REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
1	Bosma S.E., Wong K.C., Paul L., Gerbers J.G., Jutte P.C. A cadaveric comparative study on the surgical accuracy of freehand, computer navigation, and patient-specific instruments in joint-preserving bone tumor resections. *Sarcoma* . 2018;2018:4065846.	Nonexperimental	4 human cadavers	n/a	n/a	Location accuracy, entry and exit points of cutting planes, and resection time	Compared to freehand and computer-assisted surgery, patient specific instrumentation demonstrated the most accuracy in tumor and bone resection in the shortest time and was easy to use in simulated tumor resections performed on human cadaver knees.	IIIC
2	Sakes A., Hovland K., Smit G., Geraedts J., Breedveld P. Design of a novel three- dimensional-printed two degrees-of-freedom steerable electrosurgical grasper for minimally invasive surgery. *J Med Devices Trans ASME* . 2018;12(1):011007.	Case Report	n/a	n/a	n/a	n/a	Description of the process and initial proof of concept testing for a novel 3D-printed steerable grasper with bipolar capability. Further development and testing is needed, but the developed instrument creates more opportunities for patient-specific surgery and greater maneuverability than currently available rigid laparoscopic instrumentation.	VA
3	Vernikouskaya I., Bertsche D., Rottbauer W., Rasche V. 3D-XGuide: Open-source X-ray navigation guidance system. *Int J Comput Assisted Radiol Surg* . 2021;16(1):53-63.	Nonexperimental	1 MRI/Xray phantom consisting of glass spheres embedded in gel in a glass tube	n/a	n/a	Performance of steps execution; accuracy of registration and image fusion	Test of 3D-Xguide software system for multimodal fusion and navigation guidance in the cath lab and in the lab setting on phantom models. Concluded that although the system has some current performance limitations (eg, synchronization challenges for catheter tracking) in the lab setting, they may be less pronounced in the clinical setting and still accurate for image fusion during biplane operation. As an open-source system, this software will allow for future research in image-guided interventions.	IIIC
4	Huang M., Tetreault T.A., Vaishnav A., York P.J., Staub B.N. The current state of navigation in robotic spine surgery. *Ann Transl Med* . 2021;9(1):e07.	Literature Review	n/a	n/a	n/a	n/a	Although initial adoption of spine surgery robots was limited, their recent use has expanded with the introduction of 3D computer-assist navigation added to modern spine robotic platforms. Current available FDA-approved robots are shared-control where the surgeon maintains primary control of the procedure.	VA
5	Edstrom E., Burstrom G., Nachabe R., Gerdhem P., Terander A.E. A novel augmented-reality-based surgical navigation system for spine surgery in a hybrid operating room: Design, workflow, and clinical applications. *Oper Neurosurg* . 2020;18(5):496-502.	Organizational Experience	20 cases requiring pedicle screw placement	n/a	n/a	Total OR time, prep time (skin incision to CBCT acquisition), total navigation time (3D segmentation, screw path planning, navigated surgery time)	This technology is useful for performing highly accurate surgery that may reduce risk of complications and the need for revision while minimizing radiation exposure to staff.	VC
6	Burström G, Nachabe R, Homan R, et al. Frameless patient tracking with adhesive optical skin markers for augmented reality surgical navigation in spine surgery. *Spine (Phila Pa 1976)* . 2020.	Nonexperimental	113 pedicle devices from 18 CBCTs (4 cadavers); 253 pedicle screws from 35 CBCTs (20 patients)	n/a	n/a	Accuracy per level	Augmented reality surgical navigation (ARSN) using optical video cameras and adhesive skin markers for patient tracking is a viable option for spinal surgery because of its accuracy independent of vertebral position and easy incorporation into surgical workflow without obstructing the field or needing registration/calibration.	IIIB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
7	Du X., Allan M., Dore A., et al. Combined 2D and 3D tracking of surgical instruments for minimally invasive and robotic-assisted surgery. *Int J Comput Assisted Radiol Surg* . 2016;11(6):1109-1119.	Case Report	n/a	n/a	n/a	n/a	Demonstrated accuracy of novel method combining 2D and 3D tracking of surgical robotic instruments.	VC
8	Beyl T., Nicolai P., Comparetti M.D., Raczkowsky J., De Momi E., Worn H. Time-of-flight-assisted kinect camera-based people detection for intuitive human robot cooperation in the surgical operating room. *Int J Comput Assisted Radiol Surg* . 2016;11(7):1329-1345.	Organizational Experience	n/a	n/a	n/a	n/a	Describes pilot testing of detection system utilizing cameras to detect human-robot interactions in the OR.	VA
9	Van Wicklin SA, Conner R, Spry C. Guideline for processing flexible endoscopes. In: Conner R, ed. *Guidelines for perioperative practice.* Denver, CO: AORN, Inc.; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides best practice for the care and processing of flexible endoscopes.	IVA
10	Kyle E, Wood A. Guideline for care and cleaning of surgical instruments. In: Kyle E, ed. *Guidelines for perioperative practice.* Denver, CO: AORN, Inc.; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides best practice for the cleaning and care of surgical instruments.	IVA
11	Burlingame BL, Conner R. Guideline for design and maintenance of the surgical suite. In: Conner R, ed. *Guidelines for perioperative practice.* Denver, CO: AORN; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides guidance for design, construction, and maintenance of perioperative and procedural areas.	IVA
12	Jones E. Guideline for surgical smoke safety. In: Kyle E, ed. *Guidelines for perioperative practice.* Denver, CO: AORN, Inc.; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides best practice for the safe management of surgical smoke.	IVA
13	Wood A. Guideline for transmission-based precautions. In: Wood A, ed. *Guidelines for perioperative practice.* Denver, CO: AORN, Inc.; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides guidance for implementing standard precautions and transmission-based precautions to prevent pathogen transmission.	IVA
14	Burlingame BL. Guideline for prevention of hypothermia. In: Wood A, ed. *Guidelines for perioperative practice.* Denver, CO: AORN, Inc.; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides guidance for the prevention or treatment of unplanned hypothermia.	IVA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
15	Johnstone EM, Burlingame BL, Conner R. Guideline for a safe environment of care. In: Conner R, ed. *Guidelines for perioperative practice.* Denver, CO: AORN; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides guidance for maintaining a safe environment of care for patients and perioperative personnel.	IVA
16	Burlingame BL. Guideline for radiation safety. In: Kyle E, ed. *Guidelines for perioperative practice.* Denver, CO: AORN, Inc.; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides guidance for preventing injury of patients and health care workers resulting from exposure to medical ionizing radiation in the perioperative environment.	IVA
17	Van Wicklin SA. Guideline for positioning the patient. In: *Guidelines for perioperative practice.* Denver, CO: AORN, Inc.; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides best practice for positioning of the perioperative patient.	IVA
18	Burlingame BL, Kyle E, Wood A. Guideline for electrosurgical safety. In: Kyle E, Wood A, eds. *Guidelines for perioperative practice.* Denver, CO: AORN; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides best practice for the use of electrosurgical devices.	IVA
19	*Ethical considerations regarding the implementation of new technologies and techniques in surgery.* Society of American Gastrointestinal and Endoscopic Surgeons (SAGES); 2014.	Expert Opinion	n/a	n/a	n/a	n/a	Described creation of a New Technologies committee, including representation from administration, physicians, and nursing leadership, to review ethical considerations when implementing new technology and techniques in surgery. The committee reviewed new device and procedure proposals for use in the system, develop uniform credentialing standards, and track early outcomes to improve quality.	VB
20	Sabnis R, Ganesamoni R, Mishra S, Sinha L, Desai MR. Concept and design engineering: endourology operating room. Curr Opin Urol. 2013;23(2):152–157.	Literature Review	n/a	n/a	n/a	n/a	A customized integrated endourology OR will facilitate endourology procedures, ease the workflow in the OR and improve patient outcomes. Meticulous planning that involves experts in the field is critical for success of the project.	VB
21	Schaadt J, Landau B. Hybrid or 101: A primer for the or nurse. *AORN J* . 2013;97(1):81-100 20p.	Expert Opinion	n/a	n/a	n/a	n/a	Because demand for procedures that can be performed in a hybrid OR is increasing, many institutions are considering or are in the process of building a hybrid OR. Currently, no standards exist related to a hybrid OR's location, design, procedure volumes, patient types, staffing requirements, skill sets, or workflow. The unique technology and equipment inherent to a hybrid OR affects the OR workflow. The ability to successfully plan, design, and implement a hybrid OR program requires strategic vision and the cohesive efforts of a multidisciplinary team, of which the OR nurse is a key member.	VA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
22	Kaduk WMH, Podmelle F, Louis PJ. Surgical navigation in reconstruction. *ORAL MAXILLOFAC SURG CLIN NORTH AM* . 2013;25(2):313-333 21p.	Organizational Experience	n/a	n/a	n/a	n/a	Describes the process for using surgical navigation, from pre-purchase considerations through intraoperative implementation to postprocedure tasks and includes description of checklists used to aid setup and task completion.	VB
23	Korb W, Geisler N, Straus G. Solving challenges in inter- and trans-disciplinary working teams: Lessons from the surgical technology field. *Artif Intell Med* . 2015;63(3):209-219.	Literature Review	n/a	n/a	n/a	n/a	An innovative cooperative working culture for the interdisciplinary field of computer-assisted surgery requires a shared mental model, common goals, and a cooperative learning culture.	VA
