

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
1	Wilson C. Foreign bodies left in the abdomen after laparotomy. Trans Am Gynecol Soc. 1884;9:94-117.	Case series of foreign bodies left in the abdomen. Cases found through publication, interviews, and the author's own experience.	VC	Literature Review, Clinician Experience, and Case Report	n/a	n/a	n/a	n/a	Retained sponges
2	The Joint Commission. Preventing unintended retained foreign objects. Sentinel Event Alert. October 17, 2013;51. http://www.jointcommission.org/sea_issue_51/ . Accessed November 10, 2015.	The Joint Commission recommends that facilities develop effective processes and procedures for preventing unintended retained foreign objects. Their recommendations include a standardized and highly reliable counting system; development of policies and procedures; practices for counting, wound opening, and closing procedures; performance of intraoperative radiographs; use of effective communication to include briefings and debriefings; documentation of counts; and assistive technologies (ie, RF tags, RFID, radiopaque, bar coding). Also, the hospital should define a process for conducting RCA for sentinel events, such as URFO.	IVB	Consensus	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
3	Moffatt-Bruce SD, Cook CH, Steinberg SM, Stawicki SP. Risk factors for retained surgical items: a meta-analysis and proposed risk stratification system. J Surg Res. 2014;190(2):429-436.	7 elevated risk factors for RSI in pooled data in case-control studies: Estimated intraoperative blood loss >500mL, incorrect surgical count, more than one subprocedure, more than one surgical team*, operative time, surgical count not performed*, and unexpected intraoperative factors*. (*p=0.001) There was not a statistically significant RSI risk with the following factors: BMI, emergency procedure, changes in nursing staff, operating after hours, and presence of surgical trainee. Recommend use of risk stratification for prevention methods.	IIIA	Systematic Review with Meta-analysis	USA hospitals, patients with RSI	n/a	n/a	3 studies: Lincourt, Gawande, and Stawicki	Estimated intraoperative blood loss >500mL, incorrect surgical count, more than one subprocedure, more than one surgical team, operative time, surgical count not performed, unexpected intraoperative factors, BMI, emergency procedure, changes in nursing staff, operating after hours, and presence

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
4	Gawande AA, Studdert DM, Orav EJ, Brennan TA, Zinner MJ. Risk factors for retained instruments and sponges after surgery. N Engl J Med. 2003;348(3):229-235.	The risk of a retained sponge or instrument significantly increases in emergencies, with unplanned changes in procedure, and with higher BMI. Cases reviewed were reported from 1985-2001.	IIIA	Non-experimental	USA, Patients with malpractice claims or incident report for retained surgical sponge or instrument in Massachusetts	n/a	Cases matched to 4 random controls who underwent the same type of operation during the same 6-month period	54 patients with 61 RSI, 235 controls	Emergency procedure, unexpected change in procedure, >1 team, change in nursing staff during procedure, BMI, est. blood loss, counts of sponges and instruments performed, females

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
5	Lincourt AE, Harrell A, Cristiano J, Sechrist C, Kercher K, Heniford BT. Retained foreign bodies after surgery. J Surg Res. 2007;138(2):170-174.	RSI was associated with multiple major surgical procedures being performed at the same time and an incorrect instrument or sponge count. Cases reviewed were from 1996-2005.	IIIB	Non-experimental	USA, patients with ICD-9 code 998.4 (unintentional foreign object remaining in the body during surgery) and incident reports	n/a	Cases matched to at least 4 random controls who underwent the same type of operation during the same time period	30 cases, 131 control	Incorrect count recorded, total number of major procedures, multiple surgical teams, unexpected change in procedure, OR time, OR procedure performed after 5pm, and emergency procedure.
6	Stawicki SP, Moffatt-Bruce SD, Ahmed HM, et al. Retained surgical items: a problem yet to be solved. J Am Coll Surg. 2013;216(1):15-22.	RSI risk increased with longer duration of surgery, safety variances, and incorrect counts. Recommend zero tolerance approach for safety variances and enhancing reporting systems. Cases reviewed were from 2003-2009.	IIIB	Non-experimental	USA, 7 Teaching Hospitals	n/a	Cases matched to 2 controls who underwent the same procedure type within a 6-month period	59 cases, 118 controls	BMI, procedure factors, unexpected intraoperative events, safety omissions/variances, and trainee presence.

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
7	Chen Q, Rosen AK, Cevasco M, Shin M, Itani KM, Borzecki AM. Detecting patient safety indicators: how valid is "foreign body left during procedure" in the Veterans Health Administration? J Am Coll Surg. 2011;212(6):977-983.	RSI cases found by AHRQ PSI 5 measure and corresponding ICD-9-CM codes. PSI 5 had a positive predictive value of 45% for identifying RSI, and included both medical and surgical procedures. Sponges were the most commonly retained item.	IIIB	Non-experimental	28 Veterans Health Administration hospitals	n/a	n/a	93 cases flagged as PSI 5	Cases flagged as AHRQ's Patient Safety Indicator (PSI) 5, foreign body left during procedure
8	Cima RR, Kollengode A, Garnatz J, Storsveen A, Weisbrod C, Deschamps C. Incidence and characteristics of potential and actual retained foreign object events in surgical patients. J Am Coll Surg. 2008;207(1):80-87.	Cases reviewed were from 2003-2006. May have more RSI cases than expected at a facility that performs routine postoperative imaging for all operative procedures. 21/34 (62%) of RSIs had a correct count but were found on routine imaging. Adjunct technology is warranted to achieve reliable counts.	IIIB	Non-Experimental	Tertiary care institution	n/a	n/a	34 near miss, 34 retained foreign objects	Retained foreign objects identified on postoperative imaging and near misses
9	Wan W, Le T, Riskin L, Macario A. Improving safety in the operating room: a systematic literature review of retained surgical sponges. Curr Opin Anaesthesiol. 2009;22(2):207-214.	Systematic review of case reports. Gossypibomas most common in the abdomen, pelvis, and thorax. Complications included adhesion, abscess, and fistula. Average discovery time 6.9 years. Most cases occurred with a correct count.	VA	Literature Review	n/a	n/a	n/a	254 Gossypiboma	Retained surgical sponges
10	Zantvoord Y, van der Weiden RM, van Hooff MH. Transmural migration of retained surgical sponges: a systematic review. Obstet Gynecol Surv. 2008;63(7):465-471.	Although retained surgical sponges may migrate transmurally and be expelled through the rectum spontaneously, 93% of cases required an intervention for removal.	VB	Case Review	n/a	n/a	n/a	64 cases of transmural migration	Transmural migration of retained surgical sponges

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
11	Cohen SB, Bartz PJ, Earing MG, Sheil A, Nicolosi A, Woods RK. Myocardial infarction due to a retained epicardial pacing wire. <i>Ann Thorac Surg.</i> 2012;94(5):1724-1726.	20-year old man experienced cardiac arrest due to myocardial infarction from retained epicardial pacing wire after surgery as an infant to repair ASD defect. Pacing wires should be managed and accounted for intraoperatively.	VB	Case Report	USA	n/a	n/a	1 case	n/a
12	Suh DH, Yoon JR, Kang KB, Han SB, Kim HJ, Lee SJ. A gossypiboma-induced pathological fracture of the proximal femur. <i>Clin Radiol.</i> 2009;64(11):1132-1135.	60-year old man experienced a femur fracture from a retained surgical sponge on the bone after previous surgery for ORIF of the femur.	VC	Case Report	Korea	n/a	n/a	n/a	n/a
13	Tateishi M, Tomizawa Y. Intravascular foreign bodies: danger of unretrieved fragmented medical devices. <i>J Artif Organs.</i> 2009;12(2):80-89.	Review of intravascular unretrieved device fragments. Many preventable device-fracture complications are related to inappropriate use of intravascular devices, including use of devices for off-label purposes and reuse of single-use devices.	VB	Literature Review	Japan	n/a	n/a	n/a	n/a
14	Al-Moghairi AM, Al-Amri HS. Management of retained intervention guide-wire: a literature review. <i>Curr Cardiol Rev.</i> 2013;9(3):260-266.	Intervention guide-wire fracture and entrapment may lead to RSI during vascular procedures.	VA	Literature Review	n/a	n/a	n/a	n/a	n/a
15	Johnson C, Alomari AI, Chaudry G. Detachment of introducer sheath radiopaque marker during retrieval of G2 filter. <i>Cardiovasc Intervent Radiol.</i> 2011;34(2):431-434.	16-year old male with retained sheath radiopaque marker in chest found on incidental x-ray for other clinical symptoms. Recommend fluoroscopy during removal and confirmation of the marker on the sheath upon its removal.	VB	Case Report	USA	n/a	n/a	1 case	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
16	Williams TL, Bowdle TA, Winters BD, Pavkovic SD, Szekendi MK. Guidewires unintentionally retained during central venous catheterization. J Assoc Vasc Access. 2014;19(1):29-34.	Clinicians should be educated on prevention of guidewire retention. Recommended confirming removal of the guidewire and inspecting its integrity, withdrawing the guidewire together as a unit with the needle, and to replace bent wires immediately. Also, devices should be designed so that the clinician is alerted that the end of the guidewire is near. Reviewed cases from 2008-2012.	VA	Organizational Experience	University HealthSystem Consortium Safety Intelligence Patient Safety Organization database (40 organizations)	n/a	n/a	42 retained guidewire events	n/a
17	Bydon A, Xu R, Conte JV, et al. Surgical mystery: where is the missing pituitary rongeur tip? Spine. 2010;35(17):E867-E872.	61-year old woman with a broken rongeur tip during a spine procedure retained in her heart. The rongeur tip was missing when it was withdrawn from the surgical site. An intraoperative C-arm fluoroscopic radiograph showed that the tip had migrated through a vascular injury. After consulting with the vascular team, the surgical team made the decision to complete the spine procedure given the patient's hemodynamic stability. After surgery, the patient underwent an abdominal CT scan, chest radiograph, transthoracic echocardiogram, cardiac catheterization, and thoracic CT scan over the course of two days before the rongeur tip was localized to the left ventricle. The patient then underwent a sternotomy for removal of the rongeur tip and closure of a previously undiagnosed patent foramen ovale. Afterwards, the patient recovered in the cardiac intensive care unit in stable condition. Emphasized the need for rapid diagnosis and collaboration to treat a potentially devastating complication from a retained device fragment.	VB	Case Report	USA	n/a	n/a	1 case	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
18	WHO Guidelines for Safe Surgery 2009. Geneva, Switzerland: WHO Press; 2009.	International guidelines for safe surgery, including prevention of inadvertent retention of instruments and sponges in surgical wounds (objective 7).	IVB	Clinical Practice Guideline	International	n/a	n/a	n/a	n/a
19	Mehtsun WT, Ibrahim AM, Diener-West M, Pronovost PJ, Makary MA. Surgical never events in the United States. Surgery. 2013;153(4):465-472.	Estimated the cost of malpractice payments for a surgical retained foreign body to range from \$51 to \$3,988,829, with a mean of \$86,247 and median of \$33,953.	IIIB	Non-experimental	USA, National Practitioner Data Bank	n/a	n/a	9,744 paid malpractice claims	Payment amounts, patient outcomes, and provider characteristics
20	Steelman VM, Graling PR, Perkhounkova Y. Priority patient safety issues identified by perioperative nurses. AORN J. 2013;97(4):402-418.	61% of perioperative nurses identified the prevention of RSIs as one of the top priorities for perioperative patient safety.	IIIA	Survey	AORN members	n/a	n/a	37,022 members, 3,137 usable completed surveys	Perioperative patient safety issues
21	Kohn LT, Corrigan JD, Molla S. To Err Is Human: Building a Safer Health System. Washington, DC: National Academy Press; 2000.	Avoiding injuries from care that is intended to help patients was identified by the Institute of Medicine as one of six goals to achieve a better health care system.	n/a	Report	n/a	n/a	n/a	n/a	n/a
22	West N, Eng T, Kirk A. Update on State Government Tracking of Health Care-Acquired Conditions and a Four-State In-Depth Review. Baltimore, MD: Center for Medicare and Medicaid Innovation, Centers for Medicare & Medicaid Services; 2012. https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/Hospital-AcqCond/Downloads/Phase-3-State-Tracking-Report.pdf . Accessed November 10, 2015.	Many states require public reporting when RSI events occur.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
23	FY 2013, FY 2014, and FY 2015 Final HAC List. Centers for Medicare & Medicaid Services. https://www.cms.gov/medicare/medicare-fee-for-service-payment/hospitalacqcond/downloads/fy_2013_final_hacscodelist.pdf . Accessed November 10, 2015.	CMS lists retained surgical items as a hospital-acquired condition, and facilities will not receive reimbursement for additional care provided as the result of a RSI.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
24	42 CFR Subchapter C—Medical Assistance Pro- grams. Part 430. Subpart C—Grants; Reviews and Audits; Withholding for Failure To Comply; Deferral and Disal- lowance of Claims; Reduction of Federal Medicaid Pay- ments. Electronic Code of Federal Regulations. http:// www.ecfr.gov/cgi-bin/text-idx?SID=86ae42db45723f0073ecc0d7c2218484&node=sp42.4.430.c&rgn=div6 . Accessed November 10, 2015.	CMS lists retained surgical items as a hospital-acquired condition, and facilities will not receive reimbursement for additional care provided as the result of a RSI.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
25	Ricciardi R, Baxter NN, Read TE, Marcello PW, Schoetz DJ, Roberts PL. Surgeon involvement in the care of patients deemed to have “preventable” conditions. <i>J Am Coll Surg</i> . 2009;209(6):707-711.	Reviewed charts for preventable events, including retained foreign bodies. Surgeons were involved in the care of 96% of patients with retained foreign bodies. Nonpayment for “preventable” conditions may lead hospitals and surgeons to avoid complex procedures, refuse care to high-risk patients, or both.	IIIB	Non-experimental	2004 California and New York discharge data	n/a	n/a	6,618,637 patient charts 286,509 had "preventable events"	"Preventable" conditions per CMS

