

## **SUPPLEMENTARY MATERIALS**

### **BETWEEN-HOSPITAL VARIATION IN INDICATORS OF QUALITY OF CARE: A SYSTEMATIC REVIEW**

## 1. Search strategy

### Embase

('hospital performance'/de OR (('benchmarking'/de OR 'performance measurement system'/de OR 'performance'/de) AND ('hospital'/exp OR 'health center'/de OR 'hospital management'/de OR 'hospital care'/de OR 'hospital running cost'/de)) OR (((benchmark\* OR bench-mark\* OR rank OR ranking\* OR ranked) NEAR/3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics)) OR ((performan\* OR performing) NEAR/3 (measur\* OR evaluat\* OR variation\* OR assess\* OR indicator\*) NEAR/3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics)) OR ((performan\* OR performing OR indicator\* OR variation\* OR difference\*) NEXT/2 (across OR between) NEXT/1 (hospitals OR clinics OR centers OR centres)) OR ((best OR worst OR high OR low OR top OR bottom OR lowest) NEXT/1 (performan\* OR performing) NEAR/3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres)) OR ((interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR between-hospital\* OR between-center\* OR between-centre\* OR between-clinic OR between-clinics) NEAR/1 (difference\* OR compar\* OR variation\*)):ab,ti,kw OR ((compar\* OR differenc\* OR variation\*) NEAR/6 (hospitals OR clinics OR centers OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR between-hospital\* OR between-center\* OR between-centre\* OR between-clinic OR between-clinics)):ti) AND ('empirical research'/de OR 'empiricism'/de OR 'observational study'/exp OR 'cohort analysis'/exp OR 'population research'/de OR 'controlled study'/exp OR 'clinical trial (topic)'/exp OR 'methodology'/exp OR 'comparative study'/de OR 'register'/de OR 'patient registry'/exp OR 'population register'/de OR 'sampling'/de OR 'data analysis'/de OR 'scoring system'/de OR 'multilevel analysis'/de OR (empiric\* OR cohort\* OR control\* OR random\* OR trial\* OR factorial\* OR crossover\* OR multicent\* OR (cross NEXT/1 over\*) OR placebo\* OR prospectiv\* OR ((doubl\* OR singl\*) NEXT/1 blind\*) OR ((observation\* OR population\* OR epidemiolog\* OR famil\* OR comparativ\* OR communit\* OR interven\*) NEAR/6 (stud\* OR data OR research\*)) OR (national\* NEAR/3 (stud\* OR survey)) OR (health\* NEAR/3 survey\*) OR ((case OR cases OR match\*) NEAR/3 control\*) OR registry OR registries OR register OR sampling OR ((data) NEAR/3 (analys\*)) OR ((scoring) NEAR/3 (system\*)) OR multilevel\* OR multi-level\*):ab,ti,kw) NOT ([Conference Abstract]/lim OR [Conference Review]/lim) NOT ((animal/exp OR animal\*:de OR nonhuman/de) NOT ('human'/exp)) AND [english]/lim

### Medline

((Benchmarking/) AND (exp Hospitals/ OR Community Health Centers/ OR Hospital Administration/)) OR (((benchmark\* OR bench-mark\* OR rank OR ranking\* OR ranked) ADJ3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics)) OR ((performan\* OR performing) ADJ3 (measur\* OR evaluat\* OR variation\* OR assess\* OR indicator\*) ADJ3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres OR interhospital\* OR intercentre\* OR intercenter\*)) OR ((performan\* OR performing OR indicator\* OR variation\* OR difference\*) ADJ2 (across OR between) ADJ (hospitals OR clinics OR centers OR centres)) OR ((best OR worst OR high OR low OR top OR bottom OR lowest) ADJ (performan\* OR performing) ADJ3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres)) OR ((interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR between-hospital\* OR between-center\*

OR between-centre\* OR between-clinic OR between-clinics) ADJ1 (difference\* OR compar\* OR variation\*))) .ab,ti,kf. OR ((compar\* OR differenc\* OR variation\*) ADJ6 (hospitals OR clinics OR centers OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR between-hospital\* OR between-center\* OR between-centre\* OR between-clinic OR between-clinics)).ti.) **AND** (exp Empirical Research/ OR Empiricism/ OR Observational Study/ OR Observational Studies as Topic/ OR Cohort Studies/ OR Controlled Before-After Studies/ OR exp Controlled Clinical Trial/ OR exp Controlled Clinical Trials as Topic/ OR Control Groups/ OR Methods/ OR Comparative Study/ OR exp Registries/ OR Sampling Studies/ OR Data Analysis/ OR Multilevel Analysis/ OR (empiric\* OR cohort\* OR control\* OR random\* OR trial\* OR factorial\* OR crossover\* OR multicent\* OR (cross ADJ over\*) OR placebo\* OR prospectiv\* OR ((doubl\* OR singl\*) ADJ blind\*) OR ((observation\* OR population\* OR epidemiolog\* OR famil\* OR comparativ\* OR communit\* OR interven\*) ADJ6 (stud\* OR data OR research\*)) OR (national\* ADJ3 (stud\* OR survey)) OR (health\* ADJ3 survey\*) OR ((case OR cases OR match\*) ADJ3 control\*) OR registry OR registries OR register OR sampling OR ((data) ADJ3 (analys\*)) OR ((scoring) ADJ3 (system\*)) OR multilevel\* OR multi-level\*).ab,ti,kf.) NOT (news OR congres\* OR abstract\* OR book\* OR chapter\* OR dissertation abstract\*).pt. NOT (exp Animals/ NOT Humans/) AND english.la.

### Web of Science

(TS=((((benchmark\* OR bench-mark\* OR rank OR ranking\* OR ranked) NEAR/2 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics)) OR ((performan\* OR performing) NEAR/2 (measur\* OR evaluat\* OR variation\* OR assess\* OR indicator\*) NEAR/2 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres OR interhospital\* OR intercentre\* OR intercenter\*)) OR ((performan\* OR performing OR indicator\* OR variation\* OR difference\*) NEAR/2 (across OR between) NEAR/1 (hospitals OR clinics OR centers OR centres)) OR ((best OR worst OR high OR low OR top OR bottom OR lowest) NEAR/1 (performan\* OR performing) NEAR/2 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres)) OR ((interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR between-hospital\* OR between-center\* OR between-centre\* OR between-clinic OR between-clinics) NEAR/0 (difference\* OR compar\* OR variation\*)))) AND ((empiric\* OR cohort\* OR control\* OR random\* OR trial\* OR factorial\* OR crossover\* OR multicent\* OR (cross NEAR/1 over\*) OR placebo\* OR prospectiv\* OR ((doubl\* OR singl\*) NEAR/1 blind\*) OR ((observation\* OR population\* OR epidemiolog\* OR famil\* OR comparativ\* OR communit\* OR interven\*) NEAR/5 (stud\* OR data OR research\*)) OR (national\* NEAR/2 (stud\* OR survey)) OR (health\* NEAR/2 survey\*) OR ((case OR cases OR match\*) NEAR/2 control\*) OR registry OR registries OR register OR sampling OR ((data) NEAR/2 (analys\*)) OR ((scoring) NEAR/2 (system\*)) OR multilevel\* OR multi-level\*)) OR (TI=((compar\* OR differenc\* OR variation\*) NEAR/2 (hospitals OR clinics OR centers OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR between-hospital\* OR between-center\* OR between-centre\* OR between-clinic OR between-clinics)) AND TS=((empiric\* OR cohort\* OR control\* OR random\* OR trial\* OR factorial\* OR crossover\* OR multicent\* OR (cross NEAR/1 over\*) OR placebo\* OR prospectiv\* OR ((doubl\* OR singl\*) NEAR/1 blind\*) OR ((observation\* OR population\* OR epidemiolog\* OR famil\* OR comparativ\* OR communit\* OR interven\*) NEAR/5 (stud\* OR data OR research\*)) OR (national\* NEAR/2 (stud\* OR survey)) OR (health\* NEAR/2 survey\*) OR ((case OR cases OR match\*) NEAR/2 control\*) OR registry OR registries OR register OR sampling OR ((data) NEAR/2 (analys\*)) OR ((scoring) NEAR/2 (system\*)) OR multilevel\* OR multi-

