

Appendix 2: Summary of Studies Included in Systematic Review

Author, year, country	Design, Setting, Population (n)	Surgical Specialty	Interventions	IPC Measures	Compliance	SSI Def.	SSI Outcome
Acklin 2011 Switzerland/High	Before/After Single hospital Adults (370)	Ortho	Ed: Training Ex: Bundle Ev: Surveillance, feedback	Timely SAP, iodine-alcohol skin prep, sterile dressing, repeat disinfection after surgery before wound closure, double gloves, meticulous hemostasis, removal of surgical drains within 48 h, leaving sterile dressing for >48 h	Not reported	CDC (1999)	Decreased Pre: 15/217 (6.9%) Post: 3/153 (2.0%) <i>P</i> =0.029
Adler 2012 US/High	Before/After Single hospital Pediatrics (618)	Cardiac	En: Leadership engagement, multidisciplinary team Ex: Bundles Ev: Feedback	SAP policy, preop mupirocin/CHG, chlorprep for skin preparation	Increase	CDC (2008)	Decrease of 6.7 infections per 100 surgeries per 6 months (<i>P</i> = 0.002) Delayed closure: 40% to 0.8% (<i>P</i> < 0.001) Immediate closure: 4.3% to 1.8% (<i>P</i> = 0.02)
Aguilar-Nascimento 2008 Brazil/Middle	Before/After Single hospital Adults (308)	GI surgery	Ex: ACERTO protocol	ACERTO: preoperative nutritional support if malnourished, early postop feeding, no mechanical bowel preparation, Avoidance of excess fluids, drains & nasogastric tubes, early mobilization	Increase	Not reported	Decreased by 66% Pre: 9/78 (11.5%) Post: 9/230 (3.9%) <i>P</i> = 0.01; OR 3.2, CI (1.2-8.4)
Aguilar-Nascimento,	Before/After Single unit	GI surgery	Ex: Protocols	ACERTO: preoperative nutritional support if malnourished, early	Not reported	Not reported	Decrease Pre: 8/42 (19%)

2010 Brazil/Middle	Adults (117)		Ev: Surveillance, audits, and data feedback	postop feeding, no mechanical bowel preparation, avoidance of excess fluids, drains & nasogastric tubes, early mobilization			Post: 2/75 (2.7%) $P < 0.001$
Aiken 2013 Kenya/Low	Interrupted time series Single hospital Adults (3343)	Multiple	Ed: Education materials Ex: Policy Ev: Surveillance, data feedback, audit	SAP policy	Increase	CDC (2008)	Decreased for superficial SSI only: Clean, clean-contaminated Pre: 69/1130 (6.1%) Post: 83/2046 (4.1%) $P = 0.01$ Contaminated & dirty: Pre: 10/76 (13.2%) Post: 17/91 (2.2%) $P = 0.006$ Total SSI (P values not provided): Clean, clean-contaminated Pre: 82/1130 (7.3%) Post: 102/2046 (5%) Contaminated & dirty: Pre: 18/76 (23.7%) Post: 17/91 (18.7%)
Anchalia	Before/After	Multiple	En: Multidisciplinary committee	SAP, preoperative bathing, diabetes	Not reported	CDC (1999)	Decreased from 13% to 4.4%

2011 India/Low-middle	Single hospital Population: not reported		Ed: Training Ex: Protocols Ev: Surveillance, data feedback	control, no/clip hair removal, iodine skin prep, closing operating room doors and limiting staff, instrument sterilization, sterile dressing change, surveillance			<i>P</i> values not provided
Anthony 2011 US/High	RCT Single Adults (211)	Colorectal	Ex: Bundles	No mechanical bowel prep, use of pre/intraoperative warming, increased oxygen during and after, reduction of intravenous fluid	Not reported	CDC (2008)	Increased Intervention: 45/100 (45%) Control: 24/97 (25%) <i>P</i> = 0.004
Askarian 2011 Iran/Middle	Before/After Single hospital Adult (144)	Multiple	Ex: WHO safety checklist Ed: Training	SAP policy	Increase	Not reported	No change Pre: 10.4% Post: 5.3% <i>P</i> = 0.10
Ballard 2012 US/High	Retrospective Single hospital Pediatrics (394)	Ortho	En: Multidisciplinary teamwork Ed: In-services Ex: Protocols Ev: Accountability, measures of performance	SAP policy	Increase	CDC (1992)	No change Pre: 7.8% Post: 4.5% <i>P</i> = 0.203
Barchitta 2011 Italy/High	Before/After Single hospital Adults (600)	Unknown	En: Multidisciplinary teamwork Ed: Education materials Ex: Protocols Ev: Data feedback	SAP	Increase	(HELICS)/Europe (2004)	Decreased 16.4 to 8.2 per 100 surgical patients <i>P</i> = 0.018
Biskup 2015 US/High	Retrospective Single hospital Age unknown (4470)	Plastic	Ex: Modified WHO surgical safety checklist	WHO safety check list (antibiotic prophylaxis within 60 min before incision) + assuring presence of appropriate implants, administration	Not reported	Not reported	No change Pre: 38/2166 Post: 53/2310 <i>P</i> = 0.206

				of preoperative antibiotics, normothermia, thromboembolic prophylaxis			
Boaz 2014 Israel/high	Before/After Single unit Adults (760)	Ortho	Ex: Modified WHO surgical safety checklist (prophylactic antibiotic administered before surgery)	Prophylactic antibiotic, instrument sterilization	Increase	Not reported	No change Pre: 3.2% Post: 2.1% <i>P</i> = 0.368
Brandt 2006 Germany/High	Surveillance Age unknown	Multiple	Ev: Surveillance	Unknown	Not reported	NNIS (1997)	Compared with year 1: decreased in year 2: OR, 0.84; CI (0.77-0.93) Decreased in year 3: OR, 0.75; CI (0.68-0.82) no change in year 4
Brisibe 2015 Nigeria/Low	Before/After Single unit Adults: number not reported	OB/GYN	En: Commitment of the hospital management Ex: Contract outsourcing, revolving fund scheme, policy	Instrument sterilization	Not reported	Not reported	Overall: No change <i>P</i> = 0.230 (Decreased in non-booked CS; <i>P</i> = 0.032)
Bull Australia/High 2011	Before/After Single unit Adults (275)	Colorectal	En: Multidisciplinary teams Ed: Focus group meetings Ex: Checklist	Normothermia Normoglycemia Hyperoxia Antibiotics Normotension	Varied	Not reported	Pre: 15% (95% CI, 10.4-20.2) Post: 7% (95% CI, 3.4-12.6)
Bullough 2014 UK/High	Before/After Single unit Adults (660)	OB/GYN	En: Multidisciplinary team Ed: Staff education, patient education, information leaflet,	NICE pre, peri and postoperative recommendations, e.g. skin preparation, hair removal, and wound dressing timing,	Increase	Not reported	Decrease from 12% to 6%; no infection in the highest risk group