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
26	Camp M, Chang DC, Zhang Y, Chrouser K, Colombani PM, Abdullah F. Risk factors and outcomes for foreign body left during a procedure: analysis of 413 incidents after 1,946,831 operations in children. Arch Surg. 2010;145(11):1085-1090.	Among pediatric surgical admissions, a foreign body left during a procedure was observed to occur with highest likelihood during gynecologic operations. The occurrence of this adverse event was associated with longer length of stay and greater total hospital charges, but not with increased mortality.	IIIA	Case-Control Study	Nationwide Inpatient Sample and Kids' Inpatient Database: hospitalized pediatric surgical patients in the United States (aged 0-18 years) from 1988 to 2005	n/a	n/a	413 cases patients with foreign bodies left during a procedure (PDI 3) and 1227 controls	Relationship between PDI 3 and procedure category, in-hospital mortality, length of stay, and total hospital charges
27	Shah RK, Lander L. Retained foreign bodies during surgery in pediatric patients: a national perspective. J Pediatr Surg. 2009;44(4):738-742.	The rate of a retained foreign body is 0.0031% or approximately 1 in 32,672 pediatric cases and is associated with an increased charge of \$42,077 for this complication.	IIIA	Non-experimental	Kids' Inpatient Database 2003, ICD-9 code 998.4 and E code 871.0	n/a	n/a	103 reports of retained foreign bodies after surgery	Admission-related information, patient socioeconomic information, diagnosis codes, procedure codes, and discharge information
28	Murphy EK. "Captain of the ship" doctrine continues to take on water. AORN J. 2001;74(4):525-528.	The "captain of the ship" doctrine is no longer assumed to be true, and members of the entire surgical team as well as the health care facility can be held liable in RSI litigation.	VC	Expert Opinion	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
29	Brown J, Feather D. Surgical equipment and materials left in patients. Br J Perioper Nurs. 2005;15(6):259-262.	In a legal case, three circulating nurses were documented as participating in the surgery but it was not clear who verified the final count. They recommended that the name of each person performing the count be clearly documented.	VB	Case Report	UK	n/a	n/a	1	n/a
30	Retained surgical retractor. November 22, 2013. Texas Medical Liability Trust. https://www.tmlt.org/blog/Closed-Claim-Studies/General-surgery/Retained-surgical-retractor.html . Accessed November 10, 2015.	Any member of the surgical team as well as the health care facility can be held liable in RSI litigation.	VC	Case Report	USA	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
31	Judson TJ, Howell MD, Guglielmi C, Canacari E, Sands K. Miscount incidents: a novel approach to exploring risk factors for unintentionally retained surgical items. Jt Comm J Qual Patient Saf. 2013;39(10):468-474.	The length of the case and the number of providers involved in the case were independent risk factors for miscount incidents. Miscounts triggered use of the Incorrect Count Safety Checklist, which can be used to determine whether a count completed at the procedure's conclusion is consistent across disciplines.	IIIA	Non-experimental	USA, large academic medical center	n/a	n/a	23,955 operations	Surgical Service, Urgency, Age of Patient, Incision Start Time, Incision Close Time, Case Duration, Procedure Type, # of people in room, Relief of Circulating Nurse or Scrub Nurse, Time of Incorrect Count Checklist Activation

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
32	Moffatt-Bruce SD, Ellison EC, Anderson HL 3rd, et al; OPUS 12 Foundation, Inc. Multi-Center Trials Group. Intravascular retained surgical items: a multicenter study of risk factors. J Surg Res. 2012;178(1):519-523.	Unexpected procedural factors and equipment failure are significantly associated with intravascular RSI (ivRSI). The reviewers were concerned that over half of the ivRSIs were missed on confirmatory imaging after the procedure.	IIIC	Non-experimental	USA, Multicenter review of patients with intravascular RSI	n/a	Cases matched to a control who underwent the same procedure type within a 6-month period	13 cases, 14 controls	Unexpected procedural factors, equipment failure, urgent procedures, bleeding >500mL, evening procedures, trainee involvement
33	Egorova NN, Moskowitz A, Gelijns A, et al. Managing the prevention of retained surgical instruments: what is the value of counting? Ann Surg. 2008;247(1):13-18.	Retained items occurred more frequently in discrepant cases (one in 70) compared to all cases (one in 7,000). Sensitivity of counting was 77.2% and the specificity was 99.2%, but the positive predictive value was only 1.6%.	IIIA	Non-experimental	USA, Medical Event Reporting System-Total HealthSystem (MERS-TH), administrative hospital, and the New York State Cardiac Surgery Report databases (2000–2004)	n/a	n/a	153,263 operations	Count discrepancies

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
34	Greenberg CC, Regenbogen SE, Lipsitz SR, Diaz-Flores R, Gawande AA. The frequency and significance of discrepancies in the surgical count. <i>Ann Surg.</i> 2008;248(2):337-341.	Counting activities involving a personnel change of either the RN circulator or scrub person resulted in a threefold higher risk of count discrepancy than in procedures with no personnel changes. They categorized discrepancies as being a result of miscounts (eg, incorrect baseline count, overcount, undercount), documentation errors (eg, addition), or misplaced items (eg, retained). The most common discrepancy was from a misplaced, or retained, item, which occurred in 59% of cases, whereas discrepancies from human error (ie, miscount [3%], documentation [38%]) accounted for 41% of discrepancies. In their study, count discrepancies occurred in one of eight cases, or one per 14 hours of operating time, and took an average of 13 minutes to resolve.	IIIA	Prospective non-experimental	USA, large academic medical center	n/a	n/a	148 elective general surgery operations	Count discrepancies
35	Williams TL, Tung DK, Steelman VM, Chang PK, Szekendi MK. Retained surgical sponges: findings from incident reports and a cost-benefit analysis of radiofrequency technology. <i>J Am Coll Surg.</i> 2014;219(3):354-364.	Five organizations that implemented RF technology between 2008 and 2012 collectively demonstrated a 93% reduction in the rate of reported retained surgical sponges. By comparison, there was a 77% reduction in the rate of retained sponges at 5 organizations that do not use RF technology. The UHC cost-benefit analysis showed that the savings in x-rays and time spent in the operating room and in the medical and legal costs that were avoided outweighed the expenses involved in using RF technology.	IIIB	Non-experimental	University Health System Consortium (UHC) Safety Intelligence database	n/a	n/a	428 RSIs, 9,467 count issues	Incorrect counts, RSI, cost-benefit analysis
36	Rupp CC, Kagarise MJ, Nelson SM, et al. Effectiveness of a radiofrequency detection system as an adjunct to manual counting protocols for tracking surgical sponges: a prospective trial of 2,285 patients. <i>J Am Coll Surg.</i> 2012;215(4):524-533.	Use of a radiofrequency detection system assisted in the resolution of a near-miss event and the resolution of 35 surgical sponge miscounts.	IIIB	Non-experimental	USA, UNC Hospitals	n/a	n/a	2285	Miscounts

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
37	Regenbogen SE, Greenberg CC, Resch SC, et al. Prevention of retained surgical sponges: a decision-analytic model predicting relative cost-effectiveness. <i>Surgery</i> . 2009;145(5):527-535.	Predicted the cost-effectiveness of several RSI prevention strategies compared with standard counting procedures. They estimated that standard manual counting prevents 82% of retained sponges, and they found that barcoding may prevent 97.5% of retained sponges.	IIIB	Non-experimental	USA	n/a	n/a	n/a	RSS incidence and cost-effectiveness ratios
38	Steelman VM. Sensitivity of detection of radiofrequency surgical sponges: a prospective, cross-over study. <i>Am J Surg</i> . 2011;201(2):233-237.	The sensitivity and specificity of detection of the RF sponges through the torsos of subjects of varying body habitus were 100%.	IIA	Quasi-experimental, Prospective, cross-over	USA, patients and visitors to a large academic medical center and affiliated VA medical center	RF sponges	Plain sponges	210 subjects (101 morbidly obese), 840 wand readings	Detection of RF sponges by wand
39	Steelman VM, Alasagheirin MH. Assessment of radiofrequency device sensitivity for the detection of retained surgical sponges in patients with morbid obesity. <i>Arch Surg</i> . 2012;147(10):955-960.	Overall, the sensitivity of the RF mat was 98.1%, and the specificity of the RF mat was 100.0%. In the subset of 117 participants in whom the RF wand was also used, the sensitivity and specificity of the wand were each 100.0%. The RF wand is more sensitive than the RF mat in individuals with morbid obesity.	IIA	Quasi-experimental, Prospective, cross-over	USA, patients and visitors to a large academic medical center	RF sponges	Plain sponges	203 subjects (129 morbidly obese), 812 mat readings, 468 wand readings	Detection of RF sponges by wand and mat