24	Raytis J, Yuh B, Lau C, Fong Y, Lew M. Anesthetic implications of robotically assisted surgery with the da vinci xi surgical robot. *Open Journal of Anesthesiology* . 2016;06:115-118.	Expert Opinion	n/a	n/a	n/a	n/a	Describes patient safety considerations for anesthesia professionals during surgeries that use the da Vinci Xi robotic platform compared to older models. Orientation of the patient to the robot, access to the patient, and the potential for unintended patient contact with the robot arms are discussed.	VB
25	Samii A, Gerganov VM. The dedicated endoscopic operating room. World Neurosurg. 2013;79(2 Suppl):S15.e19–e22.	Expert Opinion	n/a	n/a	n/a	n/a	A dedicated endoscopy OR should be optimized for workflow and ergonomics, as well as patient safety standards. A flexible setup allows multiple service lines to utilize the space to maximize cost efficiency. Modular organization with flexible platforms for integration of novel technologies in the future may be the optimal solution.	VB
26	Holland TK, Morris S, Cutner A. Gynaecologists' and general surgeons' preference for the features of integrated theatres: A discrete choice experiment. *BMC Womens Health* . 2018;18(1):112.	Qualitative	167 surgeons (103 gyn, 64 general)	n/a	n/a	Prioritizing attributes of laparoscopic theatres: ceiling vs. floor mounted displays, adjustable vs. fixed displays, CO2 supply vs. tanks, CO2 control from field vs. non sterile personnel, room light control, cordless vs. cords on floors, external video transmission	Gynecologic and general surgeons preferred adjustable displays, followed by a wire free floor, CO2 controlled from the sterile field, and room lights controlled from the sterile field. How the displays were mounted, CO2 supply, and external image transmission were not significant. No significant differences between gynecologists and general surgeons or male and female respondents.	IIIB
27	Sakata S, Grove PM, Hill A, Watson MO, Stevenson ARL. The viewpoint-specific failure of modern 3D displays in laparoscopic surgery. *Langenbecks Arch Surg* . 2016;401(7):1007-1018.	Quasi-experimental	Experiment 1: 15 junior doctors. Experiment 2: 6 nurses, 6 surgical assistants	Viewing position (4 heights, 11 distances, 4 angles).	Comparison of different viewing positions	Visual ghosting and discomfort associated with viewing the screen	Studied the effect different viewing positions has on surgical team members' experience of visual ghosting and discomfort. Concluded that standard viewing positions during pelvic laparoscopic procedures are suboptimal for viewing 3D laparoscopic displays and may yield high levels of discomfort. Recommended interventions included raising the OR bed so that the surgeon stands when viewing the display, standing on platforms, or using multiple monitors to avoid trade-offs between the surgeon and the team's comfort.	IIB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
28	Stucky CH, Cromwell KD, Voss RK, et al. Surgeon symptoms, strain, and selections: Systematic review and meta-analysis of surgical ergonomics. *Annals of Medicine and Surgery* . 2018;27:1-8.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Found that MIS surgeons are significantly more likely to experience musculoskeletal symptoms than those performing open surgery and that most surgeons who experience work-related symptoms are unlikely to seek medical attention. Also, reported that surgeons do not utilize many of the interventions available to improve surgical ergonomics due to lack of education.	IIIA
29	Dalager T, Søgaard K, Boyle E, Jensen PT, Mogensen O. Surgery is physically demanding and associated with multisite musculoskeletal pain: A Cross-sectional study. *J Surg Res* . 2019;240:30-39.	Qualitative	284 surgeons who worked in pelvic surgery (urology, colorectal, gynecology)	n/a	n/a	Prevalence and intensity of musculoskeletal pain	93% of surgeons reported musculoskeletal pain and 77% experienced pain at multiple sites. Those who performed conventional laparoscopies reported the shoulders as most painful, and in robotic surgery, the neck was reported as the most painful site. Median pain intensity reported ranged from 2-4, and 21-40% reported that their multisite pain negatively impacted their sleep, leisure time, and work. The researchers were concerned that pain could shorten a surgeon's career and emphasized the need for additional research to evaluate preventive and rehabilitative strategies.	IIIC
30	Zahiri HR, Addo A, Park AE. Musculoskeletal disorders in minimally invasive surgery. *Adv Surg* . 2019;53:209-220.	Literature Review	n/a	n/a	n/a	n/a	Summarizes existing literature on ergonomics in minimally invasive surgery, including the significance of the problem and proposes interventions to mitigate the musculoskeletal effects of MIS on surgeons' bodies.	VB
31	Dixon RG, Khiatani V, Statler JD, et al. Society of interventional radiology: Occupational back and neck pain and the interventional radiologist. *Journal of Vascular and Interventional Radiology* . 2017;28(2):195-199.	Literature Review	n/a	n/a	n/a	n/a	Interventional radiologists often experience neck and back pain, likely from the effects of standing for long periods, wearing heavy protective garments, and awkward static positions. Interventions including participating in design of the IR suite, placement of equipment, use of free-standing shielding in place of garments, and preventive measures, like exercise, can help.	VB
32	Schmitz PM, Gollnick I, Modemann S, Rothe A, Niegsch R, Strauss G. An improved instrument table for use in functional endoscopic sinus surgery. *Medical Science Monitor Basic Research* . 2015;21:131-134.	Quasi-experimental	300 functional endoscopic sinus surgeries	Improved instrument table	No instrument table	Preparation time, SLOT-time, different instruments used, manual interactions with the instruments, interactions between surgeon and scrub for each instrument handed off and returned, ergonomics of instrument interaction.	An improved instrument table was tested in endoscopic sinus surgeries and compared to cases where the table was not used. Preparation time was slightly longer but there were reductions in SLOT-time, number of instruments used, number of manual interactions with the instruments and interactions between the surgeon and scrub. Noted 40% improvement in ergonomics as reported by the surgical team. The only potential disadvantage identified was a reduction of working space and thereby a constraint of the scope. The researchers felt this problem was minor.	IIC
33	Buzink SN, van Lier L, de Hingh,Ignace H J T., Jakimowicz JJ. Risk-sensitive events during laparoscopic cholecystectomy: The influence of the integrated operating room and a preoperative checklist tool. *Surg Endosc* . 2010;24(8):1990-1995.	Quasi-experimental	45 laparoscopic cholecystectomies	Integrated OR with and without Pro/cheQ checklist	Cart-based OR	Risk-sensitive events	Examined the influence of the integrated OR system and Pro/cheQ digital checklist tool on the number and type of equipment and instrument-related risk-sensitive events (RSE) during laparoscopic cholecystectomies. Found that using both an integrated OR and Pro/cheQ has a stronger effect on reducing the number of RSE than using an integrated OR alone. The Pro/cheQ tool supported an optimal workflow in a natural way and raised the general safety awareness amongst all members of the surgical team. Concluded that implementation process is integral to success of integrated OR systems and checklists.	IIB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
34	Pluyter JR, Buzink SN, Rutkowski AF, Jakimowicz JJ. Do absorption and realistic distraction influence performance of component task surgical procedure? *Surg Endosc* . 2010;24(4):902-907 6p.	Quasi-experimental	12 medical interns	Distracting conditions (exposure to music, conversation, and nonoptimal handling of the laparoscope)	Nondistracting conditions	Task performance (task score, errors, operating time), irritation level	Under distracting conditions, the interns showed a significant decline in task performance and significantly increased irritation toward the assistant handling the laparoscope and the sources of social distraction. The results suggest careful evaluation of the sources of distraction in the operation room to reduce irritation for the surgeon and provision of proper pre-clinical laparoscope navigation training to increase patient safety.	IIA
35	Murad FM, Banerjee S, Barth BA, et al. Image management systems. *Gastrointest Endosc* . 2014;79(1):15-22.	Literature Review	n/a	n/a	n/a	n/a	Summarizes the literature on image quality, storage and retrieval systems, ease of use, and safety considerations. The committee recommended hospitals evaluate compatibility, image capture type (eg, standard definition vs. high definition), and integration with electronic health records and centralized storage and archival systems when purchasing image management systems.	VA
36	*45 CFR 160: Administrative Data Standards and Related Requirements.* 10–1–20 Edition ed. U.S. Government Publishing Office; 2020.	Regulatory	n/a	n/a	n/a	n/a	Health Insurance Portability and Accountability Act (HIPAA), sets the legal requirements for protecting sensitive patient data. Any company that deals with protected health information (PHI) must ensure that all the required physical, network, and process security measures are in place and followed.	n/a
37	*45 CFR 164: Security and Privacy.* 10–1–20 Edition ed. U.S. Government Publishing Office; 2020.	Regulatory	n/a	n/a	n/a	n/a	Health Insurance Portability and Accountability Act (HIPAA), sets the legal requirements for protecting sensitive patient data. Any company that deals with protected health information (PHI) must ensure that all the required physical, network, and process security measures are in place and followed.	n/a
38	Nanah A, Bayoumi AB. The pros and cons of digital health communication tools in neurosurgery: A systematic review of literature. *Neurosurg Rev* . 2020;43(3):835-846.	Systematic Review	n/a	n/a	n/a	n/a	Digital health tools improve the delivery of neurosurgical care in education, emergency services, and intraoperative surgical fields. Identifies concerns related to data breaches and time or cost inefficiency.	IIIB