level\*)))) NOT TS=((animal\* OR rat OR rats OR mouse OR mice OR murine OR dog OR dogs OR canine OR cat OR cats OR feline OR rabbit OR cow OR cows OR bovine OR rodent\* OR sheep OR ovine OR pig OR swine OR porcine OR veterinar\* OR chick\* OR zebrafish\* OR baboon\* OR nonhuman\* OR primate\* OR cattle\* OR goose OR geese OR duck OR macaque\* OR avian\* OR bird\* OR fish\*) NOT (human\* OR patient\* OR women OR woman OR men OR man)) AND LA=(English) AND DT=(Article OR Review OR Letter OR Early Access)

### Cochrane

(((((benchmark\* OR bench-mark\* OR rank OR ranking\* OR ranked) NEAR/3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics)) OR ((performan\* OR performing) NEAR/3 (measur\* OR evaluat\* OR variation\* OR assess\* OR indicator\*) NEAR/3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres OR interhospital\* OR intercentre\* OR intercenter\*)) OR ((performan\* OR performing OR indicator\* OR variation\* OR difference\*) NEXT/2 (across OR between) NEXT/1 (hospitals OR clinics OR centers OR centres)) OR ((best OR worst OR high OR low OR top OR bottom OR lowest) NEXT/1 (performan\* OR performing) NEAR/3 (hospital\* OR clinic OR clinics OR center OR centers OR centre OR centres)) OR ((interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR between-hospital\* OR between-center\* OR between-centre\* OR between-clinic OR between-clinics) NEAR/1 (difference\* OR compar\* OR variation\*)):ab,ti,kw OR ((compar\* OR differenc\* OR variation\*) NEAR/3 (hospitals OR clinics OR centers OR centres OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR interhospital\* OR intercentre\* OR intercenter\* OR interclinic OR interclinics OR between-hospital\* OR between-center\* OR between-centre\* OR between-clinic OR between-clinics)):ti) **AND** ((empiric\* OR cohort\* OR control\* OR random\* OR trial\* OR factorial\* OR crossover\* OR multicent\* OR (cross NEXT/1 over\*) OR placebo\* OR prospectiv\* OR ((doubl\* OR singl\*) NEXT/1 blind\*) OR ((observation\* OR population\* OR epidemiolog\* OR famil\* OR comparativ\* OR communit\* OR interven\*) NEAR/6 (stud\* OR data OR research\*)) OR (national\* NEAR/3 (stud\* OR survey)) OR (health\* NEAR/3 survey\*) OR ((case OR cases OR match\*) NEAR/3 control\*) OR registry OR registries OR register OR sampling OR ((data) NEAR/3 (analys\*)) OR ((scoring) NEAR/3 (system\*)) OR multilevel\* OR multi-level\*):ab,ti,kw) NOT "conference abstract":pt

### Google Scholar

"benchmark|benchmarking|rank|ranking  
hospital|hospitals|clinic|clinics|center|centers|centre|centres|interhospital|intercentre|intercenter"  
empiric|empirical|cohort|control|random|trial|factorial|crossover|multicenter|registry|registries|register|sampling

'benchmark|benchmarking|rank|ranking  
hospital|hospitals|clinic|clinics|center|centers|centre|centres|interhospital|intercentre|intercenter'  
empiric|empirical|cohort|control|random|trial|factorial|crossover|multicenter|registry|registries|register|sampling

**Supplementary table 1.** Adjustments for case-mix and hospital characteristics in included articles

Study	Year	Case-mix	Hospital characteristics
Selby et al. (21)	2010	Age (categorical), gender (except for mammography), race-ethnicity, SES. For hypertension: whether last blood pressure measurement was recorded in medicine department or other (tends to be higher in surgical), seasonality, and newly diagnosed. Hyperlipidemia: seasonality and newly diagnosed.	
Osler et al. (31)	2011	Age, sex, lifestyle (alcohol, smoking status, body mass index (BMI)), year of surgery, site of tumor, stage of disease at diagnosis, urgency of operation, type of operation, specialization of surgeon, and ASA score	
Elferink et al. (25)	2011	Gender, age at diagnosis, year of diagnosis, tumor site, depth of invasion, LM involvement, grade, type of hospital, type of pathology laboratory	
Nathan et al. (15)	2011	Age, gender, tumor grade, and location	Hospital volume, hospital ownership, teaching hospital, NCI designation, rural hospital
Cooke et al. (32)	2012	Patient-level prognostic score derived from clinical data: patient level estimate of probability of death within 30 days conditional on covariates and in being treated in the top quantile of volume (age, diagnosis on admission, 30 comorbid conditions, 11 laboratory values)	
Seymour et al. (33)	2012	Age, gender, admission source, payer status, urbanicity, median zip code income, Charlson score	
Goodwin et al. (22)	2013	Age, gender, ethnicity, Medicaid eligibility, emergency admission, weekend admission, DRG weight, MDC, Elixhauser medical condition, number of hospitalizations, number of physician visits and having a PCP in year prior to admission of interest	
Koné Péfoyo (19)	2013	Age (in decade), gender, LoS, hospital stay (more than 1 time), education level, perceived health, admission (planned/emergency/transfer), pain	
Baines et al. (34)	2013	Age, sex, urgency of admission, admission to a surgical unit and main ICD9 diagnostic groups	
Gathara et al. (26)	2015	Age (categorized into 2-11 and 12-59 months), no of diagnoses made at admission (comorbidities) > categorized into no, 1, 2 and 3-5 comorbidities), clinician cadre (clinical/medical officer), experience of clinician (0-1 year, 2+ years)	
Prescott et al. (35)	2015	Severity of illness score (VA ICU severity score) using a rich mix of administrative and clinical laboratory data. This severity of illness score incorporates chronic comorbidity, acute physiologic dysregulation (worst value in first 24hr from severe sepsis onset), and age and gender.	
Van de Vijzel et al. (36)	2015	Age using six classes, type of medical procedure, open/laparoscopic procedure (when applicable), Charlson Co index, type of admission (acute, elective, diagnostic), SES, non-western immigrant, day-care (diagnose based)	
Pozo-Rodríguez et al (37)	2015	<u>In-hospital mortality:</u> Age (in decades), Previous admissions for AECOPD, Home oxygen therapy prior to admission, Acidosis, pH < 7.35, Charlson index (0–15), Performance status, Creatinine (mg/dl), Intravenous methylxanthines at admission, ventilary support at admission; <u>Clinical Practice, Guidelines score</u> (5–8 vs. 0–4) <u>90 day follow-up:</u> sex, Age (in decades), Performance status, Haemoglobin, mg/dl, Pedal oedema, Home-based ventilatory support, Home-based oxygen therapy; <u>Readmissions:</u> sex, Previous admissions for ECOPD, FEV1 (%) , Home oxygen therapy, Performance status , Charlson index (0–15), Haemoglobin (mg/dl) , Methylxanthines at discharge, Systemic steroids at discharge	
Ghith et al (30)	2016	Risk score (obtained from logistic regression including age, previous diagnoses of diseases of: cerebral arteries, arrhythmia, hypertension, ischemic coronary artery disease, varicose, peripheral vascular disease, acute myocardial infarction, other types of heart disease, respiratory disease, digestive diseases, diabetes, infectious disease, cancer, lung cancer, chronic disease of the lower respiratory tract, immunity disorder, mental diseases and injury) and gender by ethnic-origin group	
El-Sheika (38)	2016	Age, gender, allergy or reaction to drug, postoperative bleeding, wound problems, urine problems, further treatment, readmission, self-reported success, treatment satisfaction	