			patient information card Ex: Changes to wound care products	specialized wound dressing for BMI<35, negative pressure wound therapy for BMI > 35 kg/m ²			
Chen-Yen 2014 Taiwan/High	Before/After Single unit Adults (1010)	Cardiac	Ex: Care bundle Ev: Surveillance	Preoperative CHG showering, improved application, timing, and documentation of antibiotic prophylaxis, surgical gloves changed after harvests of internal mammary artery and saphenous veins	Not reported	Not reported	Decrease SWI: Pre: 15/435 (3.4%) Post: 8/575 (1.4%) <i>P</i> = 0.03 MRSA: From 2.3% to 0.5% (<i>P</i> = 0.021)
Cima 2013 US/High	Before/After Single unit Adults (729)	Colorectal	En: Multidisciplinary teams Ed: Staff education, patient education on wound care Ex: Bundles	Patient prep cleansing Antibiotics timing dosing and redosing Glove change	Increase	Not reported	Decrease 9.8-4.0 (<i>P</i> < 0.05)
Connolly 2015 US/High	Before/After Single unit Adults (1018)	GI surgery	En: Multidisciplinary review of the strategies Ed: Education meetings Ex: Preoperative checklist, wound closure guidelines, dressing sticker	SSI reduction strategy: preoperative (blood glucose, bowel preparation, shower, hair removal), intraoperative (prophylactic antibiotics, antimicrobial incisional drape, wound protector, wound closure technique), and postoperative (wound dressing technique). Re-glove, re-prepare the field, place new sterile towels over the incision area, use a reserved unused clean instrument tray for closing	Not reported	CDC (1992)	Decrease Pre: 122/379 (32.2%) Post: 59/311 (19%) <i>P</i> < 0.01

				components. Dressing sticker (dressing to be removed by the surgical team).			
Corcoran 2013 Ireland/High	Prospective Single hospital Adults (1534)	OB/GYN	Ex: Protocols, bundles Ed: Education Ev: Surveillance	Hair removal	Not reported	CDC (2008)	Decrease Pre: 114/710 (16%) Post: 40/824 (4.9%) <i>P</i> = 0.001
Crolla 2012 Netherlands/High	Prospective Single hospital Adults (2331)	Colorectal	En: Multidisciplinary Ex: Bundles Ev: Measurement of performance, accountability, feedback	SAP policy	Increase	CDC (1992)	Decrease Pre: 85/394 (21.8%) Post: 300/1537 (19%) <i>P</i> values not provided
Dimopoulou 2015 Greece/High	Before/After Single hospital Pediatrics (889)	Multiple	En: Champion physician Ex: Guideline documents, reminders Ed: 2-month educational intervention Ev: Measurement of performance	SAP	Increase	CDC (2010)	No change Pre: 0.93% and post: 0.92%, <i>P</i> = 0.992
Douglas 2012 Australia/High	Prospective Age: Unknown	Ortho	En: Multidisciplinary, stakeholders' investment Ed: Education Ex: Guidelines	SAP, operating room discipline, preop washing techniques, better patient selection	Not reported	Not reported	Decrease 30% to 0% <i>P</i> values not provided
Dyrkorn 2012 Norway/High	Prospective Adults (744)	OB/GYN	En: Leadership, multidisciplinary team Ex: Bundle	Hair removal technique, suture for skin closing, wound dressing, double gloving, preop hand washing, aseptic techniques	Not reported	CDC (1999)	Decrease Pre: 31/187 (16.6%) Post: 16/557 (2.8%) <i>P</i> < 0.0001
El Mhamdi 2014	Before/After Single hospital	Multiple	Ex: WHO checklist Ev: Direct observation by senior physician	SAP, instrument sterilization	Increase	Not reported	Decrease Pre: 25/185 (13.5%)

Tunisia/Middle	Mixed population (508)						Post: 14/323 (4.3%) <i>P</i> <0.001
Everett 2014 US/High	Before/After Single hospital Adults (1716)	Unknown	En: Multidisciplinary team (environmental services personnel, nurses, ancillary staff, infection control staff), patient engagement Ed: Trainings, meetings Ex: Protocols, checklist, surveys Ev: Measurement of performance	Comprehensive environmental and patient cleaning (clean high-touch areas, clean patients daily, hand hygiene, clean equipment, isolation protocol)	Not reported	Not reported	Decrease for CTSW & TKA CTSW: Pre: 10/204 (4.9%) Post: 1/292 (0.34%) <i>P</i> < 0.001 SF: Pre: 13/333 (3.9%) Post: 4/232 (1.72%) <i>P</i> < 0.2 TKA Pre: 9/418 (2.15%) Post: 0/237 <i>P</i> < 0.005
Forbes 2008 Canada/High	Before/After Single hospital Adults (208)	GI surgery	En: Champions, multidisciplinary team, stakeholders Ed: Academic rounds Ex: Bundles, clinical pathway, protocols Ev: Feedback	SAP, normothermia, glycemic control	Increase	CDC (1999)	No change 14.3% versus 8.7% <i>P</i> = 0.21
Garcia-Paris 2015 Spain/High	Before/After Single unit Adults (134)	Ortho	En: Multidisciplinary teams Ed: Training, meetings, workshops, live simulations Ex: WHO checklists Ev: Measurement of performance	Antibiotic prophylaxis within 60 min before incision	Increase	Not reported	Decrease Pre: 9.2% Post: without SSC: 4.6% with SSC: 1.5% <i>P</i> value not provided

Geubbels 2004 Netherlands/High	Before/After Multiple hospitals Mixed population (2335)	Multiple	En: Multidisciplinary team Ed: Education materials, new personnel booklet Ex: Protocols Ev: Surveillance, feedback	Ventilation control and air quality, freshly cleaned transportation clean transport beds, wound care, surgical drain reduction, operating room staff discipline with use of surgical masks, no jewelry, improved supply and conveyance of materials, disinfection and sterilization improvement, changed packaging materials of sterile instruments, sterile gowns, SAP, anticoagulation policy	Increase	CDC (1992)	Decrease Hosp. A: from 16.7% to 2.8% difference of 13.9%, CI (2.3% to 30.1%) Hosp. B: 6.3% to 0.9% Reduction of 5.6%, CI (1.4% to 9.9%) Hosp. C: from 5.9% to 3.8% Reduction of 2.1%; CI (-0.9% to 5.1%) Hosp. D: from 5.4% to no SSI Hosp. E: from 14.9% to 3.6% Reduction of 11.3%, CI (2.7% to 19.9%)
Geubbels 2006 Netherlands/High	Prospective Multiple hospitals	Multiple	Ev: surveillance, feedback	Not reported	Not reported	CDC (1992)	Decrease over time