39	Chen IA, Ghazi A, Sridhar A, et al. Evolving robotic surgery training and improving patient safety, with the integration of novel technologies. *World J Urol* . 2021;39(8):2883-2893.	Literature Review	n/a	n/a	n/a	n/a	Reports that studies integrating technology in robotic surgery training are low-quality, mostly expert opinion, consensus statements, and small qualitative studies. The literature reviewed discussed new technologies being used in robotic surgery training and a trend toward standardizing validated robotic training curricula. Also, the use of standardized validated robotic training curricula to objectively validate competency.	VA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
40	Santomauro M, Reina GA, Stroup SP, L'Esperance JO. Telementoring in robotic surgery. *Curr Opin Urol* . 2013;23(2):141-145.	Literature Review	n/a	n/a	n/a	n/a	Telementoring allows surgeons to remotely offer intraoperative guidance via telecommunication networks. MIS lends itself well to telementoring techniques for several reasons. The primary surgeon performing MIS works off of video images of the surgical field or images sent to a console, which gives the mentor the exact same images as the primary surgeon. This review highlights many of the latest technologies in telemedicine, which are applicable to MIS, and provides an overview of the pitfalls to be overcome to make telementoring (and eventually telesurgery) a standard practice.	VB
41	Haidegger T, Sándor J, Benyó Z. Surgery in space: The future of robotic telesurgery. *Surg Endosc* . 2011;25(3):681-690 10p.	Literature Review	n/a	n/a	n/a	n/a	Robotic technology in surgery is an emerging field, with potential for great impact on health care, especially telemedicine. Introduces a three-layer concept of currently available technology, including a teleoperated surgical robot to assist with procedures controlled earthside, telementoring, and consultancy telemedicine where an onboard flight surgeon is supported in long-distance telesurgery during human space missions.	VB
42	Saadi R., Goldenberg D. Using technology in global otolaryngology. *Otolaryngol Clin North Am* . 2018;51(3):555-561.	Literature Review	n/a	n/a	n/a	n/a	Technology, especially telemedicine and robotics, may improve access to care for otolaryngology patients in rural, remote, and resource-poor areas. Advances in telecommunications may also support remote training of surgeons and intraoperative consults.	VC
43	Abe T, Murai S, Nasuhara Y, Shinohara N. Characteristics of medical adverse Events/Near misses associated with Laparoscopic/Thoracoscopic surgery: A retrospective study based on the japanese national database of medical adverse events. *Journal of Patient Safety* . 2019;15(4):343-351. doi: http://dx.doi.org/10.1097/PTS.0000000000000422.	Nonexperimental	746 near miss or adverse events from laparoscopic or thoracoscopic procedures	n/a	n/a	Retained foreign bodies	The second most commonly reported adverse event, instrument breakage, was strongly associated with increased risk for RSI. Specialized checklists might reduce the risk of RSI and instrument breakage.	IIIA
44	Yasuhara H, Fukatsu K, Komatsu T, Murakoshi S, Saito Y, Uetera Y. Occult risk of broken instruments for endoscopy-assisted surgery. *World J Surg* . 2014;38(11):3015-3022.	Nonexperimental	39,817 non-robotic procedures from 2007 to 2011.	n/a	n/a	Rate of instrument breakage	MIS instruments broke significantly more often than regular surgical instruments. Inappropriate use and instrument wear were the top two causes of instrument breakage. Adverse events were attributed to fragments breaking off the instruments because of inappropriate use.	IIIB
45	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):324-6. doi: https://dx.doi.org/10.4103/0022-3859.138823.	Case Report	n/a	n/a	n/a	n/a	Two case reports describing retained fragments in pediatric patients. Suggested inspecting instruments for breakage upon removal from the patient.	VB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
46	Gangemi A., Danilkowicz R., Bianco F., Masrur M., Giulianotti P.C. Risk factors for open conversion in minimally invasive cholecystectomy. *JSLS* . 2017;21(4).	Organizational Experience	284 laparoscopic cholecystectomies; 676 fluorescence-aided robotic cholecystectomies	n/a	n/a	n/a	This retrospective analysis identified age >40, male gender, and preoperative diagnosis of acute or gangrenous cholecystitis as risk factors associated with higher risk of open conversion in minimally invasive cholecystectomy.	VB
47	Nakamura T., Ishii Y., Tsutsui A., Kaneda M., Sato T., Watanabe M. Safety and indications of laparoscopic surgery for postoperative small-bowel obstruction: A single-center study of 121 patients. *Surg Laparoscopy Endosc Percutaneous Tech* . 2017;27(4):301-305.	Nonexperimental	121 patients undergoing laparoscopy for postoperative small bowel obstruction	n/a	n/a	BMI, number of bowel obstructions, previous operative procedures, previous radiotherapy, operation time, blood loss, need for bowel resection	Laparoscopic surgery is safe and feasible for patients with postoperative small bowel obstruction. Multivariate analysis showed that previous radiotherapy was a risk factor for conversion to open.	IIIB
48	Stafford C., Francone T., Roberts P.L., Marcello P.W., Ricciardi R. What influences conversion to open surgery during laparoscopic colorectal resection? *Surg Endosc* . 2021;35(4):1584-1590.	Organizational Experience	744 colorectal registry patients	n/a	n/a	n/a	Concluded that a relatively low increased morbidity experienced by patients who had a laparoscopy that was converted to open procedure with 40 additional minutes of operating time translated to minimal complications compared to a cohort of patients who had an open procedure. The most common patient characteristic for converted cases was elevated body mass index; however, this value was not quantified.	VB
49	Bhama A.R., Wafa A.M., Ferraro J., et al. Comparison of risk factors for unplanned conversion from laparoscopic and robotic to open colorectal surgery using the michigan surgical quality collaborative (MSQC) database. *J Gastrointest Surg* . 2016;20(6):1223-1230.	Nonexperimental	4090 laparoscopic surgery patients and 706 robotic surgery patients	n/a	n/a	Conversion from MIS to open operation; secondary: significant risk factors for conversion to an open procedure	Risk factors for conversion in the laparoscopic group included: moderate/severe adhesions, obesity, colorectal cancer, hypertension, rectal operations, urgent priority, and tobacco use. Risk factors for conversion in the robotic group included severe adhesions, bleeding disorder, cancer, cirrhosis, and use of statins. Conversion rates were lower for robotic than laparoscopic colorectal surgery with fewer predictors of conversion.	IIIA
50	Aziret M, Koyun B, Karaman K, et al. Intraoperative hemorrhage and increased spleen volume are risk factors for conversion to open surgery in patients undergoing elective robotic and laparoscopic splenectomy. *Turk j surg* . 2020;36(1):72-81.	Organizational Experience	56 minimally invasive splenectomy patients	n/a	n/a	n/a	Found that age, gender, body mass index , ASA score, co-morbidities, operating time, accessory spleen, certain laboratory values (eg, INR, PDW, RDW, PLR, NLR), preoperative adhesions, and robotic surgery among several other factors were not associated with conversion to open surgery. Concluded that a spleen volume > 400 cm3 and intraoperative hemorrhage at the splenic hilum were associated with increased risk of conversion to open surgery in patients undergoing robotic or laparoscopic splenectomy.	VA
51	Ekici U., Tatli F., Kanlioz M. Preoperative and postoperative risk factors in laparoscopic cholecystectomy converted to open surgery. *Adv Clin Exp Med* . 2019;28(7):857-860.	Organizational Experience	145 laparoscopic cholecystectomy patients	n/a	n/a	n/a	Risk factors for conversion to an open procedure included male gender and body mass index between 20-25 as preoperative factors; intraoperative factors included history of ERCP, increased gallbladder wall thickness, the presence of multiple stones, adhesions, and chronic disease.	VC

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
52	Kohga A., Yajima K., Okumura T., et al. Laparoscopic vs open surgery for patients with strangulated small bowel obstruction. *Asian J Endosc Surg* . 2020;13(4):481-488.	Organizational Experience	96 patients who underwent surgery for strangulated small bowel obstruction	n/a	n/a	WBC, needing intestinal resection, procedure details	Identified risk factors for conversion to open procedure: elevated WBC, need for intestinal resection, and poor surgical field in patients at one facility.	VB
53	Llarena NC, Shah AB, Milad MP. Bowel injury in gynecologic laparoscopy: A systematic review. *Obstet Gynecol* . 2015;125(6):1407-1417.	Systematic Review	n/a	n/a	n/a	n/a	Included 90 studies between 1972-2014 with 474063 gynecologic laparoscopies. Reported an overall incidence of bowel injury in gynecologic laparoscopy of 1 in 769 but noted increased incidence with surgical complexity. Delayed diagnosis was associated with a mortality rate of 1 in 31.	IIA
54	Martins RC, Trevilato DD, Jost MT, Caregnato RCA. Nursing performance in robotic surgeries: Integrative review. *Rev Bras Enferm* . 2019;72(3):795-800.	Literature Review	n/a	n/a	n/a	n/a	Integrative review evaluating literature on nursing practice in robotic surgeries during preop, intraop, postop phases. Concluded that the nurse's role in robotic surgery during the three phases of care is similar to other major surgeries and focuses on patient safety, specific knowledge of positioning, and setup of the robot. Noted a disadvantage of robotics - cost - may be addressed by interventions aimed at reducing robot preparation/setup time but did not specify interventions.	VC
55	Muller M.K., Wrann S., Widmer J., Klasen J., Weber M., Hahnloser D. Perforated peptic ulcer repair: Factors predicting conversion in laparoscopy and postoperative septic complications. *World J Surg* . 2016;40(9):2186-2193.	Organizational Experience	71 patients who underwent peptic ulcer repair (35 primary open, 36 primary laparoscopic approach)	n/a	n/a	n/a	Unable to identify preoperative risk factors for conversion to open procedure for patients undergoing laparoscopic ulcer repair. Intraoperative factors for conversion included presence of generalized peritonitis and Mannheim peritonitis index > 21.	VB
