for hospital coronary artery bypass graft surgery report cards. Circulation 2007;115(12):1518-1527. 42. Shahian DM, Blackstone EH, Edwards FH et al. Cardiac surgery risk models: A position article. Ann Thorac Surg 2004;78(5):1868-1877. 43. Shahian DM, Normand SL, Torchiana DF et al. Cardiac surgery report cards: Comprehensive review and statistical critique. Ann Thorac Surg 2001;72(6):2155-2168. 44. D'Agostino RS, Jacobson J, Clarkson M, Svensson LG, Williamson C, Shahian DM. Readmission after cardiac operations: Prevalence, patterns, and predisposing factors. J Thorac Cardiovasc Surg 1999;118(5):823-832. 45. ElBardissi AW, Aranki SF, Sheng S, O'Brien SM, Greenberg CC, Gammie JS. Trends in isolated coronary artery bypass grafting: An analysis of the society of thoracic surgeons adult cardiac surgery database. J Thorac Cardiovasc Surg 2012;143(2):273-281. 46. Shahian DM, He X, Jacobs JP et al. Issues in quality measurement: Target population, risk adjustment, and ratings. Ann Thorac Surg 2013.	
12	4	No	*NA*
4. Additional suggestions or comments can be provided below. If applicable, please indicate the page and line numbers from the draft report.			
13	1	Page 9, change VASQUIP to VASQIP	*Changed*
14	2	I think this review will be very useful. My principal comment is that it would be useful to provide a more extensive summary of the controversy over adjusting for socio-economic status. This is a key policy decision facing the nominator. Another concern is that the conclusion should mention the evidence supporting readmissions as a measure for orthopedics. These comments and more minor editorial notes are included in the attached document.	*Added a summary of these aspects of SES debate: (1) SES may be associated with inequalities in care that adjusted would obscure and (2) differences in outcomes by SES are due to social factors for which hospitals should not be accountable. Also added to the conclusion section the weaker evidence supporting readmissions for hip fracture.*
15	2	Executive Summary Table, Hip replacement: Higher risk of “remission” in highest vs…	*Changed to ‘readmission’*
16	2	Executive Summary Table, I didn't see a reference to BB in the	*‘BB’ removed from abbreviations*

Comment #	Reviewer number	Comment	Author response
		table	
17	2	Line 182, …using performance measures select and monitor…	*Changed to 'using performance measures to select and monitor'*
18	2	Line 248,9 ("After a period of time…") Re-phrase more neutrally?	*Changed to: "After a period of time in which the number of new performance measures adopted by the VA and non-VA organizations grew, we have begun to reduce the number and focus on the most important."*
19	2	Line 253… replace "taking into account with 'adjusting for'	*Wording revised*
20	2	Line 256… break into 2 sentences, "…proposed. Equitable performance measures should: (1) have…"	*Revised*
21	2	Line 256… (2) 'can' be collected…	*Removed 'can'*
22	2	Line 260… (8) 'and' have minimal…	*Removed the extra 'and'*
23	2	Line 264,5… "Evidence is lacking…" - This strikes me as extremely cautious. If performance measurement is good for anything it should be useful for this purpose.	*This Introductory statement is meant to provide rationale for conducting this review. As there is no literature on adapting performance measurement for contracting providers, the intent of our review is to address this information gap.*
24	2	Line 278… "feelings of over-control," Not sure what this is intended to mean. Feelings of loss of autonomy? Feelings of being mismanaged?	*Changed to "loss of autonomy"*
25	2	Line 308, VASQUIP-	*Changed to 'VASQIP'*
26	2	Line 449,50… "However, this result…" - This is the nature of systematic reviews, right? Do you really think the single controlled subsequent study outweighs the review? That's the impression you leave. Given the relationship with complications in emergent cases, this might be a useful metric.	*Changed to: "Results were consistent regardless of variation in adjustment, cut-off time for wait time, and cut-off time for mortality." No, we think the consistent findings from the subsequent study strengthen the findings of the systematic review and added this context.*
27	2	Line 584 "…the only study one which…"	*Revised wording*
28	2	Line 601, 'outlier'	*Changed to 'outliers'*
29	2	Line 788-90… " Also, although low socioeconomic status has been shown…" -Perhaps expand on this issue? There has been much discussion in the literature and at MedPAC. It might be important to summarize as a warning to policymakers.	*Added a summary of these aspects of SES debate: (1) SES may be associated with inequalities in care that adjusted would obscure and (2) differences in outcomes by SES are due to social factors for which hospitals should not be accountable.*
30	2	Line 867… (after first sentence, this paragraph) Add a qualified statement characterizing evidence supporting use of readmissions as a metric for orthopedic procedures too.	*Done.*
31	4	I generally agree with the approach and conclusions of the report. However, I was surprised to see that CABG volume was not included as a potential measure. There is reasonable	*We identified scope as one of the general limitations of our review. In order to meet our condensed timeframe we focused our scope to a subset of the highest-priority populations and*