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
40	Thiels CA, Lal TM, Nienow JM, et al. Surgical never events and contributing human factors. <i>Surgery</i> . 2015;158(2):515-521.	Applied Reason's model to never events, including RSI, and identified four categories of human error: unsafe actions, preconditions for unsafe actions, oversight/supervisory factors, and organizational influences. During a five-year period, they captured reported incidents and near misses of never events, including RSI. Human behaviors in the incident analysis were coded in subcategories of the four main categories with nano-codes. For retained foreign objects, the majority of coded behaviors (n = 221) were in the categories of unsafe actions (n = 102) and preconditions for actions (n = 94). The researchers recommended using the Human Factors Analysis and Classification System to assist in linking human factors by error type to provide targets for intervention and mitigation.	IIIB	Non-experimental	USA, tertiary care hospital	n/a	n/a	69 events, 19 retained foreign objects	Human behaviors
41	Cima RR, Kollengode A, Storsveen AS, et al. A multidisciplinary team approach to retained foreign objects. <i>Jt Comm J Qual Patient Saf</i> . 2009;35(3):123-132.	Implemented a multidisciplinary team approach and educational campaign to reduce the incidence of RSIs. As a part of the program, they identified cultural barriers, communication problems, and lack of situational awareness as barriers to implementation, and they refocused their initiative to improve team communication.	VB	Organizational experience: Quality improvement	USA, Mayo Clinic Rochester	n/a	n/a	n/a	n/a
42	Stawicki SP, Cook CH, Anderson HL 3rd, et al. Natural history of retained surgical items supports the need for team training, early recognition, and prompt retrieval. <i>Am J Surg</i> . 2014;208(1):65-72.	Post hoc analysis of a multicenter retrospective RSI study. 90% of RSI events were associated with either a team or systems error; they recommended team training as an intervention to prevent these types of errors.	VA	Literature Review	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
43	Card R, Sawyer M, Degnan B, et al. Perioperative Protocol. Bloomington, MN: Institute for Clinical Systems Improvement; March 2014.	Eliminating unintentionally retained foreign objects. Key rules to prevent/address specific actions that pose the highest level of consequence and risk to safety of patients or staff should be established, followed, and supported by leadership. Baseline counts should be consistently performed before the patient arrives in the operating/procedure room; unreconciled counts require imaging verification and wound closure stops until count reconciliation is achieved; a preformatted whiteboard in the location that the count is performed to document counts as the primary record of the count; using a count worksheet only as a memory aid when the whiteboard is not easily accessible. Distraction and interruptions should be kept to a minimum during the count, and if the process is interrupted the category or items being counted needs to be recounted. Guidance is provided for baseline counts, resolving count discrepancies, packed wounds at the end of the procedure and upon patient return for closure, "hard stop" count reconciliation, postoperative imaging, and wound closure counts.	IVA	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
44	Statement on the prevention of retained foreign bodies after surgery. October 1, 2005. American College of Surgeons. https://www.facs.org/about-acs/statements/51-foreign-bodies . Accessed November 10, 2015.	Consistent application of reliable and standardized processes. A methodical wound exploration should be performed before closure of the surgical site. Radiopaque items should be used in the surgical wound. The OR environment should be optimized for focused performance of operative tasks. X-ray or other technology may be used to ensure there is no unintended item in the operative field. RSI measures may need to be suspended in life-threatening situations. Documentation should include results of counts, notification of surgical team members, instruments or items intentionally left as packing, and actions taken if count discrepancy occurs. Facilities must provide necessary equipment and supplies to support safety measures.	IVB	Position Statement	n/a	n/a	n/a	n/a	n/a
45	Martindell D. Update on the prevention of retained surgical items. Penn Patient Saf Advis. 2012;9(3):106-110.	RSI data and guidance from the Pennsylvania Patient Safety Authority.	IVB	Consensus	n/a	n/a	n/a	n/a	n/a
46	ECRI. Unintentionally retained surgical items. Operating Room Risk Management. 2012;2(Surgery):1.	Guidance from ECRI.	VC	Expert Opinion	n/a	n/a	n/a	n/a	n/a
47	Hempel S, Maggard-Gibbons M, Nguyen DK, et al. Wrong-site surgery, retained surgical items, and surgical fires: a systematic review of surgical never events. JAMA Surg. 2015;150(8):796-805.	RSI occurs in 1:10,000 surgeries.	IIIB	Systematic Review	n/a	n/a	n/a	21	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
48	Committee opinion no. 464: patient safety in the surgical environment. <i>Obstet Gynecol.</i> 2010;116(3):786-790.	Sponges, needles, and sharp instruments should be counted before and after surgery and vaginal delivery. Radiopaque sponges and soft goods should be used in sterile and delivery fields. If a count at the end of a procedure is incorrect or compromised, an abdominal or vaginal exploration must be done. If this does not reconcile the count, radiographic imaging needs to be obtained. Care should be taken to create checklists, systems, and routines to reduce the likelihood of retained foreign objects, and communication among surgical team members is crucial throughout the surgical process.	IVB	Position Statement	n/a	n/a	n/a	n/a	n/a
49	Reason J. Safety in the operating theatre—Part 2: human error and organisational failure. <i>Qual Saf Health Care.</i> 2005;14(1):56-60.	Errors involve some kind of deviation from routine practice. Dealing with individual errors rather than fixing a broken system will not stop unsafe acts from occurring.	VB	Literature Review	n/a	n/a	n/a	n/a	n/a
50	Riley R, Manias E, Polglase A. Governing the surgical count through communication interactions: implications for patient safety. <i>Qual Saf Health Care.</i> 2006;15(5):369-374.	Increasing professional accountability may improve patient safety by minimizing the effects of normalization and complacency that may occur during the repetitive task of the surgical count.	IIIB	Qualitative	Australia, metropolitan area, 3 OR departments	n/a	n/a	230h participant observation, 11 individual interviews, 4 group interviews	n/a
51	Sentinel Event Data: Root Causes by Event Type, 2004-2014. The Joint Commission. http://www.joint-commission.org/assets/1/18/Root_Causes_by_Event_Type_2004-2014.pdf . Accessed November 10, 2015.	Unintended retention of foreign object events from 2004 to 2014. The top root causes of events reviewed were elements of teamwork, including leadership, human factors, and communication.	n/a	n/a	n/a	n/a	n/a	986	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
52	Gurses AP, Kim G, Martinez EA, et al. Identifying and categorising patient safety hazards in cardiovascular operating rooms using an interdisciplinary approach: a multisite study. <i>BMJ Qual Saf.</i> 2012;21(10):810-818.	Efforts should focus on creating a stronger culture of safety in the cardiovascular operating room, including improving communication and teamwork.	IIIB	Qualitative	USA, 5 hospitals	n/a	n/a	20 cardiac procedures observed	Hazards (anything that has the potential to cause a preventable adverse patient safety event)
53	Gurses AP, Martinez EA, Bauer L, et al. Using human factors engineering to improve patient safety in the cardiovascular operating room. <i>Work.</i> 2012;41(Suppl1):1801-1804.	To improve patient safety in the CVOR, efforts should focus on creating a culture of safety, including improving communication and teamwork.	IIIB	Qualitative	USA, 5 hospitals	n/a	n/a	22 cardiac procedures observed	Hazards (anything that has the potential to cause a preventable adverse patient safety event)
54	Standards of perioperative nursing. In: <i>Guidelines for Perioperative Practice.</i> Denver, CO: AORN, Inc; 2015:693-708.	AORN perioperative nursing standards.	IVB	Guidelines	n/a	n/a	n/a	n/a	n/a
55	Loftus T, Dahl D, OHare B, et al. Implementing a standardized safe surgery program reduces serious reportable events. <i>J Am Coll Surg.</i> 2015;220(1):12-17.e3.	Implemented a standardized safe surgery program, including a standardized 22-rule count protocol, with the goal of reducing serious reportable event rates (ie, RSIs; wrong site, wrong patient, wrong procedure surgeries) during a four-year period. Although the researchers did not observe a statistically significant reduction in RSIs alone, there was a marked reduction in RSI rates, and the overall serious reportable event rate was significantly reduced by 52%.	IIIA	Retrospective Cohort	USA, 22 hospitals and 8 ambulatory surgery centers	n/a	n/a	683, 193 cases (OR and L&D)	Serious Reportable Events, compliance with program

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
56	Yang YT, Henry L, Dellinger M, Yonish K, Emerson B, Seifert PC. The circulating nurse's role in error recovery in the cardiovascular OR. AORN J. 2012;95(6):755-762.	Of 200 errors, 8% were attributed to counting errors. Had the RN circulator not caught these counting errors, they might not have been resolved and could have resulted in RSIs.	VB	Organizational Experience: Quality Improvement	USA, Inova Heart and Vascular Institute	n/a	n/a	18 cardiac procedures observed	Surgical errors
57	Recommended Standard of Practice for Counts. 2006. Association of Surgical Technologists. http://www.ast.org/uploadedFiles/Main_Site/Content/About_Us/Standard%20Counts.pdf . Accessed November 10, 2015.	AST count standards.	IVC	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a
58	Camos V. Coordination process in counting. Int J Psychol. 2003;38(1):24-36.	Counting targets is more difficult with distractors. Increasing counting difficulty reduced speed and accuracy. Researchers found a facilitation effect; motor activity (pointing) facilitated verbal counting. This contradicts cognitive models that 2 tasks would take more time and increase errors.	IIIB	Non-experimental	France, children and adults (university students)	n/a	n/a	26 first graders, 26 adults	Error rates, pointing times, saying times per works, mean counting time per dot
59	Camos V. Counting strategies from 5 years to adulthood: adaptation to structural features. Eur J Psychol Educ. 2003;18(3):251-265.	Counting strategies include counting by 1s, by n's, addition, and multiplication. Adults do not always count by 1s, use subitizing for subgroups. More strategies are used in adults than children. Arrangement and size effect performance. Larger sets, high density, and random assignment increase response time, error, and use of manual pointing. Errors reduce with ages 5-adult (67 to 10%). Counting by 1s used more than n's when the task became more difficult.	IIIA	Non-experimental	France, children and adults (university students)	n/a	n/a	153 children, 32 adults	Counting strategies, frequency of strategy use, efficiency of strategy