56	Carlos G, Saulan M. Robotic emergencies: Are you prepared for a disaster? *AORN J* . 2018;108(5):493-501.	Organizational Experience	n/a	n/a	n/a	n/a	Robotic emergencies are generally technical, surgical, or anesthesia-related. Experienced teams implement checklists for each type of emergency to guide care of the patient. Awareness of team members' roles in emergencies is key to successfully handling this complex situation.	VA
57	Zattoni F, Guttilla A, Crestani A, et al. The value of open conversion simulations during robot-assisted radical prostatectomy: Implications for robotic training curricula. *Journal of Endourology* . 2015;29(11):1282-1288.	Organizational Experience	20 simulated emergencies	n/a	n/a	n/a	Described improvement project that applied root cause analysis methodology to simulations of converting robotic prostatectomy to open procedure. Analysis of the simulations revealed errors that were addressed by development of a standardized open conversion protocol that outlined the order of tasks and team roles during the event.	VB
58	Kang MJ, De Gagne J,C., Kang HS. Perioperative nurses' work experience with robotic surgery: A focus group study. *Comput Inform Nurs* . 2016;34(4):152-8.	Qualitative	15 nurses who had experience in robotic surgery	n/a	n/a	Experiences with robotic surgery	Four themes emerged from focus group interviews on nurses' experiences in robotics: a need to check and recheck the patient's safety and robot functioning, unexpected robot malfunctions, feeling burdened from working on the robotic team, and looking for additional knowledge. The researchers concluded that the themes identified were sources of stress for the nurses and served as areas needing education and training to build confidence and reduce anxiety.	IIIC

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
59	Edwards JP, Balderson SS, D'Amico T,A. Management of pulmonary arterial bleeding in the post induction setting. *J Vis Surg* . 2016;2:53.	Case Report	n/a	n/a	n/a	n/a	Case report of vessel injury during thoracoscopic lobectomy that focuses on achieving control of bleeding and subsequent suture repair of the defect.	VC
60	Walters C, Webb PJ. Maximizing efficiency and reducing robotic surgery costs using the NASA task load index. *AORN J* . 2017;106(4):283-294.	Organizational Experience	25 robotics cases observed	n/a	n/a	n/a	Outlined an organization experience in measuring robotics OR staff workload for the purpose of developing a cost-effective and safe staffing plan for robotics procedures.	VC
61	Yang X, Cheng Y, Cheng N, et al. Gases for establishing pneumoperitoneum during laparoscopic abdominal surgery. *Cochrane Database of Systematic Reviews.* 2022(3).	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Update of 2017 review added one new study for a total of 10 studies, which the authors rated overall as very low quality with few participants. Assessed the safety of pneumoperitoneum achieved with helium, nitrous oxide, and room air compared to the standard carbon dioxide. The review authors concluded there is not enough evidence to establish the safety or effectiveness of nitrous oxide, helium, or room air pneumoperitoneum compared to carbon dioxide pneumoperitoneum. Further rigorous research evaluating complications, harms, and quality of life are needed.	IA
62	Park EY, Kwon J, Kim KJ. Carbon dioxide embolism during laparoscopic surgery. *Yonsei Med J* . 2012;53(3):459-466.	Literature Review	n/a	n/a	n/a	n/a	Clinically significant carbon dioxide (CO2) embolism is a rare but sometimes fatal complication during laparoscopic surgery. The most common cause is inadvertent injection of CO2 into a large vein, artery or solid organ during insufflation of CO2 into a body cavity or from direct intravascular insufflation. Clinical presentation of gas embolism ranges from asymptomatic to death, dependent on the rate and volume of CO2 entrapment and the patient's condition. This literature review describes CO2 embolism in detail along with complications and treatment.	VB
63	Lee K, Kim JY, Kwak H, Lee H, Kwon IW. The effect of heating insufflation gas on acid-base alterations and core temperature during laparoscopic major abdominal surgery. Korean Journal of Anesthesiology. 2011;61(4):275-280.	RCT	30 Adult patients undergoing major abdominal surgery	Heated insufflation gas	Room temperature CO2	Acid-base balance, core temperature	The heating of insufflation CO2 did not affect changes in the acid-base status and PaCO2 in patients undergoing laparoscopic abdominal surgery when the ventilator was set to maintain constant end-tidal CO2. However, the heated CO2 reduced the decrease in the core body at temperature 30 min after the pneumoperitoneum.	IA
64	Krishnamoorthy B, Critchley W, Nair J, et al. Randomized study comparing the effect of carbon dioxide insufflation on veins using 2 types of endoscopic and open vein harvesting. *Innovations* . 2017;12(5):320-328.	RCT	301 patients undergoing three different types of vein harvesting	Closed tunnel CO2 endoscopic vein harvesting; open tunnel CO2 endoscopic vein harvesting	Traditional open vein harvesting	PaCO2, EtCO2, pH	Closed tunnel CO2 endoscopic vein harvesting at a low pressure does not affect the quality of the harvested vein compared to an open traditional technique but further research is needed to evaluate the long-term clinical outcomes of these grafts.	IB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
65	Kim J, Kim J, Chang M, Yoo Y, Kim D. Influence of carbon dioxide insufflation of the neck on intraocular pressure during robot-assisted endoscopic thyroidectomy: a comparison with open thyroidectomy. *Surg Endosc.* 2013;27(5):1587-1593.	Nonexperimental	37 patients undergoing thyroidectomy	n/a	Open thyroidectomy vs. robotic-assist endoscopic thyroidectomy with CO2 insufflation	intraocular pressure	Intraocular pressure (IOP) was significantly higher in patients who had robotic-assist endoscopic thyroidectomy with CO2 insufflation of the neck at pressure of 6 mmHg compared to patients who underwent open thyroidectomy. The researchers suggested that the increase in IOP could be mitigated by an anesthetic-induced IOP-lowering effect (sevoflurane), thereby having no clinical significance in patients with normal IOP undergoing robot-assisted endoscopic thyroidectomy.	IIIB
66	AAGL Advancing Minimally Invasive Gynecology Worldwide, Munro MG, Storz K, et al. AAGL practice report: Practice guidelines for the management of hysteroscopic distending media: (replaces hysteroscopic fluid monitoring guidelines. J am assoc gynecol laparosc. 2000;7:167-168.). *J Minim Invasive Gynecol* . 2013;20(2):137-148.	Guideline	n/a	n/a	n/a	n/a	Practice guideline for hysteroscopic distending media	IVB
67	Craciunas L, Sajid MS, Howell R. Carbon dioxide versus normal saline as distension medium for diagnostic hysteroscopy: A systematic review and meta-analysis of randomized controlled trials. *Fertility & Sterility* . 2013;100(6):1709-14.e1-4. Accessed 20131129.	Systematic Review w/ Meta-Analysis	10 RCTs	CO2 distention media for hysteroscopy	normal saline distention media for hysteroscopy	n/a	Meta-analysis results from moderate-quality trials weakly suggest that normal saline is superior to CO2 in diagnostic hysteroscopy in terms of procedural and shoulder pain, side effects, patient satisfaction, procedure duration, and quality of view. Owing to limited clinical diversity, statistical heterogeneity, and risk of bias, it is clear that additional multicenter RCTs are needed to corroborate these findings before firm evidence-based guidelines can be developed.	IA
68	Jacobs VR, Morrison JE,Jr, Kiechle M. ILL law twenty-five simple ways to increase insufflation performance and patient safety in laparoscopy. J Am Assoc Gynecol Laparosc. 2004;11(3):410-423.	Organizational Experience	n/a	n/a	n/a	n/a	Proposes 25 suggestions for improving insufflation performance and increasing patient safety.	VA
69	*Guidelines for the use of laparoscopy during pregnancy.* Society of American Gastrointestinal and Endoscopic Surgeons (SAGES); 2017.	Guideline	n/a	n/a	n/a	n/a	Provides guidance to physicians for laparoscopy in patients who are pregnant in the areas of diagnostic work-up and treatment of conditions requiring surgical intervention.	IVB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
70	Abaza R, Martinez O, Murphy C. Randomized controlled comparison of valveless trocar (AirSeal) vs standard insufflator with ultralow pneuomoperitoneum during robotic prostatectomy. *J Endourol* . 2021;35(7):1020-1024.	RCT	100 robotic prostatectomy patients; randomized to 50 control and 50 intervention	Valveless insufflation (AirSeal)	Conventional insufflation system	Frequency of need to increase pneumoperitoneum pressure > 6mmhg; maximum pressures used and duration; quality of smoke evacuation; number of laparoscope cleanings per case; postoperative pain; respiratory and hemodynamic parameters; CO2 elimination	The researchers were unable to identify physiologic or postoperative recovery benefits but demonstrated feasibility of performing robotic prostatectomy at ultralow peritoneum (ie, 6 mmhg) with either insufflation method and more intraabdominal pressure stability in the intervention group. They recommended surgeons consider using AirSeal as it could allow them to use lower pressure pneumoperitoneum with better visibility from smoke evacuation and reduce interruptions to clean the laparoscope.	IC
71	Madueke Laveaux OS, Advincula A, Grimes CL, et al. A comparison of carbon dioxide (CO2) absorption rates in gynecologic laparoscopy with a valveless insufflation system versus standard insufflation system at intra-abdominal pressures of 10 mmHg and 15 mmHg-A randomized controlled trial. *Journal of minimally invasive gynecology* . 2017;24(7):S61.	RCT	132 patients undergoing gynecologic laparoscopic surgery	Valveless insufflation (AirSeal); insufflation pressure 10 mmHg	Standard insufflation system; insufflation pressure 15 mmHg	Primary: CO2 absorption rate; secondary: operative field visualization, ability to maintain adequate etCO2, postoperative shoulder pain	No difference in CO2 absorption, ability to maintain etCO2, or postoperative pain between valveless and standard insufflation at different pressures. Reported improved visualization with use of valveless insufflation in healthy women who have gynecologic robotic and laparoscopic surgery.	IA