Comment #	Reviewer number	Comment	Author response
		evidence that higher CABG volumes, both from a facility and provider point of view, correlates with better outcomes. It is a relatively easy measure to obtain. Thus, I would suggest that the group review volume evidence and include it in their recommendations, if the evidence review supports its inclusion.	*measures of the Office of Community Care. Volume was not included in this subset. We recognize this limits the applicability of our findings to broader populations and measures of interest, such as volume.*

REFERENCES

1. Centers for Medicare & Medicaid Services. Consensus core set: Orthopedic measures. 2015; https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityMeasures/Downloads/Orthopedic-Measures.pdf. Accessed May 9, 2017.
2. Centers for Medicare & Medicaid Services. Consensus core set: Cardiovascular measures. 2016; https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/QualityMeasures/Downloads/Cardiovascular-Measures.pdf. Accessed May 9, 2017.
3. National Quality Forum. National quality forum: Measure search. 2017; http://www.qualityforum.org/Qps/QpsTool.aspx?m=2515&e=1. Accessed May 9, 2017.
4. Khuri SF, Daley J, Henderson W, et al. The department of veterans affairs' nsqip: The first national, validated, outcome-based, risk-adjusted, and peer-controlled program for the measurement and enhancement of the quality of surgical care. National va surgical quality improvement program. *Annals of Surgery.* 1998;228(4):491.
5. Khuri SF, Henderson WG, Daley J, et al. The patient safety in surgery study: Background, study design, and patient populations. *Journal of the American College of Surgeons.* Jun 2007;204(6):1089-1102.
6. Dixon JL, Papaconstantinou HT, Hodges B, et al. Redundancy and variability in quality and outcome reporting for cardiac and thoracic surgery. *Baylor University Medical Center Proceedings.* 2015;28(1):14-17.
7. Shiloach M, Frencher SK, Steeger JE, et al. Toward robust information: Data quality and inter-rater reliability in the american college of surgeons national surgical quality improvement program. *Journal of the American College of Surgeons.* 2010;210(1):6-16.
8. Fink AS, Campbell DA, Jr., Mentzer RM, Jr., et al. The national surgical quality improvement program in non-veterans administration hospitals: Initial demonstration of feasibility. *Annals of Surgery.* Sep 2002;236(3):344-353; discussion 353-344.
9. Fry DE. Surgical site infections and the surgical care improvement project (scip): Evolution of national quality measures. *Surgical Infections.* Dec 2008;9(6):579-584.
10. Leung F, Lau TW, Kwan K, Chow SP, Kung AW. Does timing of surgery matter in fragility hip fractures? *Osteoporos Int.* Dec 2010;21(Suppl 4):S529-534.
11. Moja L, Piatti A, Pecoraro V, et al. Timing matters in hip fracture surgery: Patients operated within 48 hours have better outcomes. A meta-analysis and meta-regression of over 190,000 patients. *PLoS One.* 2012;7(10):e46175.
12. Shiga T, Wajima Z, Ohe Y. Is operative delay associated with increased mortality of hip fracture patients? Systematic review, meta-analysis, and meta-regression. *Canadian Journal of Anaesthesia.* 2008;55(3):146-154.
13. Simunovic N, Devereaux PJ, Sprague S, et al. Effect of early surgery after hip fracture on mortality and complications: Systematic review and meta-analysis. *CMAJ.* Oct 19 2010;182(15):1609-1616.
14. Khan SK, Kalra S, Khanna A, Thiruvengada MM, Parker MJ. Timing of surgery for hip fractures: A systematic review of 52 published studies involving 291,413 patients. *Injury.* Jul 2009;40(7):692-697.
15. Schepers T, De Vries MR, Van Lieshout EM, Van der Elst M. The timing of ankle fracture surgery and the effect on infectious complications; a case series and systematic review of the literature. *International Orthopaedics.* 2013;37(3):489-494.