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
60	Clark GJ. Strategies for preventing distractions and interruptions in the OR. AORN J. 2013;97(6):702-707.	Implemented a "Pause for the Counts" campaign to minimize interruptions during surgical counts. As part of the multidisciplinary initiative, the RN circulator notified the team when it was time to count and asked whether any supplies would be needed on the sterile field. This communication to the team was intended to reduce interruptions for supplies during the count.	VB	Organizational experience: Quality improvement	USA, VA medical center	n/a	n/a	n/a	n/a
61	AORN position statement on managing distractions and noise during perioperative patient care. AORN J. 2014;99(1):22-26.	AORN position statement on distraction and noise.	IVB	Position Statement	n/a	n/a	n/a	n/a	n/a
62	Iwai T, Goto T, Matsui Y, Tohna I. Endoscopic removal of throat-packing gauze swallowed during general anesthesia. J Craniofac Surg. 2012;23(5):1547-1549.	Case of swallowed throat pack after maxillofacial surgery. Created a checklist for insertion and removal of the throat pack to prevent retention. At their facility, they also tied a suture to the throat pack and taped it to the patient's cheek, and the surgeon was responsible for removing the pack at the end of the procedure. Also discussed other methods of managing throat packs that they found in their literature review.	VC	Case Report	Japan	n/a	n/a	1	n/a
63	Colbert S, Jackson M, Turner M, Brennan PA. Reducing the risk of retained throat packs after surgery. Br J Oral Maxillofac Surg. 2012;50(7):680-681.	Suggested that the anesthesia professional wear a red allergy band marked "throat pack" as a reminder to remove the throat pack. The authors alternatively suggested either placing a sticker on the patient's forehead or writing on the board that the throat pack is in place, although they discussed that these alternatives could be more prone to removal than the wrist band.	VC	Clinician Experience	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
64	Jennings A, Bhatt V. Throat packs: in your face? <i>Anaesthesia</i> . 2010;65(3):312-313.	Affixing a "throat pack in situ" label on the patient's forehead was not feasible. In their experience, the head and neck surgeons placed the throat pack after draping the patient, and the forehead was not visible. As an alternative solution, the label was placed on the surgical assistant's hat and was a visible reminder to the surgeon and anesthesia professional throughout the case. A limitation of this expert opinion report is that the risk of the sticker becoming detached from the assistant's hat and falling into the sterile field was not addressed.	VC	Clinician Experience	n/a	n/a	n/a	n/a	n/a
65	Smith M, Turnbull D, Andrzejowski J. Throat packs in neuroanaesthesia. <i>Anaesthesia</i> . 2012;67(7):804-805.	Although some clinicians did not feel that throat packs were indicated or that the risks outweighed the benefits of placing the throat pack (n = 69), the remaining respondents reported the following practices for pack retention: following formal protocols, either leaving a portion of the pack outside the mouth or attaching it to the endotracheal tube; using pre-printed "throat pack in situ" labels; counting the throat pack with the sponge count; and documenting removal by checking a box on the anesthesia record.	IIIB	Survey	Members of the Neuroanaesthesia Society of Great Britain and Ireland	n/a	n/a	208, 141 responses (68%)	n/a
66	Lyons VE, Popejoy LL. Meta-analysis of surgical safety checklist effects on teamwork, communication, morbidity, mortality, and safety. <i>West J Nurs Res</i> . 2014;36(2):245-261.	Examined the effectiveness of implementing a safe surgery checklist on the outcomes of teamwork, communication, morbidity, mortality, and compliance with safety measures. The authors found that use of the checklist significantly improved all outcomes, although they noted that the generalizability of this meta-analysis is limited and that further research is needed.	IIA	Systematic Review with Meta-Analysis	n/a	n/a	n/a	19	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
67	Haynes AB, Weiser TG, Berry WR, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med. 2009;360(5):491-499.	Landmark study. Found that implementation of a checklist significantly reduced morbidity and mortality in patients undergoing non-cardiac surgery. Completion of needle, sponge, and instrument counts were part of the checklist. Implementation of the checklist increased compliance with sponge count completion.	IIA	Quasi-experimental	Multicenter, International, 8 hospitals	Surgical Safety Checklist	Pre-checklist implementation	3733 patients (pre), 3955 patients (post implementation)	Morbidity, Mortality
68	Collins SJ, Newhouse R, Porter J, Talsma A. Effectiveness of the surgical safety checklist in correcting errors: a literature review applying Reason's Swiss Cheese Model. AORN J. 2014;100(1):65-79.	Examined the impact of culture on checklist implementation by applying Reason's Swiss Cheese Model to the use of checklists. Successful use of a checklist for prevention of medical errors included involvement of key perioperative stakeholders, an understanding of error occurrence, recognition of system and individual dynamics, and creation of a just culture in which there is a shared vision of patient safety.	VB	Literature Review	n/a	n/a	n/a	n/a	n/a
69	McDowell DS, McComb SA. Safety checklist briefings: a systematic review of the literature. AORN J. 2014;99(1):125-137.	Review of surgical checklist use in the literature. Found themes of increased communication and enhanced patient safety from checklist use.	VB	Literature Review	n/a	n/a	n/a	23 studies	n/a
70	Borchard A, Schwappach DL, Barbir A, Bezzola P. A systematic review of the effectiveness, compliance, and critical factors for implementation of safety checklists in surgery. Ann Surg. 2012;256(6):925-933.	Found surgical checklists to be effective in reducing morbidity and mortality and stated that further research is needed to determine the influence of the organization's culture on checklist implementation.	IIIA	Systematic Review	n/a	n/a	n/a	22 articles	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
71	Wahr JA, Prager RL, Abernathy JH 3rd, et al; American Heart Association Council on Cardiovascular Surgery and Anesthesia Council on Cardiovascular and Stroke Nursing and Council on Quality of Care and Outcomes Research. Patient safety in the cardiac operating room: human factors and teamwork: a scientific statement from the American Heart Association. Circulation. 2013;128(10):1139-1169.	Recommend that checklists be used for every cardiac case. Recommend that all cardiac OR team members participate in team training to improve communication, leadership, and situational awareness.	IVB	Consensus	n/a	n/a	n/a	n/a	n/a
72	Armour Forse R, Bramble JD, McQuillan R. Team training can improve operating room performance. Surgery. 2011;150(4):771-778.	Implemented Team- STEPPS and found significant improvement in OR staff teamwork and OR communications; however, the authors noted a reduction in improvement after one year of implementation and suggested continued team training to sustain culture improvement.	VB	Organizational experience: Quality Improvement	USA	n/a	n/a	n/a	Questionnaire, NSQUIP Measures, SCIP, Satisfaction
73	Papaspyros SC, Javangula KC, Adluri RKP, O'Regan DJ. Briefing and debriefing in the cardiac operating room. Analysis of impact on theatre team attitude and patient safety. Interact Cardiovasc Thorac Surg. 2010;10(1):43-47.	Implemented an element of Crew Resource Management, the briefing and debriefing, as part of a quality improvement (QI) initiative in their cardiac OR, and found a qualitative improvement in team communication.	VB	Organizational Experience: Quality Improvement	UK	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
74	Young-Xu Y, Neily J, Mills PD, et al. Association between implementation of a Medical Team Training program and surgical morbidity. Arch Surg. 2011;146(12):1368-1373.	Participating in the Medical Team Training program (n = 42) had a significantly lower surgical morbidity rate than facilities that were not participating in the program (n = 32). This study demonstrated an important link between improvement of teamwork in the OR and improvement of a measurable patient outcome, surgical morbidity.	IIIA	Non-experimental	USA, VA facilities	Medical team training	No training	74 VA facilities, 119,383 procedures	Surgical morbidity
75	Weaver SJ, Rosen MA, Diaz Granados D, et al. Does teamwork improve performance in the operating room? A multilevel evaluation. Jt Comm J Qual Patient Saf. 2010;36(3):133-142.	Researched the effect of implementation of a TeamSTEPPS team training program on several outcomes. The researchers found that a group that underwent TeamSTEPPS training significantly improved their briefings, quality of teamwork behavior during procedures, perceptions of patient safety culture, and teamwork attitudes compared with a group that did not undergo TeamSTEPPS training.	IIB	Quasi-experimental	USA, 2 community-based hospitals	TeamSTEPPS	No TeamSTEPPS	2 hospitals	Trainee reactions, learning, behaviors in the OR, and answers on the Hospital Survey on Patient Safety Culture and the Operating Room Management Attitudes Questionnaire
76	Tibbs SM, Moss J. Promoting teamwork and surgical optimization: combining TeamSTEPPS with a specialty team protocol. AORN J. 2014;100(5):477-488.	Implemented TeamSTEPPS and recommended that perioperative team members participate in team training to improve communication and team relationships.	VA	Organizational Experience: Quality Improvement	USA, large military medical center	n/a	n/a	n/a	n/a
77	Johnson HL, Kimsey D. Patient safety: break the silence. AORN J. 2012;95(5):591-601	Implemented a team training program focusing on TeamSTEPPS as part of a QI project. Their facility experienced a notable reduction in serious events, including RSIs, as a result of the initiative.	VB	Organizational Experience: Quality Improvement	academic community hospital	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
78	Guideline for a safe environment of care, part 2. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:265-290.	AORN environment of care guidelines.	IVA	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a
79	Christian CK, Gustafson ML, Roth EM, et al. A prospective study of patient safety in the operating room. Surgery. 2006;139(2):159-173.	Recorded 11 events that had the potential to compromise patient safety, including counting errors. The researchers identified communication flow problems, workflow, and competing tasks as possible sources of the events.	IIIB	Non-experimental	academic hospital	n/a	n/a	10 procedures observed	Safety-compromising events
80	Rowlands A, Steeves R. Incorrect surgical counts: a qualitative analysis. AORN J. 2010;92(4):410-419.	Qualitative analysis of incorrect surgical count events and found themes of general chaos in the OR that included loud music, excessive talking, talking during critical moments of the count, fast pace, deafening noise levels, and idle chatter.	IIIB	Qualitative	2 hospitals (academic medical center and small community hospital)	n/a	n/a	22 perioperative RNs and surgical technologists	n/a
81	Steelman VM, Cullen JJ. Designing a safer process to prevent retained surgical sponges: a healthcare failure mode and effect analysis. AORN J. 2011;94(2):132-141.	Identified 57 potential failures during the management of surgical sponges that effect counting procedures. Most frequent causes of failures were distraction, multitasking, not following procedure, and time pressure. Education is not likely to reduce failures, so technology adjuncts should be considered as controls.	VB	Organizational experience: Quality Improvement	VA Hospitals	n/a	n/a	n/a	Counting failures
82	Ortuño F, Ojeda N, Arbizu J, et al. Sustained attention in a counting task: normal performance and functional neuroanatomy. Neuroimage. 2002;17(1):411-420.	Counting activates attention and working memory parts of the brain.	IIIB	Non-experimental	Spain, Adult volunteers	n/a	n/a	10	PET scan
83	Camos V, Barrouillet P. Adult counting is resource demanding. Br J Psychol. 2004;95(1):19-30.	Counting is a resource demanding activity that required switching attention between memory and counting. Concurrent memory load increases counting times.	IIIB	Non-experimental	France, Adults (university students)	n/a	n/a	36, 36	Response time, errors, recall correctness

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
84	Railo H, Koivisto M, Revonsuo A, Hannula MM. The role of attention in subitizing. <i>Cognition</i> . 2008;107(1):82-104.	Attentional demands increase as objects to be enumerated increase. Improving attention increased accuracy, whereas only numbers one and two were enumerated when attention was reduced.	IIIA	Non-experimental	Finland, Adult volunteers	Full attention	Divided attention, inattention	72, 40	Accuracy, confidence ratings
85	Butler M, Ford R, Boxer E, Sutherland-Fraser S. Lessons from the field: an examination of count errors in the operating theatre. <i>ACORN</i> . 2010;23(3):6-16.	Found that both the RN circulator and scrub person were rushed to complete the required count procedures by the fast pace of the perioperative environment, especially when handling urgent requests of the team. The researchers also identified time pressures from the surgeon or anesthesia professional to quickly finish the surgical procedure and move to the next patient as factors contributing to count errors.	IIIB	Non-experimental	Australia, 7 large Ors	n/a	n/a	151 surveys	n/a
86	Edel EM. Surgical count practice variability and the potential for retained surgical items. <i>AORN J</i> . 2012;95(2):228-238.	Quality improvement project conducted to evaluate and eliminate variability in count practices during development of a new count policy. Ishikawa diagram created to show factors affecting the accuracy of counts.	VB	Organizational Experience: Quality Improvement	USA, large city hospital	n/a	n/a	n/a	Variation in count practices
87	Norton EK, Martin C, Micheli AJ. Patients count on it: an initiative to reduce incorrect counts and prevent retained surgical items. <i>AORN J</i> . 2012;95(1):109-121.	A QI project to reduce RSIs that involved implementing standardized count practices at a large pediatric hospital. Their activities to standardize counts included policy revision and enforcement, education, standardizing dry-erase boards to document counts, streamlining instrument sets, and updating count sheets. Found a 50% reduction in reported incorrect counts during the one-year project period.	VB	Organizational Experience: Quality Improvement	Children's Hospital Boston	n/a	n/a	n/a	n/a
88	Grant-Orser A, Davies P, Singh SS. The lost sponge: patient safety in the operating room. <i>CMAJ</i> . 2012;184(11):1275-1278.	Case report of a retained surgical sponge. Incident analysis found communication failures between multiple teams and practices inconsistent with counting protocols. Recommended developing standardized protocols for RSI prevention and consistent count policies in addition to increasing communication among team members.	VA	Case Report	Canada	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
89	Gibbs VC. Thinking in three's: changing surgical patient safety practices in the complex modern operating room. World J Gastroenterol. 2012;18(46):6712-6719.	Described RSI prevention strategies	VB	Expert Opinion	n/a	n/a	n/a	n/a	n/a
90	Boisvert MJ, Abroms BD, Roberts WA. Human nonverbal counting estimated by response production and verbal report. Psychon Bull Rev. 2003;10(3):683-690.	Verbal counting had less errors at higher levels. Manual (non-verbal) and verbal counting is accurate up to 30.	IIIB	Non-experimental	United States, Undergraduate students	Subjects prevented from counting with a cognitive distraction task.	n/a	24, 12, 10	Errors
91	Logie RH, Baddeley AD. Cognitive processes in counting. J Exp Psychol Learn Mem Cogn. 1987;13(2):310-326.	Suppression of count articulation increased errors. Memory is involved with keeping a running total of the count. Disruptions in counting increased with larger number of items.	IIIB	Non-experimental	UK, Adult volunteers	n/a	n/a	24, 16, 16, 16	Response times, errors
92	Nan Y, Knösche TR, Luo Y-J. Counting in everyday life: discrimination and enumeration. Neuropsychologia. 2006;44(7):1103-1113.	Discrimination/identification occurs before enumeration and competes for spatial attention.	IIIB	Non-experimental	China, Adult volunteers	n/a	n/a	14	Behavioral performance, ERP results
93	Trick LM, Pylyshyn ZW. Why are small and large numbers enumerated differently? A limited-capacity preattentive stage in vision. Psychol Rev. 1994;101(1):80-102.	Counting requires attention. Individuation is required to keep track of multiple objects by spatial attention.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a
94	Goldfarb L, Levy S. Counting within the subitizing range: the effect of number of distractors on the perception of subset items. PLoS One. 2013;8(9):e74152.	Counting can only begin when target locations have been identified, even for very small values (1-4).	IIIB	Non-experimental	Israel, Adults (university students)	n/a	n/a	16, 16	Response time, errors