72	Oztan MO, Koyluoglu G, Aydin G, Sutas Bozkurt P, Cigsar EB. Effects of carbon dioxide insufflation and trendelenburg position on brain oxygenation during laparoscopy in children. *Surg Laparoscopy Endosc Percutaneous Tech* . 2019;29(2):90-94.	Quasi-experimental	44 pediatric patients undergoing appendectomy (22 open, 22 laparoscopic approach)	Laparoscopic appendectomy (CO2 pneumoperitoneum with 15 degree Trendelenburg position and left tilt)	Open appendectomy (supine)	Primary: cerebral oxygen saturation. Secondary: hemodynamic parameters (eg, heart rate, mean arterial pressure, end tidal CO2 pressure, SpO2.	Trendelenburg with left tilt position during pneumoperitoneum has no negative effect on cerebral oxygen saturation in ASA I pediatric patients undergoing laparoscopic appendectomy compared to open approach.	IIB
73	Skinner S, Crossley K, Amberg B, et al. Partial amniotic carbon dioxide insufflation for fetal surgery. *Prenat Diagn* . 2018;38(13):983-993.	Literature Review	n/a	n/a	n/a	n/a	The clinical outcomes of using partial amniotic CO2 insufflation (PACI) are difficult determine due to heterogeneity in technique, (eg, insufflation pressure, duration, gas temperature, humidity) and because available literature studying animals may not be generalizable to humans. Further research needed to determine safe pressure range for PACI.	VB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
74	Madsen MV, Istre O, Staehr-Rye AK, et al. Postoperative shoulder pain after laparoscopic hysterectomy with deep neuromuscular blockade and low-pressure pneumoperitoneum: A randomised controlled trial. *European journal of anaesthesiology* . 2016;33(5):341.	RCT	99 laparoscopic hysterectomy patients	Deep neuromuscular blockade with 8 mmHg pneumoperitoneum	Moderate neuromuscular blockade with 12 mmHg pneumoperitoneum	Postoperative shoulder pain/discomfort, incisional and overall pain, opioid consumption, nausea/vomiting, antiemetic consumption, time to recovery of activities of daily living, length of hospital stay, duration of surgery.	Found that a combination of deep neuromuscular blockade (NMB) and low pressure (8mmHg) pneumoperitoneum resulted in reduced shoulder pain after laparoscopic hysterectomy compared to moderate NMB with 12mmHg pneumoperitoneum without affecting procedure duration or completion.	IC
75	Eryilmaz HB, Memis D, Sezer A, Inal MT. The effects of different insufflation pressures on liver functions assessed with LiMON on patients undergoing laparoscopic cholecystectomy. *The scientific world journal* . 2012;2012:172575.	RCT	43 laparoscopic cholecystectomy patients	10 mmHg pneumoperitoneum pressure	14 mmHg pneumoperitoneum pressure	Liver function	The results showed that insufflation pressure of 14mmHg decreased the blood flow to the liver and increased postoperative 1st hour serum AST and ALT levels. Recommend an insufflation pressure of 10mmHg for laparoscopic cholecystectomy procedures.	IA
76	Liu F, Zhu S, Ji Q, Li W, Liu J. The impact of intra-abdominal pressure on the stroke volume variation and plethysmographic variability index in patients undergoing laparoscopic cholecystectomy. *Bioscience Trends* . 2015;9(2):129-133.	Nonexperimental	45 elective laparoscopic cholecystectomy patients	n/a	n/a	Intraabdominal pressure (IAP) on stroke volume variation (SVV) and plethysmographic variability index (PVI)	Evaluated the effect of increasing intra-abdominal pressure (IAP) on stroke volume variation (SVV) and plethysmographic variability index (PVI) in patients undergoing laparoscopic cholecystectomy. Concluded that SVV and noninvasive PVI showed correlative changes with increased IAP related to CO2 insufflation.	IIIB
77	Karaveli A, Kavaklı AS, Özçelik M, Ateş M, İnanoğlu K, Özmen S. The effect of different levels of pneumoperitoneum pressures on regional cerebral oxygenation during robotic assisted laparoscopic prostatectomy. *Turk J Med Sci* . 2021;51(3):1136-1145.	Nonexperimental	45 robotic assist laparoscopic prostatectomy patients	n/a	low 12 mmHg vs. high 15 mmHg pneumoperitoneum pressure	regional cerebral oxygenation saturation (rSO2)	No statistically significant difference in rSO2 values between the two pneumoperitoneum pressures and no cerebral desaturation was observed. Concluded that low-pressure pneumoperitoneum is safe for robotic surgeries, like robotic assist laparoscopic prostatectomies.	IIIC

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
78	Munro MG, Christianson LA. Complications of hysteroscopic and uterine resectoscopic surgery. *Clin Obstet Gynecol* . 2015;58(4):765-797.	Expert Opinion	n/a	n/a	n/a	n/a	Adverse events associated with hysteroscopic procedures are generally rare, but, with increasing operative complexity, they are now more common. Complications are related to generic components of procedures, such as patient positioning, anesthesia, and analgesia. Some are specific to intraluminal endoscopic surgery and largely comprise perforation and injuries to surrounding structures and blood vessels. The response of premenopausal women to excessive absorption of nonionic fluids used for hysteroscopy deserves special attention on the part the surgeon. There is also an increasing awareness of uncommon but problematic sequelae related to the use of monopolar radiofrequency uterine resectoscopes that involve thermal injury to the vulva and vagina. The uterus that has previously undergone hysteroscopic surgery may behave in unusual ways, at least in premenopausal women who experience menstruation or who become pregnant.	VB
79	Birch DW, Dang JT, Switzer NJ, et al. Heated insufflation with or without humidification for laparoscopic abdominal surgery. *Cochrane Database Syst Rev* . 2016;10:CD007821.	Systematic Review w/ Meta-Analysis	1428 adults and children undergoing abdominal laparoscopic surgery; 22 RCTs	Heated, with or without humidification, CO2 insufflation	Cold CO2 insufflation	Primary: core temperature; secondary: postoperative pain, morphine consumption, hospital stay, PACU stay, lens fogging, operative time, major adverse events	Heated, humidified CO2 insufflation leads to a small increase in core temperature in patients undergoing laparoscopic abdominal surgery, but the clinical significance of this is unclear. This intervention did not decrease postoperative pain or pain medication use. Also no significant differences in serious adverse events; no reductions in length of PACU or hospital stay, lens fogging, or operating time. However, results should be interpreted with caution due to study design limitations. Recommend less consideration of this intervention which adds cost to cases, when normothermia can be effectively maintained by use of external warming devices and warmed irrigation.	IA
80	Balayssac D, Pereira B, Bazin J, LeRoy B, Pezet D, Gagniere J. Warmed and humidified carbon dioxide for abdominal laparoscopic surgery: Meta-analysis of the current literature. Surg Endosc. 2017;31(1):1-12.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Analysis of the studies showed only a small beneficial effect of warmed, humidified CO2 insufflation compared to standard insufflation on immediate postoperative pain and intraoperative hypothermia. No significant effect on later postoperative pain, analgesic requirements, postop body core temperature, length of stay, lens fogging, or procedure duration.	IA
81	Sutton E, Bellini G, Grieco MJ, et al. Warm and humidified versus cold and dry CO2 pneumoperitoneum in minimally invasive colon resection: A randomized controlled trial. Surg Innov. 2017;24(5):471-482.	RCT	101 adults with benign colorectal conditions undergoing elective minimally invasive colon resection	Warmed, humidified CO2 insufflation	Cold, dry CO2 insufflation	Primary: postoperative pain and analgesia requirements, core body temperature, length of stay, time to first flatus, bowel movement, tolerated solid meal; Secondary: peritoneal injury, systemic cytokine response	Significantly lower pain medication required for postoperative days 1-3 for the warmed, humidified CO2 group but no differences in pain scores between groups, so unable to make firm conclusions about warmed, humidified CO2 insufflation.	IA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
82	Jiang R, Sun Y, Xie X, Wang H, Liang M, Ting C. Effect of different carbon dioxide (CO2) insufflation for laparoscopic colorectal surgery in elderly patients: A randomized controlled trial. *Medicine* . 2019;98(41):e17520.	RCT	150 older adults undergoing laparoscopic colorectal surgery	Warmed, humidified CO2; forced air warming	Standard CO2 insufflation; electric warming blanket	Primary: resting pain, cough pain, postoperative pain medication consumption; secondary: visual image quality, hemodynamic changes, esophageal/skin/body temp, recovery time, days to 1st flatus and solid food, shivering, postop ileus, discharge time, SSI, patient and surgeon satisfaction, adverse events, coagulation studies	Concluded that warm, humidified CO2 and standard insufflation with forced air warming at 38C effectively reduced intraoperative hypothermia, coagulation dysfunction, early postoperative cough pain, sufentanil consumption, days to first flatus and solid food intake, and length of hospital stay.	IB
83	Meng-Meng T, Xue-Jun X, Xiao-Hong B. Clinical effects of warmed humidified carbon dioxide insufflation in infants undergoing major laparoscopic surgery. *Medicine (Baltimore)* . 2019;98(27):e16151.	RCT	63 infants (38 female) undergoing major laparoscopic surgery > 2 hours	Warmed, humidified CO2	Standard CO2 insufflation	Primary: core body temperature; secondary: operative time, blood loss, oxygen saturation < 90%, pain, shivering, hypothermia, postoperative bowel movement, length of hospital stay	Warm, humidified CO2 insufflation resulted in successful maintenance of normothermia and was associated with earlier bowel movement, less shivering, shorter hospital stay in healthy infants undergoing major laparoscopic surgery > 2 hrs.	IC