Study	Year	Case-mix	Hospital characteristics
Guillouet et al (17)	2016	Age, gender, modified CCI (comorbidities), underlying nephropathy, PD modality at dialysis initiation, treatment before PD	
Admon et al. (14)	2017	Sex, age, comorbidities	Critical care procedure utilization, presence of organ failure systems, hospital funding source, size, ICU capacity, teaching status, capabilities for cardiac catheterization, cardiac surgery, neurological care, organ transplantation and caseload
Orindi et al. (39)	2017	Self-rated health (poor, fair, good); nursing unit specialty (general surgery, internal medicine, and mixed); country	
Charalampopoulos et al (40)	2017	Age (continuous), gender, duration of diabetes (4 categories: <1 yr, 1 yr, 2-4 yrs, >5 yrs), ethnicity (6 categories: white, black, mixed, asian, other, not reported), deprivation (five quintiles), interaction term: age*diabetes duration	
Korda et al. (18)	2017	Age, sex, marital status, region of residence (city/region/remote), education, private health insurance, self-reported baseline health, BMI, smoking status, hospitalisation history, primary diagnosis, Charlson Index	
Bottle et al (20)	2018	Comorbidity, age group, sex, deprivation, procedure subtype, number of any- case emergency admissions in previous year	
Hekkert et al. (41)	2018	Age standardized z-score, gender, SES, urgency, year of discharge, comorbidities (CCI)	
Charalampopoulos et al (42)	2018	Sex, age, duration of diabetes, and minority status	
Gutacker et al (1)	2018	Age (5-year bands with separate categories for <25 and >-85; except for mortality in which lowest category was <60), sex, age-sex interactions, year of hospitalization, hospital emergency admission in previous year, number of Elixhauser co-morbid conditions (grouped as 0,1,2-3,4+), socio-economic status (approximated by proportion of residents at small area level)	
Berlin et al (43)	2019	Age, race, ethnicity, body mass index, comorbidity, procedure type and indication, laterality, lymph node management, smoking, radiation, and socioeconomic factors	
Kristensen et al (44)	2019	SES score (based on age, sex, education, family income, migration, employment, and cohabitation status), BMI, CCI, fracture type, frailty	
Comendiro-Maaløe et al (27)	2020	Age (groups: 40-49, 50-59, 60-69, 70-80), sex, Elixhauser risk score, coexistence of CHF in the episode of AMI, country	
Kristensen et al (45)	2020	Individual demographic, socioeconomic, and clinical characteristics (age groups, gender, biomedical risk score for all-cause mortality, education, income, migration status, cohabiting status, medication)	
Khor et al (23)	2020	Age, sex, insurance status, race, ASA score, smoking status, prior spine surgery, diagnosis (spondylolisthesis, disc herniation, post laminectomy/failed back syndrome, stenosis, pseudo arthrosis, radiculopathy), opiate use, asthma, baseline ODI scores	
Rodriguez-Lopez et al (28)	2020	Age, arrhythmia (I48-I49), cancer (C1-D4), diseases of the cerebral arteries (I6), chronic diseases of the lower respiratory tract (J4), diabetes (E10-E14), digestive diseases (K0-K9), other types of heart disease (I3-I5), hypertension (I10-I13 I15), heart failure (I50), injury (S00-T14), ischaemic coronary artery disease (I20-I25), lung cancer (C34), mental diseases (F0-F9) and peripheral vascular disease (I74 I80) as well as respiratory diseases (J0-J9)	
Wang et al (46)	2020	Age, sex, comorbidities, the number of chronic conditions, risk of mortality, severity of illness, household income, patient location, state residence and insurance status, index hospitalization length of stay, procedure type, common postoperative complications, and discharge location (e.g., home). Comorbidity measures were identified by the AHRQ comorbidity coding	
Jackson et al (47)	2020	Recipient characteristics / shared frailty model - adjusted for patient-level characteristics: donor and recipient age, recipient gender, recipient blood type, recipient race, years on dialysis, cause of end stage liver disease, panel reactive antibody (PRA), history of prior transplant,	

Study	Year	Case-mix	Hospital characteristics
		DSA strength)	
Liu et al (48)	2021	Age, sex, marital status, insurance status, outpatient/emergency, surgery yes/no, complication	
Vesterager et al (49)	2021	Age, sex, comorbidity, BMI, surgery delay, and surgery type	
Bamdad et al (24)	2022	Patient covariates including all their demographics and comorbidities	
Bernet et al (50)	2022	Age, sex, surgical procedure 14 days prior to measurement (yes/no), 21 medical diagnosis groups of the ICD-10, care dependency, intake of sedative/psychotropic medication (yes/no), fall history (patient fallen in 12 months prior to admission yes/no), CDS	
Bottle et al (51)	2022	Age (one-knot spline), gender, diabetes, hypertension, coronary heart disease, chronic obstructive pulmonary disease (COPD), obesity, cancer, renal disease, dementia, area-level Carstairs socioeconomic deprivation, emergency admission flag, source of admission (from own home, transferred from another provider), ethnic group, number of emergency admissions for any reason in the previous 12 months and month of admission	
Ferreira et al (52)	2022	Sex, age (centred around mean), language spoken at home (english or other), acuity (urgent vs semi-urgent), arrival mode (ambulance vs others), type of LBP (with/without neurological symptoms, time of presentation (aorking hours/after hours	
Stankovic et al (53)	2022	Age, sex, ischemic heart disease, heart failure, arterial hypertension, cardiac dysrhythmia, neurological disease, chronic obstructive pulmonary disease, diabetes mellitus, and cancer	
Salet et al (10)	2022	Age (in years), sex, SES, Elixhauser comorbidity score	
Chui et al (16)	2023	Demographic characteristics (age, gender, race, and insurance payor status), cardiac status (history of heart failure, New York Health Association class, history of cardiac arrest, atrial fibrillation/atrial flutter, ventricular tachycardia, nonischemic dilated cardiomyopathy, left ventricular ejection fraction [LVEF], QRS duration, ischemic heart disease, prior myocardial infarction, prior coronary revascularization, and prior coronary artery bypass surgery), comorbid conditions (cerebrovascular disease, chronic lung disease, diabetes mellitus, hypertension, end-stage renal disease, and valvular disease)	Facility ICD implant volume and characteristics (profit status, census region, bed size, and teaching status)
Liu et al (54)	2023	Sex, age (categorized), education, monthly family income, cancer type, cancer stage, self-reported health status, length of stay, respondent (patient/representative)	
Bakhtiyar et al (55)	2023	Age at listing, gender, ethnicity, history of diabetes, BMI, preoperative dialysis independence, functional status, serum creatinine, serum albumin, panel reactive antibodies, insurance status, preoperative diagnosis, donor age, donor ethnicity, kidney donor profile index, cold ischemia time, extended criteria donor organ, indication immunosuppression regimen	
Estupiñán-Romero et al (56)	2023	Age, sex, Elixhauser comorbidities, time variables for each episode characterizing lon-term structural trends and monthly seasonality, and identified special admission days (bank holidays / weekends)	