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
95	Watson DG, Maylor EA, Bruce LAM. The efficiency of feature-based subitization and counting. J Exp Psychol Hum Percept Perform. 2005;31(6):1449-1462.	Enumeration requires individuating the item location.	IIIB	Non-experimental	UK, Students	n/a	n/a	18/18, 10, 12, 12	Response time, accuracy
96	Mazza V, Pagano S, Caramazza A. Multiple object individuation and exact enumeration. J Cogn Neurosci. 2013;25(5):697-705.	Individuation is required for exact enumeration to count each item once and only once. Individuation is the process of isolating objects from distractors and may be affected by attention.	IIIB	Non-experimental	United States, Volunteers	n/a	n/a	12	Behavioral performance, ERP results, response times
97	Edel EM. Increasing patient safety and surgical team communication by using a count/time out board. AORN J. 2010;92(4):420-424.	Described RSI prevention practices at St Luke's Episcopal Hospital	VB	Clinician Experience	USA, St Luke's Episcopal Hospital	n/a	n/a	n/a	n/a
98	Thomas J, Adcock F. A review of existing count practice in the operating suite to achieve best practice and safe patient care. ACORN. 2014;27(1):20-27.	Analyzed near-miss events at a facility in Australia. Found that the practice of counting sponges twice, placing the sponges in a clear plastic bag, and keeping the bags in the room until the end of the procedure ("bagging off") was a behavior that could contribute to a preventable counting error because relief RNs were not aware of "bagged off" packs in the room.	VB	Organizational Experience: Quality Improvement	Australia	n/a	n/a	n/a	n/a
99	Guideline for transfer of patient care information. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:583-588.	AORN transfer of patient information guidelines.	IVB	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
100	Peloquin P, Vannemreddy PS, Watkins LM, Byrne RW. Intracranial cotton ball gossypiboma mimicking recurrent meningioma: report of a case with literature review for intentional and unintentional foreign body granulomas. Clin Neurol Neurosurg. 2012;114(7):1039-1041.	Case report of a retained cotton ball following brain surgery.	VC	Case Report with literature review	USA	n/a	n/a	1	n/a
101	Cho SW, Jin HR. Gossypiboma in the nasal septum after septorhinoplasty: a case study. J Oral Maxillofac Surg. 2013;71(1):e42-e44.	Sponges used for rhinoplasty should be appropriate size and attached to a thread, and should be counted. The nasal cavity should be thoroughly explored.	VB	Case Report	Korea	n/a	n/a	1	n/a
102	Chang CY, Tsai EM, Wu CH, Wang CL, Liu CM, Long CY. Pelvic floor abscess secondary to gossypiboma following a total Prolift procedure. Taiwan J Obstet Gynecol. 2012;51(2):283-284.	Sponges should be counted for prolift procedure, regardless of peritoneal or vaginal approach	VB	Case Report	Taiwan	n/a	n/a	1	n/a
103	Gibbs VC. Retained surgical items and minimally invasive surgery. World J Surg. 2011;35(7):1532-1539.	RSI prevention for minimally invasive surgery. Describes practices in the NoThing Left Behind Sponge ACCOUNTing system protocol.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
104	Agrawal A. Counting matters: lessons from the root cause analysis of a retained surgical item. <i>Jt Comm J Qual Patient Saf.</i> 2012;38(12):566-574.	A root cause analysis was conducted following the discovery of a 27-year old female with a retained vaginal sponge after repair of a vaginal tear from a normal vaginal delivery. The error was determined to be failure to perform standard protocol of counting sponges before and after the repair of the vaginal tear by the obstetric physician and nurse. The sponge count sheet and the post-delivery note in the EHR were modified to include a sign-out process to serve as a reminder. Also, the TeamSTEPPS program was implemented in L&D to improve communication.	VB	Organizational Experience: Quality Improvement	USA	n/a	n/a	n/a	n/a
105	Chagolla BA, Gibbs VC, Keats JP, Pelletreau B. A system-wide initiative to prevent retained vaginal sponges. <i>MCN AmJ Matern Child Nurs.</i> 2011;36(5):312-317.	Implemented the NoThing Left Behind Sponge ACCOUNTing system protocol.	VB	Organizational experience: Quality improvement	USA, 32 hospital system	n/a	n/a	n/a	n/a
106	Garry DJ, Asanjarani S, Geiss DM. Policy for prevention of a retained sponge after vaginal delivery. <i>Case Rep Med.</i> 2012;2012:317856.	Case of a retained vaginal sponge following an uncomplicated spontaneous vaginal delivery. Delivery room policy resulted in the discovery of the sponge on X-ray when an incorrect sponge count occurred and physical exam did not find the sponge.	VB	Case Report	USA	n/a	n/a	1	n/a
107	Healy P. Retained vaginal swabs: review of an adverse event in obstetrics through closed claims analysis. <i>Br J Midwifery.</i> 2012;20(9):666-669.	Cases of retained vaginal swabs were few. However, they represent a significant problem in that they are very difficult to defend in clinical negligence litigation. Maternity service providers must put measures in place to manage this preventable clinical risk.	IIIB	Non-experimental	Ireland	n/a	n/a	16 closed case claims	n/a
108	Lutgendorf MA, Schindler LL, Hill JB, Magann EF, O'Boyle JD. Implementation of a protocol to reduce occurrence of retained sponges after vaginal delivery. <i>Mil Med.</i> 2011;176(6):702-704.	With appropriate pre-implementation training, protocols which incorporate post-delivery vaginal sweep and sponge counts are well accepted by the health care team and can be incorporated into the delivery room routine.	VB	Organizational Experience: Quality Improvement	USA, large tertiary care military treatment facility	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
109	Retained foreign objects during vaginal deliveries. Prevention of unintentionally. 4th ed. 2012. Institute for Clinical Systems Improvement. https://www.icsi.org/guidelines__more/catalog_guidelines_and_more/catalog_guidelines/catalog_patient_safetyreliability_guidelines/rfo/ . Accessed November 10, 2015.	Institute for Clinical Systems Improvement (ICSI) recommends a protocol for preventing unintentionally retained foreign objects during vaginal deliveries, including an algorithm, quality improvement support, and human factors recommendations such as red rules. Sponges and sharps should be counted (baseline and final) for all vaginal deliveries.	IVB	Clinical Practice Guideline	Vaginal Deliveries	n/a	n/a	n/a	n/a
110	Hyslop JW, Maull KI. Natural history of the retained surgical sponge. South Med J. 1982;75(6):657-660.	Historical article. Retained surgical sponges estimated to be 1:1,000 celiotomies. If the sponge is not retained in a sterile environment or migrates to an unsterile location, such as the gastrointestinal tract, the tissue may react with an exudative inflammatory response that could result in an abscess or fistula.	VB	Case Report and Literature Review	USA	n/a	n/a	n/a	n/a
111	Wattanasirichaigoon S. Transmural migration of a retained surgical sponge into the intestinal lumen: an experimental study. J Med Assoc Thai. 1996;79(7):415-422.	Described the stages of transmural sponge migration into the intestine: <ul style="list-style-type: none"> • Stage 1 is foreign body reaction during which the sponge is encapsulated. • Stage 2 is secondary infection during which cytolysis occurs from the cotton interacting with enzymes in the intestinal lumen. • Stage 3 is mass formation during which a thick fibrous wall develops as part of the granuloma to prevent the infection from spreading in the abdomen and cotton filaments are released into the intestinal lumen. • Stage 4 is remodeling during which a fibrotic scar forms after the whole surgical sponge enters the intestinal lumen. 	IIB	Laboratory experiment	Animals	Sterile cotton swabs placed in peritoneal cavity	n/a	38 rats	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
112	Gumus M, Gumus H, Kapan M, Onder A, Tekbas G, Bac B. A serious medicolegal problem after surgery: gossypiboma. Am J Forensic Med Pathol. 2012;33(1):54-57.	12 cases of retained sponges described. Recommend that all sponges should be counted at least twice (once preoperatively and once postoperatively); use of small sponges should be avoided during laparotomy, and only sponges with radiopaque markers should be used. The surgeon should explore the abdomen before closure. In cases in which the sponge count is uncertain, an abdominal x-ray should be performed before closure.	IIIB	Retrospective Review	Turkey	n/a	n/a	12 patients with gossypibomas	n/a
113	Kaplan M, Iyikosker HI. A new complication of retained surgical gauze: development of malignant fibrous histiocytoma—report of a case with a literature review. World J Surg Oncol. 2012;10:139.	Report of a rare outcome from a retained sponge. The patient developed a malignant fibrous histiocytoma from a surgical sponge retained for 32 years and later died from metastatic cancer.	VC	Case Report and Literature Review	Turkey	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
114	Statler JD, Miller DL, Dixon RG, et al. Society of interventional radiology position statement: prevention of unintentionally retained foreign bodies during inter-ventional radiology procedures. J Vasc Interv Radiol. 2011;22(11):1561-1562.	Steps should be taken to avoid unintentionally retained foreign bodies during interventional radiology procedures. When IR procedures involve multidisciplinary teams, the wounds may be more extensive than typical IR procedures. Procedures in other areas of the hospital should be performed in accordance with the standard operating procedures of that area. Sponges smaller than 10cm x 10cm (4x4) should not be used for packing of wounds or incisions, and 4x4s should not be altered for this purpose. When using sponges in an incision or cavity, thorough visual and tactile inspections should be performed after sponge removal and before the incision is closed. If the wound does not permit thorough visual and tactile inspection, only radiopaque sponges should be used, and at the conclusion of the procedure either a final count or fluoroscopy should be performed to exclude a retained sponge. If there is concern for retention of a needle or instrument, fluoroscopy should be performed at the end of the procedure unless additional radiation is of greater concern.	IVC	Position Statement	Interventional Radiology Procedures	n/a	n/a	n/a	n/a
115	Amr AE. A submandibular gossypiboma mimicking a salivary fistula: a case report. Cases J. 2009;2:6413.	Case report of retained non-radiopaque sponge in the neck after submandibular gland excision.	VB	Case Report	Egypt	n/a	n/a	1	n/a
116	Baruah BP, Young P, Douglas-Jones A, Mansel R. Retained surgical swab following breast augmentation: a rare cause of a breast mass. BMJ Case Rep. 2009;2009. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3028288/ . Accessed November 10, 2015.	Case report of retained non-radiopaque sponge in the breast after augmentation.	VB	Case Report	Outside UK	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
117	Fouelifack FY, Fouogue JT, Fouedjio JH, Sando Z. A case of abdominal textiloma following gynecologic surgery at the Yaounde Central Hospital, Cameroon. <i>Pan Afr Med J.</i> 2013;16:147.	Case report of retained non-radiopaque sponge in the abdomen after hysterectomy.	VB	Case Report	Cameroon	n/a	n/a	1	n/a
118	Gencosmanoglu R, Inceoglu R. An unusual cause of small bowel obstruction: gossypiboma—case report. <i>BMC Surg.</i> 2003;3:6.	Case report of retained non-radiopaque sponge in the abdomen after cholecystectomy.	VB	Case Report	Turkey	n/a	n/a	1	n/a
119	Irabor DO. Under-reporting of gossypiboma in a third-world country. A sociocultural view. <i>Niger J Med.</i> 2013;22(4):365-367.	Nigerian experience with gossypiboma and prevention methods.	VB	Expert Opinion	n/a	n/a	n/a	n/a	n/a
120	Joshi MK, Jain BK, Rathi V, Agrawal V, Mohanty D. Complete enteral migration of retained surgical sponge— report of two cases. <i>Trop Gastroenterol.</i> 2011;32(3):229-232.	Case report of retained non-radiopaque sponges in the abdomen after cesarean section and laparotomy.	VC	Case Report	India	n/a	n/a	2	n/a
121	Kansakar R, Hamal BK. Cystoscopic removal of an intravesical gossypiboma mimicking a bladder mass: a case report. <i>J Med Case Rep.</i> 2011;5(1):579.	Case report of retained non-radiopaque sponge in the bladder after open cystolithotomy.	VC	Case Report	Nepal	n/a	n/a	1	n/a
122	Karasaki T, Nomura Y, Nakagawa T, Tanaka N. Beware of gossypibomas. <i>BMJ Case Rep.</i> 2013;2013.	Case report of retained non-radiopaque sponge in the abdomen after cesarean section.	VC	Case Report	Japan	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
123	Kim KS. Changes in computed tomography findings according to the chronicity of maxillary sinus gossypiboma. J Craniofac Surg. 2014;25(4):e330-e333.	Case report of retained non-radiopaque sponge in the maxillary sinus after treatment for the fracture of the orbital floor.	VC	Case Report	Korea	n/a	n/a	1	n/a
124	Kohli S, Singhal A, Tiwari B, Singhal S. Gossypi- boma, varied presentations: a report of two cases. J Clin Imaging Sci. 2013;3:11.	Case report of retained non-radiopaque sponges in the abdomen after hysterectomy and cholecystectomy.	VC	Case Report	Korea	n/a	n/a	2	n/a
125	Lundin K, Allen JE, Birk-Soerensen L. Gossypiboma after breast augmentation. Case Rep Surg. 2013;2013:808624.	Case report of retained non-radiopaque sponge in the breast after augmentation.	VC	Case Report	Denmark	n/a	n/a	1	n/a
126	Naama O, Quamous O, Elasri CA, et al. Textiloma: an uncommon complication of posterior lumbar surgery. J Neuroradiol. 2010;37(2):131-134.	Case report of retained non-radiopaque sponge in the spine after posterior lumbar surgery.	VB	Case Report	Morocco	n/a	n/a	1	n/a
127	Ogundiran T, Ayandipo O, Adeniji-Sofoluwe A, Ogun G, Oyewole O, Ademola A. Gossypiboma: complete transmural migration of retained surgical sponge causing small bowel obstruction. BMJ Case Rep. 2011;2011. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3128338/ . Accessed November 10, 2015.	Case report of retained non-radiopaque sponge in the abdomen after gynecologic laparotomy.	VC	Case Report	Nigeria	n/a	n/a	1	n/a
128	veli Ozkan O, Bas G, Akcakaya A, Sahin M. Transmural migration of a retained sponge through the rectum: a case report. Balkan Med J. 2011;28(1):94-95.	Case report of retained non-radiopaque sponge that migrated to the rectum and was defecated following a myomectomy.	VC	Case Report	Turkey	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
129	Quraishi AH. Beyond a gossypiboma. Case Rep Surg. 2012;2012:263841.	Case report of retained non-radiopaque sponge in the abdomen after emergency cesarean section.	VB	Case Report	India	n/a	n/a	1	n/a
130	Sumer A, Carparlar MA, Uslukaya O, et al. Gossypiboma: retained surgical sponge after a gynecologic procedure. Case Rep Med. 2010;2010. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2929520/ . Accessed November 10, 2015.	Case report of retained non-radiopaque sponge in the abdomen after cesarean section	VC	Case Report	Turkey	n/a	n/a	1	n/a
131	Nurse Left Sponge in Pt. During Preoperative Procedure: Case on Point: Burke v. AnMedHealth, 4828 SCCA(4/27/2011)-SC. Nurs Law Regan Rep. 2011;52(3):4.	A patient experienced discomfort and re-operation two months after an abdominal hysterectomy to remove a retained sponge that was left in her vagina during preoperative vaginal antiseptis.	VC	Case Report	USA	n/a	n/a	1	n/a
132	Yuki K, Shiba D, Ota Y, Ozeki N, Murat D, Tsubota K. A new method to prevent loss of mitomycin C soaked sponges under the conjunctiva during trabeculectomy. Br J Ophthalmol. 2010;94(8):1111-1112.	Clinician reported use of sponges with attached thread to reduce the number of missing ophthalmic sponges during trabeculectomy.	VC	Clinician Experience	Japan	n/a	n/a	n/a	n/a
133	Srivastava A, Kataria K, Chella VR. Prevention of gossypiboma. Indian J Surg. 2014;76(2):169.	Clinician reported use of laparotomy sponges tied together in packs of five sponges so that no single sponge was in the surgical wound when the peritoneum was open.	VC	Clinician Experience	India	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
134	McIntyre LK, Jurkovich GJ, Gunn ML, Maier RV. Gossypiboma: tales of lost sponges and lessons learned. Arch Surg. 2010;145(8):770-775.	Inconsistency in documentation found and the health care organization's policy on packed sponges was changed to facilitate a standardized approach to communication of packing. Cases: 1- Packing left in. Saw on x-ray. 2- Packing left in, x-ray negative, count correct. Found on CT. Incomplete imaging due to obese patient. 3- Incomplete imaging. New policy- image from diaphragm to symphysis (complete body cavity radiographs). Also added to policy to announce and document packing.	VA	Organizational Experience: Quality Improvement	USA, Level 1 trauma academic hospital	n/a	n/a	3	n/a
135	Jagger J, Berguer R, Phillips EK, Parker G, Gomaa AE. Increase in sharps injuries in surgical settings versus nonsurgical settings after passage of national needlestick legislation. J Am Coll Surg. 2010;210(4):496-502.	Reported sharps injuries to perioperative personnel from suture needles to be 43.4% of total sharps injuries and from scalpel blades to be 17% of total sharps injuries.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a
136	Guideline for sharps safety. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:365-388.	AORN sharps safety guidelines.	IVA	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a
137	Kelly RJ, Whipple OC. Retained anvil after laparoscopic gastric bypass. Surg Obes Relat Dis. 2011;7(5):e13-e15.	Case report of the anvil of a stapler retained in the abdomen after a laparoscopic gastric bypass.	VB	Case Report	USA	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
138	Magalini S, Sermoneta D, Lodoli C, Vanella S, Di Grezia M, Gui D. The new retained foreign body! Case report and review of the literature on retained foreign bodies in laparoscopic bariatric surgery. <i>Eur Rev Med Pharmacol Sci.</i> 2012;16(Suppl 4):129-133.	Case of a patient with lung abscess from a retained specimen bag containing bowel. Change in technology causes types of RSI to change. Lap procedures have restricted visual field. Check every item after removed, leave wire outside.	VA	Case Report and Literature Review	Italy	n/a	n/a	1	n/a
139	Stephens M, Ruddle A, Young WT. An unusual complication of a dropped clip during laparoscopic cholecystectomy. <i>Surg Laparosc Endosc Percutan Tech.</i> 2010;20(3):e103-e104.	Case report of biliary obstruction from retained free staple in the abdomen. Free clips should be removed from the abdomen.	VC	Case Report	UK	n/a	n/a	1	n/a
140	Chepla KJ, Wilhelm SM. Delayed mechanical small bowel obstruction caused by retained, free, intraperitoneal staple after laparoscopic appendectomy. <i>Surg Laparosc Endosc Percutan Techniq.</i> 2011;21(1):e19-e20.	Case report of retained free staple in abdomen causing bowel obstruction. Unfired staples free floating in abdomen should be removed.	VB	Case Report	USA	n/a	n/a	1	n/a
141	Ozsoy M, Celep B, Ozsan I, Bal A, Ozkececi ZT, Arıkan Y. A retained plastic protective cover mimicking malignancy: case report. <i>Int J Surg Case Rep.</i> 2013;4(12):1084-1087.	Case report of retained plastic foreign bodies following nephrectomy.	VC	Case Report	Turkey	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
142	Toubia T, Sangha R. Retained vaginal foreign body in minimally invasive gynecological surgeries. CRSLs MIS Case Reports. 2014; e2014.00240. http://crsls.sls.org/wp-content/uploads/2014/11/13-00240.pdf . Accessed November 10, 2015.	Case report of retained Asepto bulb after a robot-assisted total laparoscopic hysterectomy, and case report of a retained surgical sponge after a laparoscopic ovarian cystectomy.	VA	Case Report	USA	n/a	n/a	2	n/a
143	Sakhel K, Hines J. To forget is human: the case of the retained bulb. J Robotic Surg. 2009;3(1):45-47.	Case report of a forgotten asepto bulb in the vagina following a robot-assisted total laparoscopic hysterectomy.	VB	Case Report	USA	n/a	n/a	1	n/a
144	FDA Public Health Notification: Unretrieved Device Fragments. US Food and Drug Administration. http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/PublicHealthNotifications/ucm062015.htm . Issued January 15, 2008. Accessed November 10, 2015.	Public health notification from the US Food and Drug Administration (FDA) on patient risk for injury from retained unretrieved device fragments.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
145	Barrow CJ. Use of x-ray in the presence of an incorrect needle count. AORN J. 2001;74(1):80-81.	Needles as small as 8-0 could be faintly visualized on both the anterior-posterior and lateral views.	VB	Organizational experience: Quality improvement	USA	n/a	n/a	n/a	n/a
146	Ponrartana S, Coakley FV, Yeh BM, et al. Accuracy of plain abdominal radiographs in the detection of retained surgical needles in the peritoneal cavity. Ann Surg. 2008;247(1):8-12.	Abdominal radiographs have high sensitivity and interobserver agreement in the detection of retained surgical needles over 10 mm in length, but smaller needles are detected with significantly lower sensitivity and the utility of plain abdominal radiographs in this setting is more debatable.	IIIB	Non-experimental	Lab, pig cadavers	n/a	n/a	39 surgical needles	Detection of retained needles on radiograph
147	Use of x-rays for incorrect needle counts. Pa Patient Saf Advis. 2004;1(2):5-6.	The clinical literature provides conflicting evidence for when x-rays may be useful in locating lost surgical needles.	IVC	Consensus	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
148	Kieval JZ, Walsh M, Legutko PA, Daly MK. Efficacy of portable X-ray in identifying retained suture needles in ophthalmologic cases. Eye. 2009;23(8):1731-1734.	The use of plain film radiographs to rule-out the presence of an intraocular surgical needle is neither a sensitive nor specific imaging modality.	IIIB	Non-experimental	Lab, porcine eyes	n/a	n/a	20	Detection of 10-0 nylon ophthalmic suture on plain films taken by c-arm fluoroscopy