	Mixed population (21,920)						
Gomez 2006 Argentina/Middle	Before/After Mixed population (7478)	Multiple	Ed: Workshops, lectures and discussions Ex: Automatic STOP SAP forms	SAP timing, regimen & duration adequacy	Increase	CDC (1994)	Decrease Pre: 111/3,496 (3.2%) After: 75/3,982 (1.9%) $P < 0.01$
Hadley 2010 US/High	Before/After Unknown population (2,058)	Ortho	Ex: Protocol	MRSA screening, decolonization, SAP	Increase	CDC (2008)	Decrease Pre: 1.45% Post: 1.28% $P = 0.809$
Haycock 2005 US/High	Before/After Single hospital Age not reported	Cardiac	En: Multidisciplinary teams Ed: Intensive and peer education, protocol	Pre-op skin preparation, SAP, glucose control, wound care management, hand hygiene	Increase	Not reported	Decreased by 86.5%, ($P < 0.05$) Control group not described
Hannan 2015 Ireland/High	Before/After Single hospital Adults (844)	Cardiac	Ed: 2-month educational period	Skin prep with 2% CHG in 70% alcohol	Not reported	CDC (Not reported)	Decrease Total SSI: Pre: 17/364 (4.67%) Post: 10/480 (2.08%) $P < 0.05$
Hechenbleikner 2015 US/High	Retrospective cohort Single unit Adults (387)	GI surgery	En: Multidisciplinary team, champions, increased awareness, accountability, focus groups Ed: Educational materials, standardized on-services training patient education (interactive tablet education) Ex: Electronic flagging, preoperative patient phone call	Skin prep, mechanical bowel prep with oral antibiotics	Increase	Not reported	No change

			Ev: Audit tool, data feedback through weekly meetings				
Hedrick 2007 US/High	Before/After Single hospital Adults (307)	Colorectal	Ed: Education Ex: Standardization of antibiotics, order-sets, protocols	Proper selection, timely administration and discontinuation of antibiotic, normothermia, normoglycemia	Increase	CDC (1992)	Decrease Pre: 45/175 (25.6%) Post: 21/132 (15.9%) <i>P</i> = 0.05
Hedrick 2007 US/High	Before/After Single hospital Adults: (769)	GI surgery	En: Multidisciplinary teams Ex: Protocol Ev: Feedback	Proper SAP, timely SAP, discontinuation of SAP, normothermia, normoglycemia	Increase	CDC (1992)	Decrease 9.2% to 5.6% <i>P</i> = 0.07
Hernandez-Navaret 2005 Spain/High	Prospective Single hospital Adults (148)	Colorectal	Ex: Protocol Ev: Benchmarking	SAP	Not reported	Not reported	Decrease
Hickson 2015 US/High	Retrospective (incremental interventions in sequential approach) Single hospital Adults (4942)	OB/GYN	Ed: Patient education Ex: Revised protocol, clinical algorithm, postoperative dressing bundle	Hair clipping, preoperative bathing, skin prep with sealants, dressing changes, sutures instead of staples, advanced dressings, silver antimicrobial dressing, NPWT	Not reported	NHSN (unknown year)	Decrease Pre: 24/1125 (2.16%) Post: 1/964 (0.1%) <i>P</i> < 0.0001
Hill 2015 US/High	Retrospective Single hospital Adults (163)	GI surgery (hepatic)	Ex: Bundles, checklist	Preoperative low-calorie low-fat diet, preoperative bathing, change of antibiotic, antimicrobial incise drapes, antibiotic wound irrigation	Not reported	Not reported	Decrease Pre: 17/113 (15%) Post: 2/50 (4%) <i>P</i> = 0.06
Hogle 2014 US/High	Retrospective Single hospital Adults (3418)	Cardiac	En: Performance improvement team, surgical champion, operating room staff empowerment	Limit operating room traffic, skin prep, equipment cleaning, glucose control	Not reported	CDC (unknown year)	Decrease Pre: 36/1185 (3.0%) Post: 16/1126 (1.4%)

			Ed: Grand rounds, mandatory educational sessions Ex: Guidelines Ev: Random direct observation				$P = 0.03$
Horst 2010 US/High	Before/After Single hospital Age not reported	Multiple	En: Multidisciplinary team, project champion, stakeholders, multiple leadership structures Ed: Bedside education sessions Ex: Protocol Ev: Dashboards, project cycle	Normoglycemia	Increase	Not reported	Decrease (graph but no data)
Hover 2013 US/High	Before/After Single hospital Age not reported	Neuro	En: Administration engagement, leadership support, multidisciplinary team, failure mode & effect analysis Ed: Nursing education for wound checks and dressing changes in the PACU/ICU; patient education for wound care checks	Standardized prep, standardized wound dressings, provision of a prep kit for patients at home, chlorhexidine shampoo, standardization of SAP, standard wound dressing removal,	Not reported	Not reported	Decrease Overall elective neurosurgery: From 2.15 to 1.21% Clean neurosurgery: Decreased by 35%. P value not provided. Deep-space and organ infection rate reduced by 41% $P = 0.052$
Hutzler 2013 US/High	Before/After Single hospital Age: not reported	Ortho	En: Multidisciplinary team Ed: Educating perioperative personnel, vendor discussions Ex: Policy, guideline, scheduling processes,	Instrumentation sterilization	Increase	Not reported	Decrease From 5.4% to 1.4% P value not provided

			purchase additional instruments, change material, communication tool Ev: Monitor compliance daily, feedback				
Izquierdo-Blasco 2015 Spain/High	Before/After Single hospital Pediatrics (220)	Cardiac	En: Multidisciplinary teams Ed: Educational webinars Ex: Congenital surgery checklist Ev: Worldwide registry, annual benchmark reports	Preoperative bathing, hair clipping if needed, dedicated operating room for clean surgery, operating room ventilation, limit operating room traffic, skin prep, change gloves before incision closure, antibiotic prophylaxis	Not reported	CDC (2014)	Decrease 85% decrease 95% CI: 34-94
Jog 2008 UK/High	Before/After Single Hospital (2227)	Cardiac	Ex: Pathway	Screening for MRSA and decolonization with muporicin and triclosan SAP	Increase	HPA (2005)	Decrease Pre: 3.30% Post: 2.22% RR: 0.77 95% CI: 0.056-0.95
Jenkins 2014 17 LMIC	Prospective Multiple hospitals Pediatrics (15049)	Cardiac	En: Quality improvement teams. empower nurses Ed: Educational webinars Ex: Congenital heart surgery check list Ev: Worldwide registry	SAP, patient warming, hand hygiene	Not reported	CDC (2008)	Decreased over time SIR: for 2012 compared to 2010 was 0.77 (0.68–0.87)
John 2015 UAE/High	Before/After Single hospital Mixed population (998)	Unknown	En: Multidisciplinary work taskforce Ed: Staff and patient education Ex: Surgical bundle, safety checklist	Pre-op showering and hair removal, skin antiseptics, prophylactic antibiotics, perioperative maintenance of glycemia, and normothermia	Not reported	Not reported	Decrease From 2.07 (1.44 – 2.69) to 1.11 (0.65 – 1.62)
Johnson 2012	Retrospective Single hospital	Ortho	Ex: Checklist, bundle	SAP, skin preparation, method of wound	Not reported	HPA (2011)	Decrease 1 st bundle: 47/709 (6.6%)