**Supplementary table 2.** Categorization of quality indicators analyzed in included articles

Study	Year	Quality indicator	Indicator category
Selby et al. (21)	2010	Systolic blood pressure	Outcome
		LDL-cholesterol	Outcome
		Care experience score	Patient-reported experience
		Screening mammography	Process
Osler et al. (31)	2011	30-day mortality	Outcome
Efferink et al. (25)	2011	Number of lymph nodes assessed	Process
Nathan et al. (15)	2011	≥12 lymph nodes assessed	Process
Cooke et al. (32)	2012	30-day mortality	Outcome
Seymour et al. (33)	2012	Use of intensive care unit	Intermediate outcome
Goodwin et al. (22)	2013	Length of stay	Intermediate outcome
		30-day mortality	Outcome
		% discharged home	Intermediate outcome
		% discharged to skilled nursing facility	Intermediate outcome
		30-day readmission	Intermediate outcome
		30-day emergency room visit	Intermediate outcome
Koné Péfoyo (19)	2013	Rating nurses and doctors	Patient-reported experience
		Rating patient-centered care	Patient-reported experience
		Admission process	Patient-reported experience
		Availability of staff	Patient-reported experience
		Communication with patient	Patient-reported experience
		Communication with family	Patient-reported experience
		Discharge transition	Patient-reported experience
		Pain management	Patient-reported experience
Baines et al. (34)	2013	Adverse event (includes both mortality and infection)	Outcome
		preventable adverse event	Outcome
Gathara et al. (26)	2015	Prescription of quinine loading dose for children with malaria	Process
		Prescription correct dose/kg of crystalline penicillin for children with pneumonia	Process
		Prescription of zinc for children with diarrhea/dehydration	Process
		HIV testing for all children admitted to hospital	Process
Prescott et al. (35)	2015	In-hospital mortality	Outcome
Van de Vijzel et al. (36)	2015	Length of stay	Intermediate outcome
Pozo-Rodríguez et al (37)	2015	Inhospital mortality	Outcome
		90-day follow up mortality	Outcome
		readmissions	Intermediate outcome
Ghith et al (30)	2016	30-day mortality	Outcome
El-Sheika (38)	2016	Change in Aberdeen Varicose Vein score Questionnaire	Patient-reported outcome
Guillouet et al (17)	2016	Early PD failure (hemodialysis for more than 2 months within first 6 months)	Intermediate outcome
Admon et al. (14)	2017	ICU admission status	Intermediate outcome
Orindi et al. (39)	2017	Patient satisfaction with care (measured with 16 item survey with 7 domains)	Patient-reported experience
Charalampopoulos et al (40)	2017	Glycemic control (HbA1c)	Intermediate outcome
Korda et al. (18)	2017	30-day readmission	Intermediate outcome
		30-day mortality	Outcome
Bottle et al (20)	2018	All-cause 30-day readmission	Intermediate outcome
		Surgical 30-day readmission	Intermediate outcome
		30-day readmission with return-to-theater	Intermediate outcome
Hekkert et al. (41)	2018	All cause 30-day readmission	Intermediate outcome
Charalampopoulos et al (42)	2018	Glycemic control (HbA1c)	Intermediate outcome
Gutacker et al (1)	2018	28-day readmission	Intermediate outcome
		30-day mortality	Outcome
		Length of stay	Intermediate outcome
Berlin et al (43)	2019	Complications (major, reconstruction failure, infection)	Outcome
		Satisfaction with esthetics	Patient-reported outcome
		Satisfaction with outcome	Patient-reported outcome
Kristensen et al (44)	2019	All cause 30-day mortality	Outcome
Comendeiro-Maaløe et al (27)	2020	In-hospital mortality	Outcome



Study	Year	Quality indicator	Indicator category
<b>Kristensen et al (45)</b>	2020	All-cause mortality within 1 year from admission date	Outcome
<b>Khor et al (23)</b>	2020	MID improvement in ODI at 12 months	Outcome
		% reaching minimal disability	Outcome
<b>Rodriguez-Lopez et al (28)</b>	2020	30-day mortality	Outcome
<b>Wang et al (46)</b>	2020	30-day readmission	Intermediate outcome
<b>Jackson et al (47)</b>	2020	Mortality	Outcome
		Graft loss	Outcome
<b>Liu et al (48)</b>	2021	Length of stay	Intermediate outcome
<b>Vesterager et al (49)</b>	2021	Hospital-treated infections	Process
		Pneumonia	Intermediate outcome
		Sepsis	Intermediate outcome
		Community-treated infections	Process
<b>Bamdad et al (24)</b>	2022	Development of non-UTI postoperative complications within 30 days after surgery	Intermediate outcome
<b>Bernet et al (50)</b>	2022	Inpatient fall rate	Intermediate outcome
<b>Bottle et al (51)</b>	2022	In-hospital mortality	Outcome
<b>Ferreira et al (52)</b>	2022	Hospital adjusted admission rate	Intermediate outcome
<b>Stankovic et al (53)</b>	2022	Return of spontaneous circulation	Outcome
		1-year survival	Outcome
		30-day survival	Outcome
<b>Salet et al (10)</b>	2022	Inhospital mortality	Outcome
		ICU admission	Intermediate outcome
		Length of stay	Intermediate outcome
		30-day readmission	Intermediate outcome
		30-day reintervention	Intermediate outcome
<b>Chui et al (16)</b>	2023	Use of cardiac resynchronization therapy defibrillator (CRT-D) in eligible patients	Process
<b>Liu et al (54)</b>	2023	Patient experience of administrative process, hospital environment, medical care, symptom management; overall satisfaction	Patient-reported experiences
<b>Bakhtiyar et al (55)</b>	2023	Length of stay	Intermediate outcome
<b>Estupiñán-Romero et al (56)</b>	2023	30-day in-hospital mortality	Outcome

MID=minimal important difference; ODI= Oswestry low back pain disability index; PD = peritoneal dialysis.