149	Hacivelioglu S, Karatag O, Gungor AC, et al. Is there an advantage of three dimensional computed tomography scanning over plain abdominal radiograph in the detection of retained needles in the abdomen? Int J Surg. 2013;11(3):278-281.	Results suggest that both 3D CT and plain abdominal radiograph are effective and comparable in recognizing the retained surgical needles of various sizes.	IIIB	Non-experimental	Lab, sheep	3D CT	Plain Abdominal Radiograph	20	Detection of surgical needles
150	Ren S, Liu P, Wang W, Yang Y. Retained foreign body after laser ablation. Int Surg. 2012;97(4):293-295.	Two case reports of retained fiber optic sheaths after laser ablation.	VB	Case Report	China	n/a	n/a	2	n/a
151	Vannucci A, Jeffcoat A, Ifune C, Salinas C, Duncan JR, Wall M. Special article: retained guidewires after intraoperative placement of central venous catheters. Anesth Analg. 2013;117(1):102-108.	Four case reports of guidewire loss after central venous access procedures performed by anesthesia providers in the operating room. Recommend education and guidance on removal of guidewire during CVC placement in OR.	VB	Case Report	USA	n/a	n/a	4	n/a
152	Song Y, Messerlian AK, Matevosian R. A potentially hazardous complication during central venous catheterization: lost guidewire retained in the patient. J Clin Anesth. 2012;24(3):221-226.	Case report of an unintentionally retained guidewire during the catheterization of the internal jugular vein. In California, guidewire is reported as RFB after surgery. Recommend including guidewire on checklist.	VB	Case Report	USA	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
153	Omar HR, Sprenker C, Karlnoski R, Mangar D, Miller J, Camporesi EM. The incidence of retained guidewires after central venous catheterization in a tertiary care center. Am J Emerg Med. 2013;31(10):1528-1530.	During the 26-month period, 16 cases with retained foreign bodies requiring IR or vascular surgery for extraction were found	VB	Case Report and Literature Review	USA	n/a	n/a	16	n/a
154	Horberry T, Teng YC, Ward J, Patil V, Clarkson PJ. Guidewire retention following central venous catheterisation: a human factors and safe design investigation. Int J Risk Saf Med. 2014;26(1):23-37.	Qualitative analysis of retained guidewires in surgical patients. Highest rated solutions by clinicians were better training, active checking for guidewire removal, and streamlining of central line sets.	IIIB	Qualitative	UK	n/a	n/a	n/a	n/a
155	Ellett L, Maher P. Forgotten surgical items: lessons for all to learn: case report and 3-year audit of retained surgical items at a tertiary referral centre. Gynecol Surg. 2013;10(4):295-297.	Case report of a retained KOH cup used in laparoscopic vaginal hysterectomy that was found 14 months later.	VB	Case Report	Australia	n/a	n/a	1	n/a
156	29 CFR 1910.1030. Occupational exposure. Bloodborne pathogens. 2009. Occupational Safety & Health Administration. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10051 . Accessed November 10, 2015.2009.	OSHA Blood borne pathogens	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
157	Parelkar SV, Sanghvi BV, Shetty SR, Athawale H, Oak SN. Needle in a haystack: intraoperative breakage of pediatric minimal access surgery instruments. J Postgrad Med. 2014;60(3):324-326.	Two case reports of retained objects in pediatric minimally invasive procedures. Surgeon waited to remove item, then had a hard time finding it. Suggested magnetic tip probe or grids for x-ray to locate lost items. Check instruments when removing from cavity.	VB	Case Report	India	n/a	n/a	2	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
158	Ruscher KA, Modeste KA, Staff I, Papisavas PK, Tishler DS. Retained needles in laparoscopic surgery: open or observe? <i>Conn Med.</i> 2014;78(4):197-202.	Surveyed surgeons and residents regarding how to manage retained needles in laparoscopic surgery. 89.4% of respondents believed that converting to laparotomy created a greater risk than the RSI itself. However, 92.6% of the respondents also agreed that an intraperitoneally retained needle put the patient at some degree of future risk.	IIIB	Survey	USA	n/a	n/a	255	n/a
159	Barto W, Yazbek C, Bell S. Finding a lost needle in laparoscopic surgery. <i>Surg Laparosc Endosc Percutan Tech.</i> 2011;21(4):e163-e165.	Study to investigate the application of a new device (laparoscopic magnet) to retrieve lost needles intraoperatively using a pig and various size needles. Researchers found the laparoscopic magnet to be the safest and most efficient way of retrieving lost needles intraoperatively.	IIIB	Case Report and Non-experimental	Australia, lab	n/a	n/a	n/a	n/a
160	Small AC, Gainsburg DM, Mercado MA, Link RE, Hedican SP, Palese MA. Laparoscopic needle-retrieval device for improving quality of care in minimally invasive surgery. <i>J Am Coll Surg.</i> 2013;217(3):400-405.	In vivo testing of a novel articulating laparoscopic magnet in a porcine model. Recovery of lost surgical needles during porcine laparoscopic surgery is safe and feasible with a simple articulating magnetic device.	IIIB	Non-experimental	USA, lab	n/a	n/a	n/a	n/a
161	Jayadevan R, Stensland K, Small A, Hall S, Palese M. A protocol to recover needles lost during minimally invasive surgery. <i>JSLs.</i> 2014;18(4). http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4254476/ . Accessed November 10, 2015.	Survey was administered to minimally invasive surgeons across the US to gather data on the incidence of lost surgical needles and recovery techniques. Developed protocol for recovering lost needles during minimally invasive surgery and recommended using a magnetic device, if one is available. Also recommended halting the procedure to survey for the lost needle and conduct a systematic search.	IIIB	Survey	USA	n/a	n/a	305	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
162	Kava BR, Burdick-Will J. Complications associated with retained foreign bodies from infected penile implants: proposal for the use of an implant-specific checklist at the time of device removal. <i>J Sex Med.</i> 2013;10(6):1659-1666. 6.	Retained fragments from complex penile prosthesis removals. Recommend checklist of implant parts.	VA	Case Report	USA	n/a	n/a	4	n/a
163	Felder SI, Liou DZ, Gangi A. Gastric adjustable band as a retained foreign object: a case report. <i>Bariatric Surg Patient Care.</i> 2013;8(4):166-168.	Case report of retained adjustable gastric band following elective conversion to a gastric sleeve that was not recognized for over 12 months.	VB	Case Report	USA	n/a	n/a	1	n/a
164	Celkan MA, Bayatli K. A bulldog clamp that was forgotten during a coronary artery bypass operation 8 years ago. <i>Interact Cardiovasc Thorac Surg.</i> 2012;15(4):777-778.	Case report of patient with a retained bulldog clamp in the heart who experienced angina and underwent re-operation for removal of the RSi.	VB	Case Report	Turkey	n/a	n/a	1	n/a
165	Tulmac M, Ozer N, Ebinc H, Simsek V, Dogru MT. Uncomplicated retainment of metal coronary bulldog clips recognized five years after coronary artery bypass graft surgery. <i>Turk J Thorac Cardiovasc Surg.</i> 2011;19(3):432-433.	Case report of patient with a retained bulldog clamp who had not experienced adverse effects at the time of the report.	VC	Case Report	Turkey	n/a	n/a	1	n/a
166	Massimiliano PA, Massimo PS. Retained intra-abdominal surgical instrument: a rare condition of acute abdomen. <i>ANZ J Surg.</i> 2010;80(10):758.	Case report of a patient with retained retractor in the abdomen for one month that caused peritonitis and was removed in a subsequent laparotomy procedure.	VC	Case Report	Italy	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
167	Thomas EJ, Moore FA. The missing suction tip. AHRQ WebM&M [serial online]. https://psnet.ahrq.gov/webmm/case/37/the-missing-suction-tip . Accessed November 10, 2015.	Case report of a possible RSI from a detached suction tip. The scrub person was concerned that the tip was retained in the patient; however, the tip had actually been placed in irrigation solution.	VC	Case Report	USA	n/a	n/a	1	n/a
168	Bansal M, Heckl F, English K. Retained broken out-flow cannula recovered 6 years post-knee arthroscopy. Orthopedics. 2011;34(12):e945-e947.	Case report of a retained outflow cannula fragment found six years after a knee arthroscopy. The patient presented with acute pain, and radiographs showed a retained metallic object in the operative knee. The retained fragment was removed by arthroscopy and the patient subsequently developed deep vein thrombosis. The authors advised diligent inspection of instruments that have been used on a patient, even if the risk for complication is low.	VB	Case Report	USA	n/a	n/a	1	n/a
169	Ipaktchi K, Kolnik A, Messina M, Banegas R, Livermore M, Price C. Current surgical instrument labeling techniques may increase the risk of unintentionally retained foreign objects: a hypothesis. Patient Saf Surg. 2013;7(1):31.	Reported a near-miss event in which an instrument label fragment was discovered in the surgical wound during closing. They recommended inspecting instruments after use in their entirety, including the label, to prevent the unintentional retention of instrument label fragments.	VC	Expert Opinion	USA	n/a	n/a	n/a	n/a
170	Teixeira PG, Inaba K, Salim A, et al. Retained foreign bodies after emergent trauma surgery: incidence after 2526 cavitory explorations. Am Surg. 2007;73(10):1031-1034.	An 8 yr study of 2526 cases revealed 3 cases of retained sponges. For emergency procedures, recommend radiographic evaluation before final cavity closure even with a correct sponge count.	IIIB	Non-experimental	USA, Trauma cases	n/a	n/a	3	RSI
171	Murdock D. Trauma: when there's no time to count. AORN J. 2008;87(2):322-328.	The nature of trauma places the patient at a higher risk for retained foreign objects and, as professionals and patient advocates, the perioperative team must help reduce these risks.	VB	Clinician Experience	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
172	Guideline for cleaning and care of surgical instruments. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:615-650.	AORN cleaning and care of instruments guideline.	IVA	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a
173	Reece M, Troeleman ND, McGowan JE, Furuno JP. Reducing the incidence of retained surgical instrument fragments. AORN J. 2011;94(3):301-304.	Description of program to reduce the incidence of instrument fragments at one hospital. Sterile processing personnel disinfect and tag all damaged instruments and store them for a minimum of one year. The retired instrument is then logged into a database and monitored by the perioperative quality council.	VB	Organizational Experience: Quality Improvement	USA, academic tertiary care facility	n/a	n/a	n/a	n/a
174	Fischer RA. Danger: beware of unretrieved device fragments. Nursing. 2007;37(11):17.	Expert advised inspecting intravascular devices for breakage or manufacturing defects to minimize the risk for retained device fragments.	VB	Expert Opinion	n/a	n/a	n/a	n/a	n/a
175	Pillariseti J, Biria M, Balda A, Reddy N, Berenbom L, Lakkireddy D. Integrity of vascular access: the story of a broken sheath! J Vasc Nurs. 2009;27(3):75-77.	Case report of a retained sheath following cardiac catheterization.	VB	Case Report	USA	n/a	n/a	1	n/a
176	DerDerian T, Ascher E, Hingorani A, Jimenez R. A rare complication of a retained wire during endovascular abdominal aortic aneurysm repair. Ann Vasc Surg. 2013;27(8):1183.e11-1183.e15.	Case report of entrapped guidewire during AAA repair. At 1-year of follow-up, the patient has been asymptomatic with no obvious sequelae.	VB	Case Report	USA	n/a	n/a	1	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
177	Augello M, von Jackowski J, Gratz KW, Jacobsen C. Needle breakage during local anesthesia in the oral cavity—a retrospective of the last 50 years with guidelines for treatment and prevention. Clin Oral Investig. 2011;15(1):3-8.	In a majority of cases, needle breakage during local anesthesia in the oral cavity occurred during an inferior alveolar nerve block. This was found to be due mostly to improper technique or needles that are too thin. The risk of a retained fragment includes needle migration or injury to surrounding anatomical structures (eg, blood vessels, nerves). When a hypodermic needle fractures, it should be removed surgically under general anesthesia, using multiplane X-rays or fluoroscopy to localize the fragment.	VB	Literature Review	n/a	n/a	n/a	26	n/a
178	Malamed SF, Reed K, Poorsattar S. Needle breakage: incidence and prevention. Dent Clin North Am. 2010;54(4):745-756.	Although rare, dental needle breakage can, and does, occur. Review of the literature and personal experience of the authors brings into focus several commonalities which when avoided can minimize the risk of needle breakage with the fragment being retained from occurring. These include: -Do not use short needles for IANB in adults. -Do not use 30-gauge needles for IANBs in adults or children. -Do not bend needles when inserting them into soft tissue. - Do not insert a needle into soft tissue to its hub, unless it is absolutely essential for the success of the injection. -Observe extra caution when inserting needles in younger children or in extremely phobic adult or child patients.	VB	Literature Review	Dental	n/a	n/a	n/a	n/a
179	Pogrel MA. Broken local anesthetic needles: a case series of 16 patients, with recommendations. J Am Dent Assoc. 2009;140(12):1517-1522.	Case series of 16 patients with broken local anesthetic needles. Recommended avoiding 30g for alveolar block, short needles, bending the needle, and burying the needle in to hub.	VA	Case Report	USA	n/a	n/a	16	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
180	Catelani C, Valente A, Rossi A, Bertolai R. Broken anesthetic needle in the pterygomandibular space. Four case reports. <i>Minerva Stomatol.</i> 2013;62(11-12):455-463.	Report of 4 cases of needle breakage. Recommended checking needle before use, not inserting to the hub, avoid bending the needle, avoid changing the angle of the needle during injection, and using high quality products.	VB	Case Report	Italy	n/a	n/a	4	n/a
181	Kim SH, Huh K, Jee YS, Park MJ. Breakage of growth hormone needle in subcutaneous tissue. <i>J Spec Pediatr Nurs.</i> 2011;16(2):162-165.	Case report of needle breakage during subcutaneous growth hormone administration. Recommend checking the needle before using it, do not use dull or deformed needles, do not reuse needles, keep muscles in the injection area relaxed when injecting, inform the patient about possible pain, pinch the skin at the injection site, and do not change the direction of the needle during the injection.	VC	Case Report	Korea	n/a	n/a	1	n/a
182	Alexander G, Attia H. Oral maxillofacial surgery displacement complications. <i>Oral Maxillofac Surg Clin North Am.</i> 2011;23(3):379-386.	Discussed that needle fracture retrieval is more complicated when the hub is buried in the tissue, which places the patient at increased risk for an invasive procedure to remove the fragment. Advised against burying the needle to the hub because of the certainty of difficult retrieval in the event of breakage. Recommended that repeated use of the same needle should be avoided because this practice increases the risk for breakage. If a needle is broken, recommend to immediately discontinue the procedure and attempt to retrieve the material before it becomes inaccessible.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a
183	State Operations Manual Appendix A: Survey Protocol, Regulations and Interpretive Guidelines for Hospitals. Rev 116; 2014. Centers for Medicare & Medicaid Services. https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_a_hospitals.pdf . Accessed November 10, 2015.	CMS, Hospital	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
184	State Operations Manual Appendix L: Guidance for Surveyors: Ambulatory Surgical Centers. Rev 99;2014. Centers for Medicare & Medicaid Services. https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_l_ambulatory.pdf . Accessed November 10, 2015.	CMS, Ambulatory	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
185	Rowlands A. Risk factors associated with incorrect surgical counts. AORN J. 2012;96(3):272-284.	Six variables were significantly associated with an incorrect surgical count: a higher surgical risk, a lower body mass index, a complicated procedure, an unplanned procedure, an increased number of perioperative personnel involved, and an increased number of specialty teams involved.	IIIB	Qualitative	USA	n/a	n/a	22	Incorrect surgical counts
186	Hariharan D, Lobo DN. Retained surgical sponges, needles and instruments. Ann R Coll Surg Engl. 2013; 95(2):87-92.	The overall incidence of RSI is low although its incidence is substantially higher in operations performed on open cavities. Sponges are the most commonly retained item when compared with needles and instruments. Clinical presentation is varied, leading to avoidable morbidity, and the error is indefensible medicolegally. Risk factors include emergency operations, operations involving unexpected change in procedure, raised body mass index, and a failure to perform accurate sponge and instrument counts. The existing strategy for prevention is manual counting of sponges and instruments undertaken by surgical personnel. This, however, is fallible. Computer assisted counting of sponges using barcodes and gauze sponges tagged with a radiofrequency identification device aiding manual counting have been trialed recently, with success.	VB	Literature Review	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
187	Sencimen M, Bayar GR, Gulses A. Removal of the retained suture needle under C-arm fluoroscopy: a technical note. <i>Dent Traumatol.</i> 2010;26(6):527-529.	Case report of a suture needle, accidentally retained in the pterygomandibular space during the extraction of upper wisdom third molar that was removed via intraoral route using C-arm fluoroscopy.	VC	Case Report	Turkey	n/a	n/a	1	n/a
188	Huang J, Bouvette MJ, Chari R, Vuddagiri V, Kraemer MC, Zhou J. The detection of a retained sponge in the aorta by transesophageal echocardiography. <i>J Cardiothorac Vasc Anesth.</i> 2010;24(2):314-315.	Case report of a retained sponge in the distal aortic arch proximal descending aorta diagnosed by TEE.	VC	Case Report	USA	n/a	n/a	1	n/a
189	Hunter TB, Gimber LH. Identification of retained surgical foreign objects: policy at a university medical center. <i>J Am Coll Radiol.</i> 2010;7(9):736-738.	Described a radiograph reference guide that was created for the radiologist reviewing radiograph screening images for RSI.	VB	Organizational Experience: Quality Improvement	USA, academic medical center	n/a	n/a	n/a	n/a
190	Gayer G, Lubner MG, Bhalla S, Pickhardt PJ. Imaging of abdominal and pelvic surgical and postprocedural foreign bodies. <i>Radiol Clin North Am.</i> 2014;52(5):991-1027.	Explained various imaging presentations of RSIs and the complexity of identifying retained items amid other patient care items, such as packing, drains, and implants.	VA	Expert Opinion/ Literature Review	n/a	n/a	n/a	n/a	n/a
191	Asiyanbola B, Etienne-Cummings R, Lewi JS. Prevention and diagnosis of retained foreign bodies through the years: past, present, and future technologies. <i>Technol Health Care.</i> 2012;20(5):379-386.	Review of detection methods for retained items.	VA	Literature Review	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
192	Berkowitz S, Marshall H, Charles A. Retained intra-abdominal surgical instruments: time to use nascent technology? Am Surg. 2007;73(11):1083-1085.	Integration of technology, such as RFID, is essential to improving patient safety and preventing RSI, but it is unlikely to be sufficient. Human error is complex and relies on interpersonal interaction and system parameters (staffing, training, organizational culture). As such, systems-level interventions, such as RFID, are important to reduce the incidence of RSI.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a
193	Ellner SJ, Joyner PW. Information technologies and patient safety. Surg Clin North Am. 2012;92(1):79-87.	Discussion of the role of technology in the prevention of RSIs.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a
194	ECRI. Radio-frequency surgical sponge detection: a new way to lower the odds of leaving sponges (and similar items) in patients. Health Devices. 2008;37(7):193-203.	Review of RF technology for RSI prevention.	VC	Expert Opinion	n/a	n/a	n/a	n/a	n/a
195	Electromagnetic Compatibility (EMC). Radio Frequency Identification (RFID). US Food and Drug Administration. http://www.fda.gov/Radiation-EmittingProducts/RadiationSafety/ElectromagneticCompatibilityEMC/ucm116647.htm . Accessed November 10, 2015.	Harms to the patient from RFID technology may include the potential to interfere with pacemakers, implantable cardioverter defibrillators, and other electronic medical devices, or the potential hazard of electromagnetic interference (EMI) to electronic medical devices from RF transmitters.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
196	Hadjiiski L, Marentis TC, Chaudhury AR, Rondon L, Chronis N, Chan HP. Computer aided detection of surgical retained foreign object for prevention. Med Phys. 2015;42(3):1213.	Trial of a 3D micro tag for surgical sponges that is designed to have a signature appearance on radiograph from any view. As part of the trial, the researchers embedded 3D micro tags in surgical sponges that were placed in cadavers. The researchers then imaged the cadavers and assessed the sensitivity of detecting the 3D micro tags on radiograph images among surgeons (81.5%) and radiologists (96.1%). This study also presented the application of computer-aided detection technology for detection of the micro tag on radiograph imaging.	IIIB	Non-experimental	Lab, cadaver	n/a	n/a	1800	Detection of 3D micro tag
197	Guideline for product selection. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:179-186.	AORN product selection guidelines	IVB	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a
198	Etchells E, Koo M, Daneman N, et al. Comparative economic analyses of patient safety improvement strategies in acute care: a systematic review. BMJ Qual Saf. 2012;21(6):448-456.	Systematic review of cost-benefit analysis reports comparing various RSI prevention methods. Found that standard counting is the most economical strategy. More comparative economic analyses are needed.	IIIA	Systematic Review	n/a	n/a	n/a	5 reports, 7 comparisons	Cost