UK/High	Age not reported (1830)			closure and use of implanted antibiotics			2 nd bundle: 19/670 (2.8%) 3 rd bundle: 4/451 (0.9%) 1 st to 2 nd ($P =$ 0.001) 1 st to 3 rd ($P < 0.0001$) 2 nd to 3 rd ($P =$ 0.020)
Jordan 2012 US/High	Before/After Single hospital Adults	Ortho	En: Outpatient workup/physician awareness Ex: Early follow-up with primary care physicians	Hand washing, universal precautions, brushless hand-scrubbing protocol, preoperative MSSA & MRSA screening and decolonization, CHG wipes preop	Not reported	Not reported	Decrease by 13% P value not provided
Joyce 2011 US/High	Before/After Multiple hospitals Age not reported	Unknown	En: Leadership, frontline staff, multidisciplinary team and rounds Ev: Audits, dashboards, newsletter, data publishing	Skin preparation, clip, not hair shaving, CHG prep, timely SAP, normothermia and normoglycemia	Increase	Not reported	No change Pre: 24.9%, Post: 18.8% $P = 0.1292$
Kanter 2006 US/High	Before/After Single hospital Age not reported	Multiple	En: Multidisciplinary teamwork, champions Ed: Grand rounds, educational sessions, in-services, educational materials Ex: Protocol, policies Ev: Data feedback, benchmarking	SAP	Increase	NNIS (Not reported)	Decrease Pre: 3.8%, Post: 1.4% P values not provided
Kawamura 2015 Japan/High	Retrospective Single unit Adults (3299)	Ortho	Ex: Bundle	Active surveillance cultures, contact precautions (gloves and a gown plus single-room isolation or cohorting) for MRSA-positive patients	Increase	CDC (2008)	MRSA SSI rate decreased Pre: 29/1333 (2.18%) Post: 19/1966 (0.97%)

				and cefazolin-based antimicrobial prophylaxis			<i>P</i> = 0.003)
Keenan 2015 US/High	Retrospective Single unit Adults (787)	GI surgery	En: Multidisciplinary team Ed: Pre- and postoperative patient education & counseling Ex: SSIB, ERP Ev: Monthly feedback meeting, direct supervision by surgeon	Preoperative: mechanical bowel prep, CHG wipe antibiotic within 1 h, skin prep. Intraoperative: limit operating room traffic, normoglycemia, wound protector, gowns/gloves change before closure. Postoperative: normoglycemia & normothermia, removal of sterile dressing within 48 h, daily incision CHG washing for a week.	Increase	Not reported	Decrease Superficial SSI Pre: 83/337 (24.6%) ERP 31/165 (18.8%) ERP+SSIB 18/285 (6.3%) <i>P</i> < 0.01
Kelly 2000 US/High	Before/After Single hospital Pediatrics (92)	Unknown	En: Multidisciplinary teamwork Ed: In-service, educational material, educational sessions, protocol	SAP	Not reported	Not reported	No change & no details reported
Khan 2006 India/Low	Before/After Single unit Adults (308)	GI surgery	En: Teamwork/multidisciplinary Ed: Educational materials Ex: Guideline development (nominal group technique)	SAP policy, hair removal, patient bathing, skin prep, diabetes control, surgical hand scrub	Increase	CDC (Not reported)	Decrease Pre: 21/222 (9.45%) Post: 0/56
Kim 2015 Moldova/Low	Before/After Single hospital Adults (2743)	Multiple	Ex: WHO surgical safety checklist, training, provision of pulse oximeters Ev: Indicators, process measures feedback	Antibiotic prophylaxis timing	Increase	Not reported	Decrease Pre: 22% Short term: 8.5% <i>P</i> <0.01 Long term: 6%, (<i>P</i> =0.03)
Kim 2010	Before/After Single Hospital	Ortho	Ed: Patient education Ex: Screening protocol and eradication protocol	Decolonization (Mupirocin and CHG wash) SAP	Increase	Not reported	Decrease Pre: 0.45% Post: 0.19% <i>P</i> =0.0093

US/High	Adults (12,312)						
Kles 2015 US/High	Prospective Single hospital Adults (590)	Cardiac	En: Leadership engagement, multidisciplinary team Ed: Staff education Ex: Six Sigma, contextual model, flowchart	New suture technique, disposable electrocardiogram leads & pacing wires, antibiotic-coated sutures, hair clipping, MRSA screening and decolonization, glucose control	Increase	Not reported	Decrease Pre: 16 (3.74%) Intermediate: 2/262 (0.7%) Post: zero <i>P</i> value not provided
Koch 2015 Norway/High	Prospective Single hospital Mixed population (17,308)	Multiple	En: Structural improvement Ed: Training health care workers Ev: Prevalence surveys with regular feedback to administrators	Not reported	Not reported	CDC (1988)	Increase <i>P</i> < 0.05
Kwok 2013 Moldova/Low	Before/After Single hospital Mainly adults (4357)	Multiple	Ed: Staff training Ex: WHO surgical safety checklist, provision of pulse oximeters Ev: Indicators, process measures feedback	SAP	Increase	Not reported	Decrease Pre: 297/1993 (14.9%) Post: 98/2106 (4.7%) <i>P</i> < 0.001
Larochelle 2011 US/High	Before/After Single hospital Age: Unclear (709)	GI surgery	Ex: Bundles, protocols Ev: Data feedback, accountability, measurement of performance	SAP Policy and Normothermia from SCIP	No change	Not reported	No change (<i>P</i> = 0.84)
Lavu 2012 US/High	Retrospective Single hospital Adults (466)	GI surgery	En: Multidisciplinary teamwork Ex: Bundles	Hair removal, skin preparation, SAP, glycemic control, temperature control	Not reported	CDC (1992)	Decreased Pre: 35/233 (15%) Post: 18/233 (7.7%) <i>P</i> = 0.01
Le	Retrospective	Neuro	Ex: Bundle	Vancomycin, postoperative barrier	Not reported	Not reported	Decrease