84	Gunusen I, Akdemir A, Sargin A, Karaman S. The effects of CO2 pneumoperitoneum at different temperature and humidity on hemodynamic and respiratory parameters and postoperative pain in gynecological laparoscopic surgery: A prospective randomized controlled study. *Asian journal of surgery / Asian Surgical Association* . 2022;45(1):154-161.	RCT	100 ASA I-II patients 40-65 who underwent laparoscopic hysterectomy for benign pathology; 4 excluded intraoperatively for malignancy	Heated, humidified CO2 insufflation	Cold, dry CO2 insufflation with external forced air warming	Primary: hemodynamic and respiratory parameters (blood pressure, heart rate, pulse oximetry, end tidal Co2, temperature, peak pressure); secondary: pain scores, analgesic consumption, blood gas values, inflammation markers (leukocytes, neutrophils, NLR).	Heated, humidified CO2 insufflation produced a significantly increased inflammatory response and statistically significantly higher body temperature (although not clinically significant) in healthy patients compared to standard cold, dry CO2. No significant differences in postoperative pain. Considering the cost of the heat/humidification device, recommend that heating and humidifying CO2 may not be necessary for healthy patients.	IB
85	Breuer M, Rossaint R, Van Waesberghe J, et al. Warm and humidified insufflation gas during gynecologic laparoscopic surgery reduces postoperative pain in predisposed patients-a randomized, controlled multi-arm trial. *Surg Endosc* . 2021;36:4154-4170.	RCT	150 patients undergoing laparoscopic gyn surgery longer than 60 min	Warmed, humidified CO2 insufflation without forced air warming; warmed, humidified CO2 insufflation with forced air warming	Cold, dry CO2 insufflation with external forced air warming	Primary: postoperative pain; Secondary: analgesic consumption, duration of epidural anesthesia, PONV, activities of daily living, length of stay in PACU, total length of stay	Warmed, humidified CO2 insufflation was not clinically relevant in reducing postoperative pain overall, however, among patients with endometriosis or expected high pain levels (ie, without history of previous abdominal surgery), the intervention resulted in less pain lasting up to several days; therefore, using warmed, humidified CO2 in predisposed patients may be beneficial.	IB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
86	Liu L, Lv N, Hou C. Effects of a multifaceted individualized pneumoperitoneum strategy in elderly patients undergoing laparoscopic colorectal surgery: A retrospective study. *Medicine (Baltimore)* . 2019;98(14):e15112.	Quasi-experimental	245 older adults undergoing laparoscopic colorectal surgery	Warmed, humidified CO2 insufflation	Standard CO2 insufflation (cold, dry)	Intraop hemodynamics, blood pH, lactic acid levels; intraabdominal pressure, postoperative shivering, patient and surgeon satisfaction, time to 1st flatus and bowel movement, tolerance of food, discharge time, vomiting, diarrhea, SSI.	Concluded that using warm, humidified insufflation CO2 in elderly patients undergoing laparoscopic colorectal surgery could maintain the stability of hemodynamics, and reduce lactic acid levels, recovery time in the PACU, and incidence of acute GI injury symptoms. Reported significantly higher patient and surgeon satisfaction in the warmed/humidified insufflation group.	IIB
87	Oderda M, Gontero P, Munegato S, et al. The impact of warmed and humidified CO2 insufflation during robotic radical prostatectomy: Results of a randomized controlled trial. Urologia. 2019;86(3):130-140.	RCT	64 robot-assist radical prostatectomy patients	Warmed, humidified CO2 insufflation with Humigard device and forced air warming blanket	Standard CO2 insufflation and forced air warming blanket	Primary: body core temperature; secondary: inflammatory markers, blood gas parameters, postoperative pain, bowel transit, length of stay,	Warmed, humidified CO2 significantly increased body core temperature compared to standard insufflation, but the difference (0.2˚C) was clinically minimal and did not affect patient outcomes; the researchers interpreted this as more effective in maintaining heat homeostasis. The intervention did not significantly affect inflammatory markers, postoperative pain, or other recovery parameters.	IC
88	Binda MM. Humidification during laparoscopic surgery: Overview of the clinical benefits of using humidified gas during laparoscopic surgery. *Arch Gynecol Obstet* . 2015;292(5):955-971.	Literature Review	n/a	n/a	n/a	n/a	Using warm, humidified insufflation gas is clinically beneficial to patients, creates a physiologic peritoneal environment, and reduces postoperative pain and hypothermia. Concluded that humidified gas should be used during laparoscopic surgery, however, further research is needed to determine what temperature is best.	VA
89	Otsuka Y, Katagiri T, Ishii J, et al. Gas embolism in laparoscopic hepatectomy: What is the optimal pneumoperitoneal pressure for laparoscopic major hepatectomy? *Journal of Hepato-biliary-pancreatic Sciences* . 2013;20(2):137-140.	Literature Review	n/a	n/a	n/a	n/a	Major laparoscopic hepatectomy patients are at higher risk of gas embolism. Concluded that maintaining a lower pressure pneumoperitoneum of 12 mmHG may lower the risk of severe gas embolism.	VB
90	Kim S, Park K, Shin H, Yi J, Kim D. ILL law paradoxical carbon dioxide embolism during endoscopic thyroidectomy confirmed by transesophageal echocardiography. Journal of Anesthesia. 2010;24(5):774-777.	Case Report	n/a	n/a	n/a	n/a	This case report reinforces the importance of monitoring the patient for CO2 embolism after endoscopic thyroidectomy.	VC
91	Seifert PC, Yang Z, Munoz R. Crisis management of air embolism in the OR. *AORN Journal* . 2015;101(4):471-481.	Expert Opinion	n/a	n/a	n/a	n/a	Describes crisis considerations for managing air embolism in the OR including signs and symptoms and interventions for management.	VA
92	Van Kruchten PM, Vermelis JMFW, Herold I, Van Zundert AAJ. Hypotonic and isotonic fluid overload as a complication of hysteroscopic procedures: Two case reports. *Minerva Anestesiol* . 2010;76(5):373-377.	Case Report	n/a	n/a	n/a	n/a	Complications such as laceration of the cervix, uterine perforation, absorption of irrigation solutions and, rarely, gas or air embolism may occur. Hypotonic as well as isotonic distension media can cause serious complications. Factors that may increase the risk of fluid overload should be known to both anesthesiologists and gynecologists.	VC

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
93	Castel-Onate A., Marin-Pena O., Cuellar-Gutierrez R., et al. Intra-abdominal pressure changes during hip arthroscopy: A prospective multicenter study. *Arthroscopy J Arthroscopic Relat Surg* . 2020;36(4):1053-1060.	Nonexperimental	105 hip arthroscopy patients	n/a	n/a	Primary: intra-abdominal pressure; secondary:	Intra-abdominal pressure (IAP) increased significantly during the first 60 minutes of hip arthroscopy before stabilizing. No significant associations between increased IAP at different time points during surgery. It is easy to monitor IAP, which allows for rapid detection of signs of increased IAP during surgery.	IIIA
94	Kocher MS, Frank JS, Nasreddine AY, et al. Intra-abdominal fluid extravasation during hip arthroscopy: A survey of the MAHORN group. *Arthroscopy* . 2012;28(11):1654-1660.e2.	Qualitative	15 hip arthroscopy surgeons	n/a	n/a	Incidence of IAFE and circumstances surrounding its occurrence	Symptomatic intra-abdominal fluid extravasation (IAFE) after hip arthroscopy is rare. Prevention of IAFE should include close intraoperative and postoperative monitoring of abdominal distention, core body temperature, and hemodynamic stability. Iliopsoas tenotomy and high pump pressures may be risk factors leading to symptomatic IAFE.	IIIB
95	Yousef AA, Suliman GA, Elashry OM, Elsharaby MD, Elgamasy AEK. A randomized comparison between three types of irrigating fluids during transurethral resection in benign prostatic hyperplasia. *BMC ANESTHESIOL* . 2010;10:7p-7p 1p.	RCT	360 patients with benign prostatic hyperplasia undergoing transurethral resection of the prostate	Glycine 1.5% irrigation and glucose 5% irrigation	Saline 0.9% irrigation	Perioperative morbidity, operation time, length of hospital stay	Endoscopic TURP performed using either glucose 5% or saline 0.9% irrigating solution during and after surgery is associated with lower incidence of TUR syndrome, lower catheterization period, shorter hospital stay and no cardiac toxicity in comparison with glycine 1.5% solution.	IB
96	Umranikar S, Clark TJ, Saridogan E, et al. BSGE/ESGE guideline on management of fluid distension media in operative hysteroscopy. *Gynecological surgery* . 2016;13(4):289-303.	Guideline	n/a	n/a	n/a	n/a	Practice guideline for fluid distension media during hysteroscopy.	IVA
97	Abutalib RA, Alamri AJ, Aqel SA, Alhumaidi IM, Almohini IA. Acute respiratory distress and hyperchloremic metabolic acidosis as a result of massive irrigation fluid extravasation after arthroscopic shoulder surgery: A case report and recommendations for preventable complications. *Am J Case Rep* . 2020;21:e926357.	Case Report	n/a	n/a	n/a	n/a	Case report of symptomatic extravasation in a patient after shoulder arthroscopy. Recommends postoperative assessment to include check for swelling of the soft tissues surrounding the shoulder area, limiting procedure length, and keeping irrigation pump settings at the lowest possible to reduce the likelihood of complications.	VB
98	Edwards DS, Davis I, Jones NA, Simon DW. Rapid tracheal deviation and airway compromise due to fluid extravasation during shoulder arthroscopy. *Journal of Shoulder & Elbow Surgery* . 2014;23(7):e163-5.	Case Report	n/a	n/a	n/a	n/a	Case report of rapid tracheal deviation and subsequent airway compromise in an otherwise healthy woman undergoing elective shoulder arthroscopy. Most likely due to irrigation fluid moving from the glenohumeral joint through the tissue planes into the pharyngeal structures. Other reports of airway compromise due to soft tissue swelling resulting from irrigation fluid have occurred after longer operating times but never so rapidly as this case. Suggest careful placement of drapes and evaluation of soft tissue to assess for extravasation of fluid.	VC

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
99	Khan F, Padmanabha S, Shantaram M, Aravind M. Airway compromise due to irrigation fluid extravasation following shoulder arthroscopy. *Journal of Anaesthesiology Clinical Pharmacology* . 2013;29(4):578-579.	Case Report	n/a	n/a	n/a	n/a	Case report describing fluid extravasation during shoulder arthroscopy which led to airway complications. Patients at risk are in cases with long duration (>90-120min), amount of fluid absorbed, weight gain and increased pump pressure.	VC