**Supplementary table 3.** Categorization of primary diagnosis or medical procedure

Study	Year	Primary diagnosis or medical procedure/population	(Disease) category
Selby et al. (21)	2010	Hypertension	Vascular disease
		Hyperlipidemia	Other
		Patients with primary care visits	General inpatient population
		Women 52-69 years	General inpatient population
Osler et al. (31)	2011	Colorectal cancer surgery	Malignancies
Elferink et al. (25)	2011	Surgical resection for stage I-III colon carcinoma	Malignancies
Nathan et al. (15)	2011	Colon cancer resection	Malignancies
Cooke et al. (32)	2012	Non-surgical mechanically ventilated patients	Other
Seymour et al. (33)	2012	Acute myocardial infarction	Vascular disease
		Pneumonia	Infections
		Congestive heart failure	Vascular disease
		Surgery for colorectal cancer	Malignancies
Goodwin et al. (22)	2013	Hospitalized patients	General inpatient population
Koné Péfoyo (19)	2013	General acute inpatient population	General inpatient population
Baines et al. (34)	2013	Inpatient population	General inpatient population
Gathara et al. (26)	2015	Malaria (children)	Infections
		Pneumonia (children)	Infections
		Diarrhea/dehydration (children)	Infections
		Underage inpatient population	General inpatient population
Prescott et al. (35)	2015	First hospitalization involving severe sepsis	Infections
Van de Vijzel et al. (36)	2015	Acute myocardial infarction	Vascular disease
		Cerebrovascular accident	Vascular disease
		Congestive heart failure	Vascular disease
		Cholecystectomy	Other
		Femoral fracture	Hip/Knee surgery
		Total hip arthroplasty	Hip/Knee surgery
		Total knee arthroplasty	Hip/Knee surgery
		Pneumonia	Infections
		Colon cancer surgery	Malignancies
Pozo-Rodríguez et al (37)	2015	COPD exacerbations	Other
Ghith et al (30)	2016	Patients with primary diagnosis of heart failure	Vascular disease
El-Sheika (38)	2016	Elective varicose veins treatment	Vascular disease
Guillouet et al (17)	2016	Peritoneal dialysis	Other
Admon et al. (14)	2017	Congestive heart failure	General inpatient population*
		Acute myocardial infarction	
		Acute ischemic stroke	
		Chronic obstructive pulmonary disease	
		Pneumonia	
Orindi et al. (39)	2017	Hip fracture (treated with arthroplasty)	
		General inpatient population	General inpatient population
Charalampopoulos et al (40)	2017	Diabetes mellitus type 1 (children)	Other
Korda et al. (18)	2017	Heart failure	Vascular disease
Bottle et al (20)	2018	Elective total hip arthroplasty	Hip/Knee surgery
		Elective total knee arthroplasty	Hip/Knee surgery
Hekkert et al. (41)	2018	Biliary tract disease	Other
		Osteoarthritis	Hip/Knee surgery
		Fracture of neck of femur (hip)	Hip/Knee surgery
		Cardiac dysrhythmia	Vascular disease
		Appendicitis and other appendiceal conditions	Other
		Calculus of urinary tract	Other
		Abdominal hernia	Other
		Complication of device; implant or graft	Infections
		Hyperplasia of prostate	Other
		Complications of surgical procedures or medical care	Infections
Charalampopoulos et al (42)	2018	Type 1 Diabetes in children	Other
Gutacker et al (1)	2018	Acute myocardial infarction	Vascular disease
		Isolated coronary artery bypass graft surgery	Vascular disease
		Pneumonia	Infections
		Hip fracture	Hip/Knee surgery

Study	Year	Primary diagnosis or medical procedure/population	(Disease) category
		Total hip arthroplasty	Hip/Knee surgery
		Acute ischemic stroke	Vascular disease
<b>Berlin et al (43)</b>	2019	Breast cancer surgery (immediate breast reconstruction including patients receiving unilateral or bilateral reconstruction (including prophylactic mastectomy))	Malignancies
<b>Kristensen et al (44)</b>	2019	Patients with hip fracture treated surgically with osteosynthesis or alloplastic	Hip/Knee surgery
<b>Comendeiro-Maaløe et al (27)</b>	2020	Acute myocardial infarction + subgroup congestive heart failure	Vascular disease
<b>Kristensen et al (45)</b>	2020	Hip fracture	Hip/knee surgery
<b>Khor et al (23)</b>	2020	Lumbar fusion procedure	Other
<b>Rodriguez-Lopez et al (28)</b>	2020	Acute myocardial infarction	Vascular disease
<b>Wang et al (46)</b>	2020	Pancreatic cancer surgery	Malignancies
<b>Jackson et al (47)</b>	2020	HLA-incompatible living donor kidney transplantation	Other
<b>Liu et al (48)</b>	2021	Diabetes mellitus type 2	Other
<b>Vesterager et al (49)</b>	2021	Hip fracture surgery	Hip/knee surgery
<b>Bamdad et al (24)</b>	2022	Elective colectomy	Other
<b>Bernet et al (50)</b>	2022	Acute care inpatient population	General inpatient population
<b>Bottle et al (51)</b>	2022	COVID-19 (Coronavirus Disease 2019) in acute non-specialist hospitals	Infections
<b>Ferreira et al (52)</b>	2022	Emergency department presentations of patients with low back pain	Other
<b>Stankovic et al (53)</b>	2022	Cardiac arrest	Vascular disease
<b>Salet et al (10)</b>	2022	Laparoscopic resection of colorectal carcinoma	Malignancies
		Transurethral resection of urinary bladder carcinoma	Malignancies
		Acute percutaneous coronary intervention	Vascular disease
		Total knee arthroplasty for osteoarthritis	Hip/Knee surgery
<b>Chui et al (16)</b>	2023	Patients eligible for cardiac resynchronization therapy-defibrillator (CRT-D)	Vascular disease
<b>Liu et al (54)</b>	2023	Adult inpatients	General inpatient population
<b>Bakhtiyar et al (55)</b>	2023	Kidney transplantation	Other
<b>Estupiñán-Romero et al (56)</b>	2023	Acute ischemic stroke	Vascular disease

\*This study examined CHF, AMI, AIS, pneumonia, COPD, hip fracture patients, but only reported between-hospital and between-diagnoses VPC estimates, therefore categorized as general inpatient population.