2014 US/High	Single hospital Adults (57)			dressing for 3 days, daily topical chlorhexidine wound decolonization for three days or until hospital discharge			From 23.8% to 2.8% <i>P</i> = 0.0217
2015 Finland/High	Before/After Single unit Adults (5418)	Neuro	Ex: WHO checklist	SAP within 60 min of incision	Increase	Not reported	Decrease Pre: 47/103 (45.6%) Post: 28/72 (38.9%) <i>P</i> value not provided
2010 Singapore/High	Before/After Single hospital Age not reported (2408)	Multiple	En: Multidisciplinary teamwork Ed: Educational material Ex: Bundles Ev: Pilot study, data feedback	SAP policy, hair removal with clippers, glucose monitoring, and normothermia	Not reported	CDC (1999)	Decrease from 3.1% to 0.5% <i>P</i> < 0.001
2015 Sweden/High	Before/After Single unit Adults (503)	Cardiac	En: Multidisciplinary teams Ed: Training of surgeons Ex: WHO checklist Ev: Unannounced inspections	4% CHG preoperative shower and scrub, less time in hospital preoperatively, antibiotic prophylaxis on the day of surgery, operating room discipline, double gloves, standardized sternal incision	Not reported	Not reported	Decrease Pre: 44/362 (12.2%) Post: 4/141 (2.8%) <i>P</i> value not provided
2004 US/High	Before/After Single hospital Adults	Cardiac	Ex: Protocols, bundles Ev: Data feedback	Patient bathing, operating room discipline (7 interventions: sterile dressing, separating of cleaning and bathing cloths, glucose monitoring, sports bra, intranasal	Not reported	Not reported	Decreased from 7.58% to 3.47% <i>P</i> values not provided
2014	Prospective Nationwide	Unknown	Ev: Surveillance		Not reported	ECDC (2012)	Decrease

Italy/High	Mixed population (60,460)						
McDonald 2015 US/High	Before/After Single hospital Adults (901)	Ortho	Project JOINTS En: Nurses motivated physician & surgeon, team collaboration fostered administration approval Ed: On-site patient education from RN about nasal testing process and rationale and skin prep with pamphlets distributed and time checklists given to assist in completing the process, Ex: Protocol, bundle	<i>S. aureus</i> nasal screening, decolonization of skin and nares, intra-op skin prep with alcohol, SAP	Increase	Not reported	No change <i>S. aureus</i> SSI Pre: 1.8% Post: 0.66% <i>P</i> = 0.05
Mejia 2015 US/High	Before/After Multiple hospitals Adults	Ortho	En: Operating room leadership, interdisciplinary team Ed: Operating room educator - educating staff on targeted perioperative system issues Ev: Monthly dashboards	Operating room cleaning, operating room traffic and conversation, avoiding flash sterilization, surgical hand antisepsis and gloving, culture technique	Not reported	CDC (2010)	No change in overall PJI Pre: 2.5% Post: 2.1% <i>P</i> = 0.104 Decrease in hip prosthesis SSI (<i>P</i> = 0.04)
Miller 2014 US/High	Before/After Single hospital Adults (241)	Colorectal	ERAS pathway model En: Multidisciplinary team Ed: 3-month staff training Ex: ERAS pathway	Nutritional supplements, CHG sponges, goal-directed intravenous fluid therapy, early feeding, thromboprophylaxis, SAP	Not reported	Not reported	No change Pre: 37.3% Post: 28.8% <i>P</i> = 0.16
Miyahara 2014	Before/After Single hospital	Cardiac	Ex: Bundle	Screening & mupirocin for MRSA carriage, preop showers, clipper use, CHG + povidone-	Not reported	CDC (1999)	Decrease Pre: 13/682 (1.9%)

Japan/High	Adults (1374)			iodine skin prep disinfectant, antimicrobial incise drape, SAP timing, re- dosing & discontinuation, surgical hand antisepsis, double gloving, saline wound irrigation, wound care practices, removal of steroids, normoglycemia, hyperoxia, hydrocolloid dressings			Post: 1/692 (0.14%) <i>P</i> = 0.001
Mori 2015 US/High	Prospective Single hospital Age not reported	Ortho	Johns Hopkins nursing evidence-based practice model En: Multidisciplinary team asks about infectious state, reviews and summarizes evidence Ex: Early preadmission testing Ed: Education documents and patient preop checklist to document completion of preop CHG wash and nasal ointments; <i>S. aureus</i> -colonized patients sent to a pre- surgical joint education class and taught the importance of using CHG preop and nasal decolonization. Ex: Action plan for implementing changes	Nasal swab for MRSA and MSSA, CHG wash, decolonization with intranasal antibiotic	Increase	CDC (2015)	Decrease <i>S. aureus</i> SSI from 5.3% to zero <i>P</i> value not reported
Morris	Prospective	Ortho	Ex: Package of interventions	SAP, hair clipping, alcohol-based skin prep	Increase	NHSN (2005)	Decrease

2015 New Zealand/High	Multiple hospitals Age not reported (9298)		Ev: Surveillance				Pre: 30/1887 (1.6%) Post: 34/2738 (1.2%) P value not provided
Murray 2014 US/High	Prospective Single hospital Pediatrics (283)	Cardiac	En: Interdisciplinary task force Ex: Antibiotic protocol Ev: Prescriber audit/surveillance and feedback	SAP (selection, dose, timing, discontinuation)	Increase	CDC (2008)	No change Pre: 6.21% Post: 5.8 % P = 0.88
Nayar 2015 US/High	Prospective No description of control Single hospital Pediatrics (1582)	Cardiac	En: Multidisciplinary team, improved communication, monthly review meetings Ed: Billing coder education Ex: Bundle, clinical protocol changes, wound alert report. Bedside review, data visualization tool	Preoperative bathing, CHG cloth bath, intranasal mupirocin, oral peridex (CHG oral rinse)	Not reported	NHSN (Not reported)	Decrease Pre: 21/769 (2.73%) Post: 9/813 (1.11%) P value not provided
Neumayer 2000 US/High	Before/After Single hospital Adults (1353)	Multiple	Ex: Protocols	Not closing skin or using retention based on risk factors	Not reported	CDC (Not reported)	No change in superficial SSI Pre: 23/634 (3.6%) Post: 12/719 (1.7%) P = 0.49
Ng, Wil 2015 Canada/High	Prospective TSA (no description of the control group) Single hospital Adults (9442)	OB/GYN	Ed: Health care provider and patient education on hair removal practices, no hair removal posters in waiting rooms and labor and delivery floor,	SAP, optimization of hair removal services, patient education on hair removal practices, safety surgical checklists, CHG skin prep	Not reported	CDC (1999)	Decrease From 8.2% to 4.1% P value not provided