100	Manjuladevi M, Gupta S, Upadhyaya KV, Kutappa AM. Postoperative airway compromise in shoulder arthroscopy: A case series. *Indian J Anaesth* . 2013;57(1):52-55.	Case Report	n/a	n/a	n/a	n/a	Risk factors for upper airway compromise during shoulder arthroscopy are longer surgery time, increased pump pressure, large volume of irrigation fluid used, lateral decubitus position and obesity.	VC
101	Wegmuller B, Hug K, Meier Buenzli C, Yuen B, Maggiorini M, Rudiger A. Life-threatening laryngeal edema and hyponatremia during hysteroscopy. *Critical Care Research & Practice* . 2011;2011:140381.	Case Report	n/a	n/a	n/a	n/a	Recommends communication of clinical observations between anesthesiologist and surgeon, exact measurement of fluid deficit, termination of the procedure if fluid absorption reaches 2000 ml, and minimizing resection time to less than 60 minutes.	VC
102	Yang B, Feng L. Symptomatic hyponatremia and hyperglycemia complicating hysteroscopic resection of intrauterine adhesion: A case report. *Chin Med J* . 2012;125(8):1508-1510.	Case Report	n/a	n/a	n/a	n/a	Surgical teams must be vigilant in fluid deficit monitoring and serum electrolyte analysis.	VC
103	Atieh AS, Abu Shamma OK, Abdelhafez MO, et al. Acute severe hyponatremia following hysteroscopic procedure in a young patient: A case report and review of the literature. *Case Rep Nephrol* . 2021;2021:7195660.	Case Report	n/a	n/a	n/a	n/a	Case report of severe hyponatremia following hysteroscopy in a 43 year old patient. Recommend using electrolyte-based distension media instead of hypo-osmolar solutions to reduce systemic absorption, closely monitoring and reducing fluid intake. Recommend future randomized trials studying anesthesia techniques and possible use of intrauterine vasopressin to protect against volume overload and hyponatremia.	VA
104	Silva JMJ, Barros MA, Chahda MAL, Santos IM, Marubayashi LY, Malbouisson LMS. Risk factors for perioperative complications in endoscopic surgery with irrigation. *Brazilian Journal of Anesthesiology* . 2013;63(4):327-333.	Nonexperimental	142 adults undergoing endoscopic surgery with irrigation fluids	n/a	n/a	Serum sodium, demographics, total irrigation administered	Reported a 21.8% incidence of complications in adults who underwent endoscopic surgery with irrigation fluid with a higher prevalence in TURP, then hysteroscopy, bladder tumor, and knee and shoulder arthroscopy. The primary complication was cardiovascular related (ie, arrhythmia). Multiple regression analysis showed that age, serum sodium at procedure end, and total volume of irrigation administered during surgery to correlated with risk for complications. They recommended measuring serum sodium and determining total fluid volume at the end of procedures to help with rapid identification of complications.	IIIA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
105	Donan Jr PC, Pace KA, Ruiz CW, Gracia MM. Distending media used during hysteroscopy: Perioperative nursing implications. *AORN J* . 2020;112(6):634-648.	Expert Opinion	n/a	n/a	n/a	n/a	Provides background information on hysteroscopy, including uterine anatomy. Describes the various distending media used for hysteroscopy, recommended maximum fluid deficits, and nursing considerations.	VA
106	Curtin B, Friebe I. Dermal burn during hip arthroscopy. *Orthopedics* . 2014;37(8):e746-9. Accessed 20140808.	Case Report	n/a	n/a	n/a	n/a	Report of injury from a radiofrequency device during hip arthroscopy. Second-degree burn to the skin resulting from outflow irrigant. The authors recommended bacitracin ointment to prevent superficial wound infection even with no disruption of the skin. The authors continue to use radiofrequency devices in hip arthroscopy, but recommend remaining vigilant in maintaining dedicated outflow suction throughout the procedure and following all manufacturer instructions on the use of such devices.	VA
107	Verma M, Sekiya JK. Intrathoracic fluid extravasation after hip arthroscopy. *Arthroscopy* . 2010;26(9 Suppl):S90-4.	Case Report	n/a	n/a	n/a	n/a	Development of hyperthermia may be an early warning for extravasation. The five warning signs of fluid extravasation (1) inability to distend the joint, (2) increased fluid requirements to maintain distention, (3) frequent cutoff of pump irrigation systems, (4) abdominal and thigh distension, and (5) acute hypothermia. Fluid extravasation during hip arthroscopy can lead to abdominal compartment syndrome, hypotension and cardiac arrest.	VB
108	You AH, Lee JY, Choi JH, Kim MK. Hyperchloremic metabolic acidosis during bipolar transurethral resection of the prostate: A report of two cases. *J Int Med Res* . 2021;49(6):3000605211024480.	Case Report	n/a	n/a	n/a	n/a	Report on two cases of hyperchloremic metabolic acidosis after bipolar TURP. Recommend anesthesiologists monitor acid-base and electrolyte status if rapid absorption of isotonic solution suspected. Identified risk factors for rapid absorption: prolonged surgery, large irrigation volume, irrigation bag height > 60cm, and large prostate weight (preop and resected).	VC
109	Hermanns T, Fankhauser CD, Hefermehl LJ, et al. WILEY prospective evaluation of irrigation fluid absorption during pure transurethral bipolar plasma vaporisation of the prostate using expired-breath ethanol measurements. BJU Int. 2013;112(5):647-654.	Nonexperimental	55 bipolar plasma vaporization of the prostate patients	n/a	n/a	Fluid absorption via breath ethanol concentration; serum electrolytes, venous pH, operation time, irrigation volume, capsular perforation	Significant intraoperative fluid absorption can occur during bipolar plasma vaporization of the prostate. Care should be taken if performing this procedure on patients with significant cardiovascular comorbidities. Respecting the anatomical borders of the prostate seems to play a relevant role in preventing fluid absorption during the procedure. Venous pH could be used to detect potentially dangerous fluid absorption if intraoperative monitoring of breath ethanol measurements are not available.	IIIB
110	Darwish AM, Hassan ZZ, Attia AM, Abdelraheem SS, Ahmed YM. Biological effects of distension media in bipolar versus monopolar resectoscopic myomectomy: A randomized trial. *Journal of Obstetrics & Gynaecology Research* . 2010;36(4):810-817.	RCT	155 hysteroscopic myomectomy patients	0.9% saline distention media with bipolar resectoscopy	1.5% glycine distention media with monopolar resectoscopy	Hemodynamic measurements (mean BP, heart rate, CVP, cardiac output measurements), coagulation studies, CBC, arterial blood gas, SpO_2, $ETCO_2$, fluid infused and absorbed	Using bipolar resectoscope with 0.9% saline distention media was not associated with hyponatremia or hypo-osmolarity compared to monopolar resectoscope with 1.5% glycine distending media in procedures resecting submucosal myomas of considerable size.	IB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
111	Park JT, Lim HK, Kim S, Um DJ. A comparison of the influence of 2.7% sorbitol-0.54% mannitol and 5% glucose irrigating fluids on plasma serum physiology during hysteroscopic procedures. *Korean Journal of Anesthesiology* . 2011;61(5):394-398.	RCT	30 hysteroscopy patients	2.7% sorbitol-0.54% mannitol	5% glucose	Amount of irrigation fluid, fluid intake, procedure duration, serum electrolyte levels	No clinical evidence of hyponatremic hypo-osmolality in any of the patients. No difference between 2.7% sorbitol-0.54% mannitol and 5% glucose as an irrigating fluid for hysteroscopic procedures with mild to moderate irrigant absorption. Concluded that the two solutions can be treated as nearly equivalent unless massive absorption occurs.	IC
112	Rademaker BMP, van Kesteren PJM, de Haan P, Rademaker D, France C. How safe is the intravasation limit in hysteroscopic surgery?. *Journal of Minimally Invasive Gynecology* . 2011;18(3):355-361.	Nonexperimental	234 records of hysteroscopic myomectomy patients	n/a	n/a	Physiological changes indicating emboli formation	During transcervical resection of myomas, physiological changes that could be attributed to gaseous embolism occurred in 33% to 43% of patients with 1000 to 2500 mL fluid intravasation. Nearly half of those patients had cardiovascular disturbances that indicated the formation of emboli. Therefore, cardiovascular disturbances that indicate gaseous embolism during transcervical resection of myomas may occur despite the limitation of intravasation according to current view.	IIIB
113	Bergeron M, Ouellet P, Bujold E, et al. The impact of anesthesia on glycine absorption in operative hysteroscopy: A randomized controlled trial. *Anesthesia & Analgesia* . 2011;113(4):723-728.	RCT	95 hysteroscopy patients	Local anesthesia with sedation	General anesthesia	Median absorption of glycine; secondary - glycine absorption 500 - 1000 ml and > 1000 ml, premature termination of surgery due to excessive absorption, change in serum sodium, severe postoperative hyponatremia, patient satisfaction with anesthesia and quality of life 24 hrs postop	Less glycine absorption occurred when local anesthesia was the method of anesthesia.	IA
114	Haude O, Overdijk LE, van Kesteren PJM, Geerts BF, Rademaker BMP. Comparing volumetric and biochemical assessment of intravasation caused by hysteroscopic surgery. *Acta Anaesthesiol Scand* . 2020;64(2):232-237.	Nonexperimental	51 hysteroscopic transcervical resection of myoma patients	n/a	n/a	Fluid deficit, calculated intravasation	There was a weak correlation between calculated intravasation and volumetrically measured fluid deficit, meaning it was unclear which method was most accurate in determining the actual volume of intravasated fluid.	IIIC
115	Deffieux X, Gauthier T, Menager N, Legendre G, Agostini A, Pierre F. Hysteroscopy: Guidelines for clinical practice from the french college of gynaecologists and obstetricians. *European Journal of Obstetrics Gynecology and Reproductive Biology* . 2014;178:114-122. Accessed 26 February 2016. doi: 10.1016/j.ejogrb.2014.04.026.	Position Statement	n/a	n/a	n/a	n/a	Hysteroscopy guidelines from the French College of Gynecologists and Obstetricians.	IVA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