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
199	Greenberg CC, Diaz-Flores R, Lipsitz SR, et al. Bar-coding surgical sponges to improve safety: a randomized controlled trial. <i>Ann Surg.</i> 2008;247(4):612-616.	RCT compared a barcoded sponge system (ie, 2D matrix) to a traditional count protocol and found that the barcoding system identified significantly more count discrepancies than the traditional manual count protocol, although the system increased the time spent counting. The researchers discussed that the introduction of technology and the associated learning curve may have influenced the study results, as a qualitative survey showed that some personnel struggled while most easily adapted to the technology. A limitation of the study is that it was not statistically powered to detect a reduction in retained surgical sponges, which is a rare event requiring a very large sample size.	IB	RCT	USA	Barcoded sponge system	Traditional count protocol	300 general surgery procedures	Primary: number of incidents of miscounted or misplaced sponges detected. Secondary: total time devoted to counting activities, the number of miscounts, and the number of misplaced or retained sponges, the number of operations with any discrepancy and each type of discrepancy, and the

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
200	Cima RR, Kollengode A, Clark J, et al. Using a data-matrix-coded sponge counting system across a surgical practice: impact after 18 months. Jt Comm J Qual Patient Saf. 2011;37(2):51-58.	Implemented a data-matrix-coded (ie, 2D matrix) sponge system. They initially conducted two trials to assess the system before institution-wide implementation. In an 18-month period during which 87,404 procedures were performed, no RSIs were reported. The first trial measured time spent counting data-matrix coded sponges (n = 365) and control sponges (n = 335) for colon and rectal procedures. Although the initial time for counting data-matrix-coded sponges was 11 seconds, the time was reduced to five seconds after four days of implementation; the time to count control sponges was four seconds. This report is limited by the nature of an organizational experience report and may not be generalizable to other institutions.	VB	Organizational experience: Quality improvement	USA	n/a	n/a	n/a	n/a
201	Macario A, Morris D, Morris S. Initial clinical evaluation of a handheld device for detecting retained surgical gauze sponges using radiofrequency identification technology. Arch Surg. 2006;141(7):659-662.	Tested an RFID wand device in eight patients undergoing abdominal surgery as part of an experimental trial with blinding. The RFID wand detected all sponges correctly in less than three seconds. However, the study was limited by a very small sample size.	IIC	Quasi-experimental	USA	RFID sponges	n/a	8 patients undergoing abdominal or pelvic surgery	Detection of sponges
202	Fabian CE. Electronic tagging of surgical sponges to prevent their accidental retention. Surgery. 2005;137(3):298-301.	Assessed the feasibility of identifying RF-tagged surgical sponges and durability of the device in water and body fluids.	IIB	Quasi-experimental	Lab, cadavers	RF tagged sponges	n/a	600 readings	Detection and durability of tagged sponges
203	Rogers A, Jones E, Oleynikov D. Radio frequency identification (RFID) applied to surgical sponges. Surg Endosc. 2007;21(7):1235-1237.	Assessed the feasibility of identifying RFID-tagged surgical sponges and durability of the device in water and body fluids.	IIIB	Non-experimental	Lab, animal	n/a	n/a	n/a	Detection and durability of tagged sponges