**Supplementary table 4.** Risk of bias appraisal using the NIH Tool for observational and cohort studies

Study	Year	1	2	4	5	11	14	Quality rating
Selby et al. (21)	2010	Yes	Yes	Yes	No	Yes	Yes	Good
Osler et al. (31)	2011	Yes	Yes	Yes	No	Yes	Yes	Good
Elferink et al. (25)	2011	Yes	Yes	Yes	No	Yes	Yes	Good
Nathan et al. (15)	2011	Yes	Yes	Yes	No	Yes	Yes	Good
Cooke et al. (32)	2012	Yes	Yes	Yes	No	Yes	Yes	Good
Seymour et al. (33)	2012	Yes	Yes	Yes	No	Yes	Yes	Good
Goodwin et al. (22)	2013	Yes	Yes	Yes	No	Yes	Yes	Good
Koné Péfoyo (19)	2013	Yes	Yes	No	No	Yes	Yes	Good
Baines et al. (34)	2013	Yes	Yes	Yes	No	Yes	Yes	Good
Gathara et al. (26)	2015	Yes	Yes	No	No	Yes	Yes	Fair
Prescott et al. (35)	2015	Yes	Yes	Yes	No	Yes	Yes	Good
Van de Vijssel et al. (36)	2015	Yes	Yes	Yes	No	Yes	Yes	Good
Pozo-Rodríguez et al (37)	2015	Yes	Yes	No	No	Yes	Yes	Fair
Ghith et al (30)	2016	Yes	Yes	Yes	No	Yes	Yes	Good
El-Sheika (38)	2016	Yes	Yes	No	No	Yes	Yes	Fair
Guillouet et al (17)	2016	Yes	Yes	Yes	No	Yes	Yes	Good
Admon et al. (14)	2017	Yes	Yes	Yes	No	Yes	Yes	Good
Orindi et al. (39)	2017	Yes	Yes	No	No	Yes	Yes	Fair
Charalampopoulos et al (40)	2017	Yes	Yes	Yes	No	Yes	Yes	Good
Korda et al. (18)	2017	Yes	Yes	Yes	No	Yes	Yes	Good
Bottle et al (20)	2018	Yes	Yes	Yes	Yes	Yes	Yes	Good
Hekkert et al. (41)	2018	Yes	Yes	Yes	No	Yes	Yes	Good
Charalampopoulos et al (42)	2018	Yes	Yes	Yes	No	Yes	Yes	Good
Gutacker et al (1)	2018	Yes	Yes	Yes	Yes	Yes	Yes	Good
Berlin et al (43)	2019	Yes	Yes	Yes	No	Yes	Yes	Good
Kristensen et al (44)	2019	Yes	Yes	Yes	No	Yes	Yes	Good
Comendeiro-Maaløe et al (27)	2020	Yes	Yes	Yes	No	Yes	Yes	Good
Kristensen et al (45)	2020	Yes	Yes	Yes	No	Yes	Yes	Good
Khor et al (23)	2020	Yes	Yes	Yes	No	Yes	Yes	Good
Rodríguez-Lopez et al (28)	2020	Yes	Yes	Yes	No	Yes	Yes	Good
Wang et al (46)	2020	Yes	Yes	Yes	No	Yes	Yes	Good
Jackson et al (47)	2020	Yes	Yes	Yes	No	Yes	Yes	Good
Liu et al (48)	2021	Yes	Yes	Yes	Yes	Yes	Yes	Good
Vesterager et al (49)	2021	Yes	Yes	Yes	No	Yes	Yes	Good
Bamdad et al (24)	2021	Yes	Yes	Yes	No	Yes	Yes	Good
Bernet et al (50)	2022	Yes	Yes	Yes	No	Yes	Yes	Good
Bottle et al (51)	2022	Yes	Yes	Yes	No	Yes	Yes	Good
Ferreira et al (52)	2022	Yes	Yes	Yes	No	Yes	Yes	Good
Stankovic et al (53)	2022	Yes	Yes	Yes	No	Yes	Yes	Good
Salet et al (10)	2022	Yes	Yes	Yes	Yes	Yes	Yes	Good
Chui et al (16)	2023	Yes	Yes	Yes	No	Yes	Yes	Good
Liu et al (54)	2023	Yes	Yes	Yes	Yes	Yes	Yes	Good
Bakhtiyar et al (55)	2023	Yes	Yes	Yes	No	Yes	Yes	Good
Estupiñán-Romero et al (56)	2023	Yes	Yes	Yes	No	Yes	Yes	Good

1. Was the research question or objective in this paper clearly stated?; 2. Was the study population clearly specified and defined?; 4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?; 5. Was a sample size justification, power description, or variance and effect estimates provided?; 11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?; 14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?

## 5.1 Vascular disease

Study	Condition(s)	Sample size (N)					Indicator	Levels	Partitioned variation*	Reliability
		Country	Hospital	Physician	Patient	Ward				
<i>Outcome indicators</i>										
Comendeiro -Maaløe et al (27)	AMI + subgroup CHF	5	107		46875		In-hospital mortality	Hospital	CHF+ = 8.34% CHF - = 3.9%	
Gutacker et al (1)	AMI		148	1746	138044		30-day mortality	Hospital Physician	0.6% 1.4%	0.94 0.45
	Isolated CABG surgery		30	212	24505		30-day mortality	Hospital Physician	0.4% 0.9%	0.91 0.48
	AIS		144	1214	144114		30-day mortality	Hospital Physician	0.4% 1.1%	0.94 0.37
Korda et al. (18)	CHF		251		5074		30-day mortality	Hospital	0%	
Rodriguez-Lopez et al (28)	AMI		68		43247		30-day mortality	Hospital Patient	0.7% 34.1%	
Selby et al.	Hypertension		35	1262	410976		Systolic blood pressure	Hospital Physician	0.35% 1.81%	
Ghith et al (30)	Heart failure (primary diagnosis)		71		36943	565	30-day mortality	Hospital Ward		
Salet et al (10)	Acute PCI		24	202	31870		Inhospital mortality	Hospital Physician	29% 1%	1.00 0.66
Estupiñán-Romero et al (56)	Acute Ischemic Stroke (AIS) - patients undergoing reperfusion therapies		37		196099		Inhospital mortality	Hospital	3.1%	
	Acute Ischemic Stroke (AIS) - patients not undergoing reperfusion therapies						Inhospital mortality	Hospital	1.6%	
Stankovic et al (53)	Cardiac arrest		24		1627		Return of spontaneous circulation	Hospital	1.6%	
			24		782		30-day survival	Hospital	2.8%	
			24		614		1-year survival	Hospital	3.4%	

Study	Condition(s)	Sample size (N)					Indicator	Levels	Partitioned variation*	Reliability
		Country	Hospital	Physician	Patient	Ward				
<i>Patient-reported outcome indicators</i>										
El-Sheika (38)	Varicose vein treatment		162		24460		Change in QoL as determined by the AVVQ	Hospital	1.96%	
<i>Process indicators</i>										
Chui et al (16)	Patients eligible for CTR-D		1377		30134		CRT-D utilization	Hospital	74%	
<i>Intermediate outcome indicators</i>										
Gutacker et al (1)	AMI		148	1746	138044	28- day readmission	Hospital	0.4%	0.87	
		Physician					0.4%	0.19		
		Length of stay				Hospital	4.5%	0.99		
						Physician	6.5%	0.79		
	Isolated CABG surgery	28- day readmission	Hospital	0.3%	0.89					
			Physician	0.8%	0.47					
		Length of stay	Hospital	3.4%	0.99					
			Physician	5.2%	0.85					
AIS	28- day readmission	Hospital	0.4%	0.92						
		Physician	0.8%	0.29						
	Length of stay	Hospital	0.4%	0.95						
		Physician	1.5%	0.79						
Hekkert et al. (41)	Cardiac dysrhythmias		53		15129	28- day readmission	Hospital	1.11%		
Seymour et al. (33)	AMI		88		22086	ICU use	Hospital	27.5%		
	CHF		90		76439	ICU use	Hospital	16.4%		
Korda et al. (18)	CHF		215		5074	28-day readmission	Hospital	0.74%		
Salet et al (10)	Acute PCI	ICU admission	24	202	31870	Hospital	13%	0.99		
						Physician	1%	0.51		
		Length of stay				Hospital	2%	0.97		
						Physician	0%	0.19		
		30-day readmission				Hospital	6%	0.99		
		Physician				1%	0.54			
30-day reintervention	Hospital	9%	0.99							
	Physician	1%	0.70							