16. Légaré JF, MacLean A, Buth KJ, Sullivan JA. Assessing the risk of waiting for coronary artery bypass graft surgery among patients with stenosis of the left main coronary artery. *CMAJ.* Aug 16 2005;173(4):371-375.

17. Sobolev BG, Fradet G, Kuramoto L, Rogula B. An observational study to evaluate 2 target times for elective coronary bypass surgery. *Medical Care.* Jul 2012;50(7):611-619.

18. Meessen JM, Pisani S, Gambino ML, et al. Assessment of mortality risk in elderly patients after proximal femoral fracture. *Orthopedics.* Feb 2014;37(2):e194-200.

19. Holvik K, Ranhoff AH, Martinsen MI, Solheim LF. Predictors of mortality in older hip fracture inpatients admitted to an orthogeriatric unit in oslo, norway. *Journal of Aging & Health.* Dec 2010;22(8):1114-1131.

20. Karademir G, Bilgin Y, Ersen A, et al. Hip fractures in patients older than 75 years old: Retrospective analysis for prognostic factors. *International Journal Of Surgery.* Dec 2015;24(Pt A):101-104.

21. Clague JE, Craddock E, Andrew G, Horan MA, Pendleton N. Predictors of outcome following hip fracture. Admission time predicts length of stay and in-hospital mortality. *Injury.* Jan 2002;33(1):1-6.

22. Griffiths EJ, Cash DJ, Kalra S, Hopgood PJ. Time to surgery and 30-day morbidity and mortality of periprosthetic hip fractures. *Injury.* Dec 2013;44(12):1949-1952.

23. Lund CA, Moller AM, Wetterslev J, Lundstrom LH. Organizational factors and long-term mortality after hip fracture surgery. A cohort study of 6143 consecutive patients undergoing hip fracture surgery. *PLoS ONE [Electronic Resource]*. 2014;9(6):e99308.

24. Lurati Buse GA, Bhandari M, Devereaux P, Inverstigators T. Accelerated care versus standard care among patients with hip fracture: The hip attack pilot trial. *CMAJ.* Jan 07 2014;186(1):E52-60.

25. Ryan DJ, Yoshihara H, Yoneoka D, Egol KA, Zuckerman JD. Delay in hip fracture surgery: An analysis of patient-specific and hospital-specific risk factors. *Journal of Orthopaedic Trauma.* Aug 2015;29(8):343-348.

26. Tennent TD, Calder PR, Salisbury RD, Allen PW, Eastwood DM. The operative management of displaced intra-articular fractures of the calcaneum: A two-centre study using a defined protocol. *Injury.* Jul 2001;32(6):491-496.

27. Vallier HA, Super DM, Moore TA, Wilber JH. Do patients with multiple system injury benefit from early fixation of unstable axial fractures? The effects of timing of surgery on initial hospital course. *Journal of Orthopaedic Trauma.* Jul 2013;27(7):405-412.

28. Hannan EL, Zhong Y, Lahey SJ, et al. 30-day readmissions after coronary artery bypass graft surgery in new york state. *Jacc: Cardiovascular Interventions.* 2011;4(5):569-576.

29. Hannan EL, Racz MJ, Walford G, et al. Predictors of readmission for complications of coronary artery bypass graft surgery. *JAMA.* 2003;290(6):773-780.

30. Parina RP, Chang DC, Rose JA, Talamini MA. Is a low readmission rate indicative of a good hospital? *Journal of the American College of Surgeons.* 2015;220(2):169-176.

31. Stefan MS, Pekow PS, Nsa W, et al. Hospital performance measures and 30-day readmission rates. *Journal of General Internal Medicine.* 2013;28(3):377-385.