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
204	Guideline for environmental cleaning. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:9-30.	AORN environmental cleaning guidelines.	IVA	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a
205	Kranzfelder M, Schneider A, Fiolka A, et al. Real-time instrument detection in minimally invasive surgery using radiofrequency identification technology. J Surg Res. 2013;185(2):704-710.	Used RFID tagged instruments in 10 laparoscopic cholecystectomies and found that this technology was feasible for real-time, reliable instrument detection. However, some miscounts occurred during continuous application of electrosurgery current. This study is limited by a small sample size.	IIIB	Non-experimental	Germany	n/a	n/a	10	Detection of tagged instruments
206	Neumuth T, Meissner C. Online recognition of surgical instruments by information fusion. Int J Comput Assist Radiol Surg. 2012;7(2):297-304.	Used RFID information fusion technology and correctly identified instrument usage during surgical procedures 97% of the time.	IIIB	Non-experimental	Germany, simulation	n/a	n/a	n/a	Detection of tagged instruments
207	Guideline for sterilization. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:665-692.	AORN sterilization guidelines.	IVA	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
208	Yamashita K, Kusuda K, Tokuda Y, et al. Validation of cleaning evaluation of surgical instruments with RFID tags attached based on cleaning appraisal judgment guidelines. Conference Proceedings: Annual International Conference of the IEEE Engineering in Medicine & Biology Society; 2013:926-929.	Evaluated the effectiveness of a washer-disinfector for cleaning surgical instruments with attached RFID tags. After fixation of simulated contaminants (sheep blood treated with heparin and 1% protamine sulfate) on the surgical instrument RFID tag, the researchers cleaned one group of instruments in a washer disinfector and another group in an ultrasonic washer; a third group underwent no cleaning process. Following these interventions, the residual protein was recovered and measured using cleaning appraisal guidelines from Japan and Germany. The results showed that the washer-disinfector was effective in achieving recommended residual protein amounts after cleaning of instruments with RFID tags. Although the researchers concluded that secondary infection risk from surgical instruments with RFID tags attached was low, the study was not designed to assess patient outcomes and infection risk. A major limitation of this study was that the sample size and type of instruments were not reported.	IIC	Quasi-experimental	Japan	RFID tagged instruments	Washer disinfector vs. ultrasonic washer vs. no cleaning process	Not reported	Cleanliness of RFID tagged instruments (residual protein)
209	Guideline for health care information management. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:491-512.	AORN documentation guidelines.	IVB	Clinical Practice Guideline	n/a	n/a	n/a	n/a	n/a
210	LD.04.01.07: The hospital has policies and procedures that guide and support patient care, treatment, and services. In: Hospital Accreditation Standards. Oakbrook Terrace, IL: Joint Commission Resources; 2014.	Joint Commission: The hospital has policies and procedures that guide and support patient care, treatment, and services.	n/a	Accreditation	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
211	SS.1: Organization. In: NIAHO Interpretive Guidelines and Surveyor Guidance. 10.1 ed. Milford, OH: DNV Healthcare Inc; 2012:70-71.	DNV Surgical Services Standards	n/a	Accreditation	n/a	n/a	n/a	n/a	n/a
212	2014 Accreditation Requirements for Acute Care Facilities. Chicago, IL: Healthcare Facilities Accreditation Program; 2014.	HFAP Standards	n/a	Accreditation	n/a	n/a	n/a	n/a	n/a
213	Burton JL. Health and safety at necropsy. J Clin Pathol. 2003;56(4):254-260.	Counted sharps and instruments that are retained in the organ donor may cause injury at autopsy.	VC	Expert Opinion	n/a	n/a	n/a	n/a	n/a
214	Karl R, Karl MC. Adverse events: root causes and latent factors. Surg Clin North Am. 2012;92(1):89-100.	Two approaches to human error: individual and system are presented in two cases with recommendations using cause analysis.	VB	Expert Opinion	n/a	n/a	n/a	n/a	n/a
215	Elbardissi AW, Sundt TM. Human factors and operating room safety. Surg Clin North Am. 2012;92(1):21-35.	Historically, surgical errors have been viewed as being determined primarily by the technical skill of the surgeon. However, focusing only on individual skill assumes that surgeons and other members of the surgical team perform highly and uniformly, regardless of the variable working conditions within the OR environment. Alternatively, a work systems approach recognizes that surgical skill alone is not sufficient to determine outcomes, because the process of delivering surgical care involves several interdependent variables, many of which vary across hospitals, ORs, or surgical cases, and most of which are not normally under the control of the surgical team.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a
216	Boysen PG 2nd. Just culture: a foundation for balanced accountability and patient safety. Ochsner J. 2013;13(3):400-406.	Perioperative team members in a just culture are not only accountable for their own actions but are also accountable to each other in protecting patients.	VB	Literature Review	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
217	LD.04.04.05 The hospital has an organization-wide, integrated patient safety program within its performance improvement activities. In: Hospital Accreditation Standards. Oakbrook Terrace, IL: Joint Commission Resources; 2015.	Joint Commission: The hospital has an organization wide, integrated patient safety program within its performance improvement activities.	n/a	Accreditation	n/a	n/a	n/a	n/a	n/a
218	American Association for Accreditation of Ambulatory Surgery Facilities. Quality assessment/quality improvement: quality improvement. In: Regular Standards and Checklist for Accreditation of Ambulatory Surgery Facilities. Version 14 ed. Gurnee, IL: American Association for Accreditation of Ambulatory Surgery Facilities; 2014:65.	AAAASF Quality Program Standards	n/a	Accreditation	n/a	n/a	n/a	n/a	n/a
219	Quality management system. In: NIAHO Interpretive Guidelines and Surveyor Guidance. 10.1 ed. Milford, OH: DNV Healthcare Inc; 2012:10-16.	DNV Quality Program Standards	n/a	Accreditation	n/a	n/a	n/a	n/a	n/a
220	Quality management and improvement. In: 2014 Accreditation Handbook for Ambulatory Health Care. Skokie, IL: Accreditation Association for Ambulatory Health Care; 2014:32-36.	AAAHC Quality Program Standards	n/a	Accreditation	n/a	n/a	n/a	n/a	n/a

Guideline for Prevention of Retained Surgical Items
Evidence Table

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
221	Bell R. Hide and seek, the search for a missing swab: a critical analysis. J Perioper Pract. 2012;22(5):151-156.	Reported a critical incident analysis of a near miss where the sponge was found in the drapes during count reconciliation procedures.	VA	Clinician Experience	n/a	n/a	n/a	n/a	n/a
222	Serious Reportable Events in Healthcare—2011 Update: A Consensus Report. Washington, DC: National Quality Forum; 2011.	National Quality Forum event reporting.	n/a	Quality Organization	n/a	n/a	n/a	n/a	n/a