Study	Condition(s)	Sample size (N)					Indicator	Levels	Partitioned variation*	Reliability
		Country	Hospital	Physician	Patient	Ward				
Van de Vijssel et al. (36)	AMI		61		25619		Length of stay	Hospital	5-15%	
	CHF		61		17491		Length of stay	Hospital	<5%	
	AIS		61		20282		Length of stay	Hospital	<5%	

AMI = acute myocardial infarction; AIS = acute ischemic stroke; AVVQ = Aberdeen Varicose Vein Score; CABG = coronary artery bypass graft; CHF = chronic heart failure; CRT-D = cardiac resynchronization therapy-defibrillator; PCI = percutaneous coronary intervention; QoL = quality of life. \*based on ICC or VPC multiplied by 100%

## 5.2 Malignancies

Study	Procedure	Sample size				Indicator(s)	Levels included	Partitioned variation*	Reliability	
		Region	Hospital	Physician	Pathologist					Patient
<i>Outcome indicators</i>										
Berlin et al (43)	Breast cancer surgery		11			2252	Complication	Hospital	4.5%	
Osler et al.	Colorectal cancer surgery		43			11287	30-day mortality	Hospital	2.4%	
Salet et al (10)	Laprosopic resection of CRC		48	131		6640	Inhospital mortality	Hospital Physician	<1% 5%	
	Resection of urinary bladder carcinoma		62	310		14030	Inhospital mortality	Hospital Physician	<0.01 6%	
<i>Patient-reported outcome indicators</i>										
Berlin et al (43)	Breast cancer surgery		11		2252		Satisfaction with breast esthetics (BREAST-Q)	Hospital	1%	
				Satisfaction with outcome (BREAST-Q)			Hospital	0.8%		
<i>Intermediate outcome indicators</i>										
Van de Vijssel et al. (36)	Colorectal cancer surgery		61			5988	Length of stay	Hospital	<5%	
Seymour et al. (33)	Colorectal cancer surgery		89			10232	ICU use	Hospital	8.0%	
Wang et al (46)	Pancreatic cancer surgery	22	405			3619	28- day readmission	Hospital	0.41%	
Salet et al (10)	Laprosopic resection of CRC		48	131		6640	ICU admission	Hospital Physician	9% <1%	
					Length of stay		Hospital Physician	2% 0%		
					30-day readmission		Hospital Physician	<1% 1%		
					ICU admission		Hospital Physician	12% <1%		
					Length of stay		Hospital Physician	1% 1%		
					30-day readmission		Hospital Physician	3% <1%		
	Resection of urinary bladder carcinoma		62	310		14030		ICU admission	Hospital Physician	12% <1%
					Length of stay		Hospital Physician	1% 1%		
					30-day readmission		Hospital Physician	3% <1%		
					30-day reintervention		Hospital Physician	11% <1%		
<i>Process indicators</i>										
Elferink et al. (25)	Colorectal cancer surgery		97		58	33206	Number of LNs examined	Hospital Pathologist	3.2% 4.9%	
Nathan et al. (15)	Colorectal cancer surgery		1113	4180	2656	27101	≥12 LN assessment	Hospital Physician Pathologist	16% 1.8% 4.1%	

CRC = colorectal carcinoma; LN = lymph nodes; \*based on ICC or VPC multiplied by 100%



**5.3 Hip/Knee surgery**

Study	Condition	Sample size (N)				Indicator	Levels included	Partitioned variation*	Reliability		
		Municipality	Hospital	Physician	Patient						
<i>Clinical outcome indicators</i>											
Gutacker et al (1)	Hip fracture		148	1735	156145	30-day mortality	Hospital Physician	0.7% 1.2%	0.95 0.52		
Kristensen et al (45)	Hip fracture	290	54		54999	1-year all-cause mortality	Municipality Hospital	0.1% 0.2%			
Kristensen et al (44)	Hip fracture (treated surgically with osteocynthesis or alloplasty)		32		60004	30-day mortality	Hospital	0.87%			
<i>Intermediate clinical outcome indicators</i>											
Bottle et al (20)	Total hip arthroplasty		Unknown	Unknown	259980	30 day readmission	Hospital Physician	1.7% 0.66%			
						Surgical 30-day readmission	Hospital Physician	2.87% 3.43%			
						30-day readmission RTT	Hospital Physician	3.14% 1.63%			
						Total knee arthroplasty		Unknown	Unknown	311033	30 day readmission
						Surgical 30-day readmission	Hospital Physician	2.34% 5.14%			
						30-day readmission RTT	Hospital Physician	2.7% 1.33%			
	Stankovic et al (53)	Total knee arthroplasty for osteoarthritis	62	531	39790	ICU admission	Hospital Physician	15% 1%	0.99 0.41		
						Length of stay	Hospital Physician	18% 1%	0.99 0.43		
30-day readmission						Hospital Physician	3% 2%	0.95 0.60			
Gutacker et al (1)						Hip fracture	148	1735	156145	28- day readmission	Hospital Physician
	Length of stay	Hospital Physician	2.2% 3.2%	0.98 0.74							
	Primary hip replacement	229	1325	170678	28- day readmission	Hospital Physician				1.6% 2.5%	0.97 0.71
					Length of stay	Hospital Physician				9.9% 12.7%	0.99 0.93
Hekkert et al. (41)	Osteoarthritis				53		83302	30 day readmission	Hospital	1.81%	
								Fracture of neck of femur (hip)		53	

Study	Condition	Sample size (N)				Indicator	Levels included	Partitioned variation*	Reliability
		Municipality	Hospital	Physician	Patient				
Van de Vijssel et al. (36)	Femoral fracture		61		11609	Length of stay	Hospital	<5%	
	Hip replacement		61		13497	Length of stay	Hospital	15-25%	
	Knee replacement		61		10264	Length of stay	Hospital	15-25%	
Vesterager et al (49)	Hip fracture surgery		23		29598	Pneumonia	Hospital	12.1%	
				Sepsis		Hospital	1.8%		
<i>Process indicators</i>									
Vesterager et al (49)	Hip fracture surgery		23		29598	Hospital-treated infections	Hospital	18.8%	
				Community-treated infections		Hospital	13.3%		

RTT = return-to-theater; \*based on ICC or VPC multiplied by 100%

**5.4 (General) inpatient population**

Study	Population	Sample size (N)				Indicator	Levels included	Partitioned variation*	Reliability
		Country	Hospital	Physician	Nursing unit				
<i>Outcome indicators</i>									
Baines et al. (34)	General inpatient population		20			3996	Adverse event	Hospital	8.2%
							Preventable adverse event	Hospital	14.9%
Goodwin et al. (22)	Inpatient population		Unknown	1099		131710	30-day mortality	Hospital	1.02%
								Physician	7.5%
								Patient	42.15%
<i>Intermediate outcome indicators</i>									
Admon et al. (14)	CHF, AMI, AIS, pneumonia, COPD, hip fracture patients		1120			348462	ICU admission status	Hospital	17.6%
Bernet et al (50)	Acute inpatient population		138			35998	Inpatient fall rate	Hospital	3.0%
Goodwin et al. (22)	Inpatient population		203	1064		113289	Length of stay	Hospital	2.94%
								Hospitalist	2.6%
								Patient	11.54%
								Hospital	1.78%
								Hospitalist	7.3%
								Patient	37.23%
			Unknown	Unknown		99522	% admissions discharged home	Hospital	1.78%
								Hospitalist	7.3%
								Patient	37.23%
								Hospital	3.56%
								Hospitalist	10.0%
								Patient	39.74%
			Unknown	Unknown		108547	30 day readmission	Hospital	0.09%
								Hospitalist	0.18%
								Patient	24.03%
			Unknown	Unknown		108226	30-day ER visit	Hospital	0.37%
								Hospitalist	0.12%
								Patient	22.7%
<i>Process indicators</i>									
Gathara et al. (26)	Underage inpatient population		22	337		1036	HIV testing	Hospital	48.0%
Selby et al. (21)	Women 52-69 years		35	1198		258810	Screening mammography	Hospital	1.1%
								Physician	2.8%