			hair removal education in prenatal books Ex: Serially introduced multifaceted bundle, surgical safety checklist Ev: Post-discharge surveillance and feedback				
Ng, Wai 2015 UAE/High	Before/After Single hospital Age not reported	Multiple	En: Multidisciplinary, leadership taking responsibility Ed: Pre-op education about use of clippers and pre-op bathing, education for surgeons, orientation of new employees Ex: Bundles, electronic bundle compliance tool, prompt feedback, PDSA cycles	SAP, operating room traffic, normothermia, hair clippers, surgical dressing, wound dressing	Increase	Not reported	Decrease From 2.8% to 1.0% <i>P</i> value not provided
Peagues 2014 US/High	Before/After Multiple hospitals Mixed population	Unknown	CIPP model Ex: Standardized order sets and process mapping Ev: Increased electronic surveillance of surgical site infections	SAP	Unknown	Not reported	Decrease SSI ratio down 67% (to 0.327 from 0.827)
Perez-Blanco 2015 Spain/High	Before/After Single hospital Adults (342)	GI surgery	Ed: Presentation at department meeting Ex: Protocol, bundle	SAP, normothermia, glove change, glycemic control, patient hygiene, aseptic surgical wound care	Increase	Not reported	Decrease Pre: 60/218 (27.5%) Post: 21/124 (16.9%) <i>P</i> = 0.03
Prospero 2011	Prospective Single hospital	Unknown	En: Multidisciplinary teamwork	SAP	Increase	Not reported	Decrease 1 st yr: 2.81%, 6 th yr: 1.03% (<i>P</i> < 0.001)

Italy/High	Age not reported (28,621)		Ex: Standardized protocol, schematic table Ev: Audits with monthly feedback to surgeons				
Rao 2004 US/High	Prospective Single hospital Age not reported (2,364)	Cardiac	En: Leadership, teamwork Ex: Protocols Ev: Data feedback	Instruments, prospective surveillance of infection	Increase	Not reported	Decrease 2.1% -1.5% (P = 0.35)
Rao 2011 US/High	CBA Single hospital Age not reported (4,465)	Ortho	Ed: Patient education Ex: Screening and decolonization protocol	Preoperative screening and decolonization, SAP	Increase	Not reported	Decrease Pre: 2.7% Post: 1.2% P < 0.009
Rauk 2010 US/High	Before/After Single hospital Adults (800)	OB/GYN	En: Teamwork Ed: Training Ex: Protocol, bundle Ev: Data feedback	Preop skin bathing, skin preparation and instrument sterilization	Not reported	Not reported	Decrease Pre: 33/441 (7.5%) Post: 5/436 (1.2%) P = 0.001
Reames 2015 US/High	Prospective Multiple hospitals Adults (36,085)	GI surgery	En: Senior executive partnership, multidisciplinary Ed: Education materials provided to operating staff, briefing/debriefing sessions held, monthly coaching calls and semi-annual collaborative meetings Ex: Checklist	SAP (selection, timing & discontinuation), hair clipping, normothermia, glucose control	Not reported	Not reported	No change Pre: 5.9%, Post: 6.5% P = 0.3

Riley 2012 US/High	Observational Single hospital Adults (1844)	OB/GYN	En: Multidisciplinary teamwork Ed: Patient and staff education Ev: Surveillance, measurement of performance, data feedback	CHG preop bathing, skin chloraprep, SAP	Increase	CDC (2008)	Decrease 6.27% to 2.29% <i>P</i> = 0.003
Rovaldi 2015 US/High	Before/After Single hospital Age not reported	Ortho	En: Champions, multidisciplinary, eliciting suggestions from frontline staff Education Ex: Magnetic signs, pull-shades, caution tapes Ev: Timely reporting and feedback	Operating room traffic	Increase	Not reported	No change
Ryan 2014 US/High	Before/After Single hospital Pediatrics (267)	Ortho	En: Working group, bi-monthly meeting Ex: Protocol	Operating room traffic, SAP, hair clip, hand scrubbing, skin prep, wound irrigation with antibiotics, double gloving, vancomycin powder, antimicrobial sutures, postoperative wound care	Increase	SRS (2014)	Decrease Pre: 5.8% Post: 6/267 (2.2%) <i>P</i> = 0.0362 Control group not described.
Ryckman 2009 US/High	Before/After Multiple hospitals Pediatrics	Ortho	En: Multidisciplinary teamwork, champions Ex: Bundles Ev: Surveillance, accountability, data feedback	SAP, bundle includes skin preparation, temperature, hair removal, oxygen administration, and glucose management	Not reported	CDC (1992)	Decrease Pre: 1.5 per 100 procedure days Post: 0.54 per 100 procedure days <i>P</i> values not provided
Salim 2011 Israel/High	Prospective Single hospital Adults (1616)	OB/GYN	En: Multidisciplinary teamwork Ed: Staff education with refresher courses Ex: Protocol	Aseptic and scrub techniques + SAP	Not reported	CDC (1999)	Decrease Pre: 37/751 (4.9%) Post: 18/865 (2.1%)

			Ev: Surveillance, data feedback				<i>P</i> = 0.002
Sanchez-Hernandez 2016 Spain/High	Before/After Single hospital Adults (412)	Ortho	En: Multidisciplinary teams Ex: Clinical pathway, protocols, questionnaire, review meetings	SAP, oxygen therapy, nutrition	Not reported	Not reported	Decrease Pre: 14/216 (6.48%) Post: 4/196 (2.04%) <i>P</i> = 0.031
Schaffzin 2015 US/High	Before/After (no description of control) Multiple hospitals Pediatrics	Unknown	PDSA cycle: En: Network leadership team, network webinars, promotion of a culture of safety Ed: In-person annual training, webinars, discussion boards, Sharepoint for posting relevant materials Ex: Bundles Ev: Reports of process and outcome measures with senior leaders, daily huddles for process failure review	Pre-op bathing, skin antisepsis, SAP (timing, re-dosing and duration), no razor	Increase	CDC (2013)	Decrease Pre: 2.5% Post: 1.8% <i>P</i> value not provided
Schönmeyr 2014 India/Low	Before/after Mixed population (mainly pediatrics) (654)	Plastics	Ed: Standardized patient education, nursing education regarding postop care protocols, nurses delivered targeted individual and group education program on wound care protocols, discharge materials provided in local language with pictures Ex: Standardized postoperative care	Wound care, postoperative care was standardized	Not reported	Not reported	Decrease Pre: 8/220 (3.7%) Post: 1/252 (0.4%) <i>P</i> < 0.05