32. Thomas JW. Does risk-adjusted readmission rate provide valid information on hospital quality? *Inquiry.* Fall 1996;33(3):258-270.

33. Tsai TC, Joynt KE, Orav EJ, Gawande AA, Jha AK. Variation in surgical-readmission rates and quality of hospital care. *New England Journal of Medicine.* Sep 19 2013;369(12):1134-1142.

34. Zitser-Gurevich Y, Simchen E, Galai N, Braun D. Prediction of readmissions after cabg using detailed follow-up data: The israeli cabg study (iscab). *Medical Care.* 1999;37(7):625-636.

35. Auerbach AD, Hilton JF, Maselli J, Pekow PS, Rothberg MB, Lindenauer PK. Follow the crowd or shop for the best? Volume, quality, and outcomes of coronary artery bypass surgery. *Annals of Internal Medicine.* 2009;150(10):696-704.

36. Bhattacharyya T, Freiberg AA, Mehta P, Katz JN, Ferris T. Measuring the report card: The validity of pay-for-performance metrics in orthopedic surgery. *Health Aff (Millwood).* Mar-Apr 2009;28(2):526-532.

37. Brinkman W, Herbert MA, O'Brien S, et al. Preoperative beta-blocker use in coronary artery bypass grafting surgery: National database analysis. *JAMA Internal Medicine.* Aug 2014;174(8):1320-1327.

38. Cotogni P, Barbero C, Passera R, Fossati L, Olivero G, Rinaldi M. Violation of prophylactic vancomycin administration timing is a potential risk factor for rate of surgical site infections in cardiac surgery patients: A prospective cohort study. *BMC cardiovascular disorders.* 2017;17(1).

39. Kim ES, Park SW, Lee CS, Gyung Kwak Y, Moon C, Kim BN. Impact of a national hospital evaluation program using clinical performance indicators on the use of surgical antibiotic prophylaxis in korea. *International Journal of Infectious Diseases.* Mar 2012;16(3):e187-192.

40. Kurlansky PA, Argenziano M, Dunton R, et al. Quality, not volume, determines outcome of coronary artery bypass surgery in a university-based community hospital network. *The Journal of Thoracic and Cardiovascular Surgery.* 2012;143(2):287-293. e281.

41. LaPar DJ, Isbell JM, Kern JA, Ailawadi G, Kron IL. Surgical care improvement project measure for postoperative glucose control should not be used as a measure of quality after cardiac surgery. *Journal of Thoracic & Cardiovascular Surgery.* Mar 2014;147(3):1041-1048.

42. McDonnell ME, Alexanian SM, Junqueira A, Cabral H, Lazar HL. Relevance of the surgical care improvement project on glycemic control in patients undergoing cardiac surgery who receive continuous insulin infusions. *Journal of Thoracic & Cardiovascular Surgery.* Feb 2013;145(2):590-594; discussion 595-597.

43. Rasouli MR, Jaberi MM, Hozack WJ, Parvizi J, Rothman RH. Surgical care improvement project (scip): Has its mission succeeded? *Journal of Arthroplasty.* Aug 2013;28(7):1072-1075.

44. Schelenz S, Tucker D, Georgeu C, et al. Significant reduction of endemic mrsa acquisition and infection in cardiothoracic patients by means of an enhanced targeted infection control programme. *Journal of Hospital Infection.* Jun 2005;60(2):104-110.

45. Wang Z, Chen F, Ward M, Bhattacharyya T. Compliance with surgical care improvement project measures and hospital-associated infections following hip arthroplasty. *Journal of Bone & Joint Surgery - American Volume.* Aug 01 2012;94(15):1359-1366.

46. Guru V, Tu JV, Etchells E, et al. Relationship between preventability of death after coronary artery bypass graft surgery and all-cause risk-adjusted mortality rates. *Circulation.* 2008;117(23):2969-2976.

47. Smith T, Li X, Nylander W, Gunnar W. Thirty-day postoperative mortality risk estimates and 1-year survival in veterans health administration surgery patients. *JAMA Surgery.* 2016;151(5):417-422.