Study	Population	Sample size (N)				Indicator	Levels included	Partitioned variation*	Reliability
		Country	Hospital	Physician	Nursing unit				
<i>Patient-reported experience indicators</i>									
Koné Péfoyo (19)	General acute inpatient population		68			37231	Overall rating doctors & nurses	Hospital	3.0%
			68			37339	Overall rating patient centered care	Hospital	3.0%
			68			33267	Admission process	Hospital	3.1%
			68			19993	Availability of staff	Hospital	3.0%
			68			33700	Communication with patient	Hospital	2.4%
			68			21719	Communication with family	Hospital	1.6%
			68			24832	Discharge transition	Hospital	1.9%
			68			24108	Pain management	Hospital	1.1%
Orindi et al. (39)	General inpatient population	7	186		824	Patient experiences with care	Hospital Nursing unit	>10% >5%	
Selby et al.	Patients with primary care visits		35	1104		72171	Care experience score	Hospital Physician	0.1% 6.7%
Liu et al (54)	Adult inpatients		30			4847	Patient experience with administrative process	Hospital	10.8%
							Patient experience with hospital environment	Hospital	15.5%
							Patient experience with medical care	Hospital	16.1%
							Patient experience with symptom management	Hospital	6.9%
							Overall satisfaction	Hospital	14.4%

AMI = acute myocardial infarction; CHF = chronic heart failure; COPD = chronic obstructive pulmonary disease; ICU = intensive care unit; ER = emergency room; PREM = patient reported experience measure; \*based on ICC or VPC multiplied by 100%

**5.5 Infections**

Study	Condition	Sample size (N)				Indicator(s)	Levels included	Partitioned variation*	Reliability
		Region	Hospital	Physician	Patient				
<i>Outcome indicators</i>									
Bottle et al (51)	COVID-19		124		74781	Inhospital mortality	Hospital	1.4%	
Gutacker et al (1)	Pneumonia		152	3760	405671	30-day mortality	Hospital Physician	0.7% 1.2%	0.98 0.51
Prescott et al. (35)	Sepsis	21	114		43733	Inhospital mortality	Region Hospital	0.3% 1.4%	
<i>Intermediate outcome indicators</i>									
Gutacker et al (1)	Pneumonia		152	3760	405671	28 day readmission	Hospital Physician	0.3% 0.4%	0.94 0.26
						Length of stay	Hospital Physician	0.5% 2.1%	0.99 0.64
Hekkert et al. (41)	Complication of device; implant or graft					30 day readmission	Hospital	1.73%	
	Complications of surgical procedures or medical care					30 day readmission	Hospital	0.7%	
Van de Vijssel et al. (36)	Pneumonia					Length of stay	Hospital	<5%	
Seymour et al. (33)	Pneumonia		90		36525	ICU use	Hospital	7.7%	
<i>Process indicators</i>									
Gathara et al. (26)	Malaria		19	187	368	Prescription quinine loading dose	Hospital	36%	
	Pneumonia		22	226	468	Prescription of correct dose per kg bodyweight of crystalline penicillin	Hospital	26%	
	Diarrhoea (dehydration)		22	153	206	Prescription of zinc	Hospital	10%	

\*based on ICC or VPC multiplied by 100%

**5.6 Other**

Study	Condition/ Procedure	Country (N)	Region (N)	Hospital (N)	Physician (N)	Patient (N)	Indicator	Levels included	Partitioned variation*	Reliability
<i>Outcome indicators</i>										
Khor et al (23)	Lumbar fusion procedure			17	58	737	MID improvement in ODI at 12 months	Hospital Physician	1.2% 3.5%	
							% patients reaching minimal disability	Hospital Physician	0.01% 0.1%	
Selby et al.	Hyperlipidemia			35	1247	338914	LDL-cholesterol	Hospital Physician	0.59% 2.45%	
Cooke et al. (32)	Non-surgical mechanically ventilated patients			119		5131	30-day mortality	Hospital	0.6%	
Jackson et al (47)	HLA-incompatible living donor kidney transplantation			25		1358	Mortality	Hospital	4.7%	
							Graft loss	Hospital	4.4%	
Pozo-Rodríguez et al (37)	COPD exacerbations			129		5178	Inhospital mortality	Hospital	4.0%	
							90-day follow up mortality	Hospital	5.0%	
							Readmissions	Hospital	1.0%	
<i>Intermediate outcome indicators</i>										
Charalampopoulos et al (40)	DM1 (children)		11	176		21773	Glycaemic control (HbAc1)	Hospital	2.4%	
Charalampopoulos et al (42)	DM1 (children)	8		528		64666	Glycaemic control (HbAc1)	Hospital	Sweden: 4.0% Germany: 16.8% Austria: 13.9% Denmark: 4.0% Norway: 1.8% England: 5.5% USA: 7.9% Wales: 4.7%	
Liu et al (48)	DM2			25		12888	Length of stay	Hospital	10.5%	
Bakhtiyar et al (55)	Kidney transplantation					61798	Length of stay	Hospital	28.8%	
Bamdad et al (24)	Elective colectomy					15755	Development of non-UTI postoperative complications within 30 days after surgery	Hospital Surgeon	1.8% 2.4%	
Ferreira et al (52)	ED presentations of patients with low back pain			177		176729	Hospital adjusted admission rate (HAAR)	Hospital	14%	
Guillouet et al (17)	PD patients			128		5406	Early PD failure	Hospital	1.0%	

Study	Condition/ Procedure	Country (N)	Region (N)	Hospital (N)	Physician (N)	Patient (N)	Indicator	Levels included	Partitioned variation*	Reliability
Hekkert et al. (41)	Biliary tract disease			53		47379	30 day readmission	Hospital	0.48%	
	Appendicitis and other appendiceal conditions			53		24546	30 day readmission	Hospital	1.45%	
	Calculus of urinary tract			53		11300	30 day readmission	Hospital	2.31%	
	Abdominal hernia			53		23647	30 day readmission	Hospital	1.36%	
	Hyperplasia of prostate			53		15591	30 day readmission	Hospital	2.70%	
Van de Vijssel et al. (36)	Cholecystectomy			61		12703	Length of stay	Hospital	5-15%	

MID = minimal important difference; ODI = oswestry disability index; DM = diabetes mellitus; PD = peritoneal dialysis; \*based on ICC or VPC multiplied by 100%;