Schweizer 2015 US/High	Before/After Multiple hospitals Adults (42,534)	Multiple	Ex: Bundle	Screening for <i>S. aureus</i> and nasal decolonization, CHG bathing, targeted prophylaxis	Increase	CDC (2013)	Decrease <i>S. aureus</i> SSI: Pre: 101/28,218 Post: 29/14,316 RR 0.58 (CI, 0.37-0.92)
Sechriest 2013 US/High	Before/After Single hospital Adults (1726)	Ortho	En: Leadership, task force, input from experienced providers and hospital staff Ed: Standardized patient education material, mandatory staff education and training Ex: Hospital-wide clinical pathway, bundle, checklists, physician orders Ev: Ongoing evaluation of surgical practices	Skin prep, antibiotics, equipment sterilization	Not reported	Not reported	Decrease Pre: 24/1226 (1.96%) Post: 0/500 <i>P</i> = 0.003
Shea 2015 US/High	Before/After Single hospital Adults	Unknown	En: Project Zero, leadership, multidisciplinary, frontline staff/surgeon engagement and buy-in Ed: Educational programs for staff, educational displays and posters in staff lounges, departmental meetings and email Ex: Simplified protocol, case preference cards to improve equipment availability and decrease operating room traffic, pre-op	Operating room traffic, hand hygiene, operating room uniforms, skin prep, wound care, operating room cleaning, surgical instrument sterilization processes	Increase	Not reported	Decrease From 1.2% to 0.54% <i>P</i> value not provided

			clinic to identify higher risk patients and optimize them— including colonization Ev: Surgical feedback				
Singh 2012 India/Low	Time series analysis Single unit Adults (2838)	Cardiac	En: Multidisciplinary teamwork Ed: Staff education program (two training modules and online continuous education) Ex: Protocol Ev: Surveillance	Hand hygiene, isolation precautions, and wound care	Not reported	CDC (1988)	Decrease Pre: 46% Post: 3.27% <i>P</i> < 0.0001
Starčević 2015 Serbia/Middle	Prospective (no description of the control group) Single hospital Age not reported (3867)	Ortho	Ev: Surveillance	Surveillance	Not reported	CDC (1992)	Decrease 4.6% to 1.6% <i>P</i> value not provided
Starling 1997 Brazil/Middle	Prospective Multiple hospitals Population unknown	Unknown	En: Multidisciplinary teamwork, cooperative research Ed: Yearly training courses Ex: Policy Ev: Surveillance and data feedback	SAP policy, active surveillance cultures	Not reported	CDC (1992)	Decrease CS: 11.6% to 5.9% <i>P</i> < 0.05
Staszewicz 2014 Switzerland/High	Prospective Surveillance Mixed population	Unknown	Ev: Surveillance with yearly feedback to hospital IPC officials and surgeons to implement or reinforce preventive measures	Not reported	Not reported	CDC (1992)	No change over time
Suchitra 2009	Before/After 3 hospitals	Multiple	Ed: Staff education program	Surveillance, hand hygiene, universal	Not reported	CDC (1999)	Decrease Pre: 136/1125 (12.1%)

India/Low	Unknown mixed population (2244)		Ev: Surveillance, data feedback	precautions, skin disinfection, SAP policy			Post: 45/1119 (4%) $P < 0.001$
Takahashi 2010 Japan/High	Before/After Single hospital Mixed (3,254)	Unknown	En: Multidisciplinary teams Ex: Manuals, protocols Ev: Surveillance, data feedback	SAP	Increase	Not reported	Decrease GI: from 18.4% to 8.1% $P = 0.002$ <i>P. aeruginosa</i> isolates from 13% (68/538) to 7.3% (37/509) $P = 0.004$
Thompson 2011 US/High	Before/After Single hospital (6,986)	Multiple	En: Multidisciplinary, leadership, frontline staff engagement Ex: Bundle Ev: Data feedback, transparency and communication, score cards, staff survey	SAP, clippers for hair removal, normothermia, <i>S. aureus</i> decolonization, standardized perioperative skin cleansing, hand hygiene, improved operating room attire, airflow and coverings	Increase	CDC (2008)	Decrease Pre: 2.16% Post: 0.92% $P = 0.001$
Tillman 2013 US/High	Before/After Single hospital Age not reported (29,928)	Multiple	En: Multidisciplinary team Ex: Bundle, checklist Ev: Surveillance, data feedback	SAP, normothermia, hair removal	Increase	NSQIP (2009)	No change Pre: 3.13% (104/3319) Post: 2.96% (107/3616) $P = 0.72$
Toltzis 2014 US/High	Before/After Multiple (8) hospitals Pediatrics	Multiple	En: Administrators, transparency of teams without liability, leadership teams, teleconferences with other teams to share lessons learned Ed: Monthly conference call,	Prohibition of razor, alcohol CHG skin prep use, SAP timing & redosing	Increase	CDC (2008)	Decrease From 4.48% to 1.89% P value not provided

			biannual face-to-face meetings Ex: Model for improvement, bundle, SAP recommendation table Ev: Daily review of procedures				
Toor 2015 Pakistan/Low	Before/After Single hospital Adults (613)	Multiple	Ex: WHO Surgical Safety Checklist	Preoperative antibiotic use, sterile instruments	Increase	CDC (1999)	Decrease Pre: 99/303 (32.7%) Post: 47/310 (15.2%) <i>P</i> < 0.001
Trussel 2008 US/High	Before/After Adults (1482)	Cardiac	En: Multidisciplinary teams Ex: Patient care protocol/pathway	SAP policy, tight glucose control, hair removal with clippers	Increase	CDC (1999)	Decrease Pre: 3.5% Post: 1.5% <i>P</i> = 0.001
Usry 2002 US/High	Before/After Adults (1482)	Cardiac	En: Multidisciplinary teamwork Ex: Protocols Ev: Surveillance and feedback	Intranasal mupirocin ointment use	Increase	CDC (1992)	Decrease Pre: 68/2595 (2.62%) Post: 15/1205 (1.24%) <i>P</i> = 0.007
Van Der Slegt 2013 Netherlands/High	Prospective Single hospital Adults (720)	Cardiac	En: Multidisciplinary teamwork Ex: Bundles Ev: Surveillance, measurement of performance, data feedback	Hair removal, operating room discipline, SAP, normothermia	Increase	CDC (1992)	Decrease 51% lower in 2011 compared to 2009 <i>P</i> value not provided
Van Kasteren 2005 Netherlands/High	Prospective Multiple hospitals Mixed population (3813)	Multiple	Ex: Policy Ed: Educational sessions Ev: Audits and data feedback	SAP	No change	CDC (1999)	No change Pre: 5.4% (95% CI, 4.3– 6.5) Post: 4.6% (95% CI, 3.6– 5.4)

Vincent 2008 France/High	Surveillance Multiple hospitals Adults (37,074)	OB/GYN	En: Multidisciplinary teamwork, peer network Ev: Surveillance	Not reported	Not reported	CDC/FNCIC (1988/1999)	Decrease over time 2.5% to 1.3% $P < 0.0001$
Waits 2014 US/High	Retrospective Age not reported (4,085)	GI surgery	En: Multidisciplinary, peer teamwork Ex: Checklists and bundles	SAP, normothermia, normoglycemia, bowel prep, minimally invasive surgery, shorter operations	Increase	Not reported	Decrease SSI rates: 1 bundle: 17.5% (CI, 27.1-10.8) 6 bundles: 2.0% (CI, 7.9-0.5)
Walsh 2011 US/High	Before/After Age not reported (5262)	Cardiac	Ex: Comprehensive MRSA intervention program	MRA screening and decolonization, SAP	Increase	CDC/NHSN (Not reported)	Decrease Pre: 2.1% Post: 0.8% $P < 0.001$
Weinberg 2001 Colombia/Middle	Segmented TSA Multiple hospitals Adults (16,464)	OB/GYN	En: Leadership, teamwork/multidisciplinary Ed: Training Ex: CQI tools and principle Ev: Data feedback, accountability	SAP policy, hair removal, skin prep	Increase	CDC (1992)	Decrease Hosp A: $P < 0.001$ Hosp B: $P = 0.04$
Wick 2012 US/High	Before/After Single hospital Adults (512)	Colorectal	En: Leadership, champions, multidisciplinary teamwork, briefings Ex: Protocols Ev: Surveys/data feedback	Skin prep, normothermia, intraoperative sterile techniques	No change	Not reported	No change
Wick 2015 US/High	Before/After Single hospital Adults (640)	Colorectal	En: Leadership (chief financial officer, senior vice president for patient safety), multidisciplinary team for CUSP, frontline staff, dedicated team of engaged anesthesia	Mechanical bowel prep, preop bathing, CHG wash cloths, use of forced air warming devices in the preop area, skin chloraprep, preop smoking cessation	Not reported	Not reported	Decrease (SSI 18.8% vs 7.3%, $P < 0.05$) Control group not described

			<p>providers and single inpatient unit: Trust-Based Accountability Model, CUSP: staff safety assessment, learning from defects, optimized briefings and debriefings, TRIP, patient engagement strategies</p> <p>Ed: Pathway that engaged patients and their families through education and shared responsibility for recovery; all process measures were discussed with frontline staff and changed based on feedback.</p> <p>Ex: Resource allocations, operating room staffing standardization, bundles, processes integrated into EMR and checklists were developed where appropriate.</p> <p>Ev: Dashboards demonstrating length of stay, SSI, and patient satisfaction; transparent reporting of process and outcome measures to leaders and frontline staff, pathway bulletin board</p>				
Witter	Prospective	OB/GYN	En: CS SSI task force	Preoperative bathing, hair clipping, SAP (<30	Increase	NHSN	Decrease

2014 US/High	Single unit Adult females		Ed: Training in skin prep, SSI diagnosis Ex: PDSA cycle, best practice, incremental addition of interventions Ev: Direct observation, chart review, feedback to physicians	min preoperatively, redosing after 3 h), skin prep, surgical hand scrubbing, glucose control, normothermia, transverse wound incision, wound irrigation, closed wound suctioning, postoperative dressing		(Not reported)	2005 (1st yr): 48/618 (7.7%) 2012: 21/648 (3.24%) <i>P</i> value not provided
Wilson 2006 UK/High	Prospective Multiple hospitals Adults (15548)	Multiple	Ev: Surveillance, surveys	SAP, wound dressing, temperature	Not reported	CDC (1992)	Decrease OR, 0.69 CI, 0.57–0.83
Woodward 2012 US/High	Prospective Pediatrics (308)	Cardiac	En: Multidisciplinary teamwork Ex: Bundles/protocols Ev: Data feedback, accountability	SAP policy, skin preparation, preop baths, hair removal, glucose control	Increase	CDC (1999)	No change OR, 0.35 CI, 0.12–1.01 <i>P</i> = 0.059
Woster 1995 US/High	Before/After Single hospital Mixed population (316)	Multiple	En: Multidisciplinary teamwork Ev: Data feedback	SAP	Increase	CDC (1992)	No change Pre: 9/164 (5.5%) Post: 4/118 (3.4%) <i>P</i> = 0.407
Wu 2008 Taiwan/High	Prospective Single hospital Adults (72)	OB/GYN	En: Leadership, multidisciplinary teamwork, collaborative work Ex: Change package	SAP	Increase	Not reported	No change
Yang 2014 China/Middle	Prospective Single hospital Adults (1543)	Multiple	Ed: Reinforcement by educational sessions delivered by pharmacists every 3 months to include new physicians Ex: SAP guidelines and physician	SAP type, timing, redosing and duration	Increase	Not reported	No change <i>P</i> = 0.923

			computerized order entry system				
Yegge 2014 US/High	Before/After Age not reported	Multiple	En: Multidisciplinary team to develop the protocol Ex: Performance improvement investigation protocol, action plan, checklist, incentives scorecards Ev: Observation tool, chart review	SAP (dose, timing, redosing), hair removal, preoperative bathing	Increase	CDC (Not reported)	Decrease (no more details provided)

IPC, infection prevention control; SSI, surgical site infection; Ortho, orthopedic; Ed, educate; Ex, execute; Ev, evaluate; SAP, surgical antimicrobial prophylaxis; CDC, Centers for Disease Control; NNIS, National Nosocomial Infection Surveillance; NHSN, National HealthCare Safety Network (NHSN); US, United States; SRS, Scoliosis Research Society; NSQIP, National Surgical Quality Improvement Program; En, engage; CHG, chlorhexidine; GI, gastrointestinal (abdominal); ACERTO, Accelerating the Total Recovery; IVF, OR, odds ratio; CI, confidence interval; RCT, randomized controlled trial; WHO, World Health Organization; UK, United Kingdom; OB/GYN, obstetrics and gynecology; NICE, National Institute for Health and Care Excellence ; BMI, body mass index; HPA, Health Protection Agency of United Kingdom; SWI, sternal wound infection; MRSA, methicillin-resistant *Staphylococcus aureus*; CTSW, cardiothoracic surgery sternal wounds; TKA, total knee arthroplasty; SF, spinal fusion; SSC, Surgical Safety Checklist ; NPWT, Negative Pressure Wound Therapy ; PACU, post-anesthesia care unit; ICU, intensive care unit; SIR, standardized infection ratio; UAE, United Arab Emirates; MSSA, methicillin-sensitive *Staphylococcus aureus*; ERP, enhanced recovery program; SSIB, surgical site infection bundle; ACS, American College of Surgeons ; ECDC, European Centre for Disease Prevention and Control; PJI, periprosthetic joint infection; ERAS, enhanced recovery after surgery; TSA, time-series analysis; PDSA, Plan-Do-Study-Act; CIPP= Context-input-process-product model; CBA, controlled before-after; CS, cesarean section; FNCIC, French National Council of Infection Control; CQI, continuous quality improvement; CUSP, comprehensive unit-based safety program; TRIP, translating research into practice model; EMR, electronic medical record.