116	Maerz DA, Beck LN, Sim AJ, Gainsburg DM. Complications of robotic-assisted laparoscopic surgery distant from the surgical site. *Br J Anaesth* . 2017;118(4):492-503.	Literature Review	n/a	n/a	n/a	n/a	Found that complications in robotic-assisted laparoscopic surgery were most strongly associated with extreme positioning, abdominal insufflation, and long procedure duration and not directly related to the robot itself.	VB
117	Louie BE. Catastrophes and complicated intraoperative events during robotic lung resection. *J Vis Surg* . 2017;3:52.	Literature Review	n/a	n/a	n/a	n/a	Describes complications and emergent situations (eg, injury of airway, major vessels) that can arise during robotic lung resection and the medical management of these conditions.	VB
118	*Small sample survey final report. topic: Da vinci surgical SystemComputer-assisted surgical systems.* U.S. Food & Drug Administration: Center for Devices and Radiological Health (CDRH), Office of Surveillance and Biometrics (OSB), Medical Product Safety Network (MedSun); 2013.	Expert Opinion	n/a	n/a	n/a	n/a	The FDA interviewed surgeons experienced in using the da Vinci robotic surgery platform to gain understanding of challenges during use compared to conventional surgical approaches.	VB
119	Johansson VR, von Vogelsang A. Patient-reported extremity symptoms after robot-assisted laparoscopic cystectomy. *J Clin Nurs* . 2019;28(9-10):1708-1718.	Nonexperimental	94 patient	n/a	n/a	Extremity symptoms	A large proportion of patients reported postoperative extremity symptoms after robot-assisted laparoscopic cystectomy and only some of their symptoms were accurately documented in the medical record. Preventive nursing interventions (ie, proper positioning and assessment), accurate documentation, and follow up are needed to detect and treat extremity injuries.	IIIA
120	Spruce L. Guideline for prevention of perioperative pressure injury. In: Kyle E, ed. *Guidelines for perioperative practice.* Denver, CO: AORN Inc.; 2022.	Guideline	n/a	n/a	n/a	n/a	This guideline provides best practices for the prevention of perioperative pressure injury.	IVA
121	*Potential risks of robotic surgery.* The Joint Commission (TJC); 2014.	Expert Opinion	n/a	n/a	n/a	n/a	Discusses sentinel events in robotic surgery and recommends interventions to improve safety, including improving OR communication because the surgeon may be isolated at the console away from the sterile field and rest of the surgical team.	VB
122	Steenwyk B, Lyerly R3. Advancements in robotic-assisted thoracic surgery. *Anesthesiology Clinics* . 2012;30(4):699-708.	Expert Opinion	n/a	n/a	n/a	n/a	Advancements in RATS present potential advantages for patients as well as new challenges for the anesthesia and surgery teams. It has become increasingly used as a technique to facilitate less invasive thoracic surgery.	VB
123	Schuessler Z, Scott Stiles A, Mancuso P. Perceptions and experiences of perioperative nurses and nurse anaesthetists in robotic-assisted surgery. *J Clin Nurs* . 2020;29(1-2):60-74.	Qualitative	17 participants (6 preop/PACU RNs, 7 intraop RNs, 4 CRNAs)	n/a	n/a	Perceptions and experiences with robotic-assist laparoscopic surgery.	Results indicate nurses perceive that robotic-assist laparoscopic surgery improves patient outcomes when done efficiently by skilled surgeons and surgical teams; must also consider patient characteristics, reason for operating, and costs. Emphasizes importance of standardized education, standardized implementation protocols, and outcome tracking, with focus on teamwork and communication.	IIIA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
124	Almeras C, Almeras C. Operating room communication in robotic surgery: Place, modalities and evolution of a safe system of interaction. *J Visc Surg* . 2019;156(5):397-403.	Qualitative	130 surveys sent to "various French surgical centers with robotics"; 69 responses (40 scrub nurses, 10 operating assists, 19 operators)	n/a	n/a	Working conditions/training; perception of potential communication difficulties; origin of communication difficulties; environment/roles; work environment; training phase	During robotic surgery, operators become totally immersed at the console, decreasing non-verbal exchange with the team and view of the environment. The assistant experiences isolation at the bedside. Systematic verbal communication should be taught during training and continued, although may be relaxed as skills and experience increase with improved team dynamic.	IIIC
125	Myklebust MV, Storheim H, Hartvik M, Dysvik E. Anesthesia professionals' perspectives of teamwork during robotic-assisted surgery. *AORN J* . 2020;111(1):87-96.	Qualitative	9 anesthesia professionals (3 anesthesiologists, 6 nurse anesthetists)	n/a	n/a	Experiences of teamwork in robotic surgery	Main theme emerged from individual interviews - teamwork is important element of patient safety. Two subthemes - important non-technical skills that enhance teamwork and important non-technical and technical barriers that challenge teamwork. The researchers concluded that a lack of teamwork during surgery may increase patients' risk of adverse outcomes.	IIIB
126	Sexton K, Johnson A, Gotsch A, Hussein AA, Cavuoto L, Guru KA. Anticipation, teamwork and cognitive load: Chasing efficiency during robot-assisted surgery. BMJ quality & safety. 2018;27(2):148-154.	Nonexperimental	1330 communication requests from 12 robotic prostatectomy surgeries	n/a	n/a	Team familiarity, cognitive load, level of inconvenience, request duration, anticipation ratio.	Higher familiarity correlated with fewer inconveniences. Anticipated requests were significantly shorter than non-anticipated. Training to improve anticipation and team familiarity may improve team efficiency during robotic-assisted surgery.	IIIA
127	Schiff L, Tsafrir Z, Aoun J, Taylor A, Theoharis E, Eisenstein D. Quality of communication in robotic surgery and surgical outcomes. *JSLS : Journal of the Society of Laparoendoscopic Surgeons* . 2016;20(3):e2016.00026.	Organizational Experience	40 robotic gynecologic surgeries. 32 OR team members responded to the postprocedure surveys.	n/a	n/a	Communication quality, surgical outcomes: procedure length, blood loss, complications	Poor communication quality was associated with longer procedure duration and higher blood loss. Also found that surgeons gave worse communication ratings than other team members. Concluded that physical distance and equipment create a barrier between team members, which could interfere with communication efficiency and impair nonverbal communication that occurs in other surgical approaches. This pilot study provides rationale for additional comprehensive study.	VB
128	Allers JC, Hussein AA, Ahmad N, et al. Evaluation and impact of workflow interruptions during robot-assisted surgery. *Urology* . 2016;92:33-37.	Organizational Experience	10 recorded robotic assisted radical prostatectomies	n/a	n/a	n/a	Main disruptors during surgery included console surgeons switching, surgical equipment preparation (eg, cleaning camera, changing inst), device (eg, stapler, suture) needed. About 14% of the interruptions were avoidable. The authors concluded that identifying and analyzing interruptions allows for improvements in efficiency and patient safety when evidence-based strategies are implemented. Also, team familiarity among the key members could help during integration of new team members without jeopardizing safety or efficacy.	VB
129	Raheem S, Ahmed YE, Hussein AA, et al. Variability and interpretation of communication taxonomy during robot-assisted surgery: Do we all speak the same language? *BJU Int* . 2018;122(1):99-105	Nonexperimental	26 robotic surgeries	n/a	n/a	Frequency, time to execute, inconveniences, acknowledgement	Retrospective analysis of recordings from 26 robotic-assist surgeries. Data was categorized into five tasks and further classified into clarity of the tasks (specified, non-specified, unclear). Frequency, time to execute, inconveniences, and acknowledgement were also determined for each request. Concluded that standardized communication should be included during structured team training to improve efficiency and minimize error during robotic-assisted surgery.	IIIC

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
130	Randell R, Honey S, Hindmarsh J, et al. A realist process evaluation of robot-assisted surgery: Integration into routine practice and impacts on communication, collaboration and decision-making. *Health Serv Deliv Res* . 2017;5(20).	Organizational Experience	n/a	n/a	n/a	n/a	Describes elements leadings to successful implementation of RAS. Team interviews showed problems hearing the surgeon compounded by the absence of nonverbal communication due to the surgeon's presence at console. Recognized that a need to repeat requests and instructions could contribute to longer procedure times.	VA
131	Weigl M, Weber J, Hallett E, et al. Associations of intraoperative flow disruptions and operating room teamwork during robotic-assisted radical prostatectomy. *Urology* . 2018;114:105-113.	Qualitative	40 robotic prostatectomy surgeries for 123 h, 43 min total observation time; 2012 total flow disruptions observed	n/a	n/a	Flow disruptions (source and severity), intraoperative teamwork, phase of procedure (prerobot, robot docking, console time), presence of trainees	Studied flow disruptions in robotic prostatectomy. Aim was to identify sources of flow disruptions during different phases of the procedure, evaluate the severity of disruptions and potential impact on OR team's perception of teamwork. Surgeons rated teamwork higher than OR nurses and anesthesia. Higher rates of severe flow disruptions were significantly associated with inferior evaluations of intraoperative teamwork.	IIIB
132	Mathew R, Markey K, Murphy J, Brien BO. Integrative literature review examining factors affecting patient safety with robotic-assisted and laparoscopic surgeries. *Journal of Nursing Scholarship* . 2018;50(6):645-652.	Systematic Review	n/a	n/a	n/a	n/a	12 studies analyzed for quality and content. Three themes emerged: intraoperative communication, teamwork, and disruptions. *Does it say that repeated communications contribute to disruptions - message not heard or no acknowledgement from the receive of having heard* ***and*** *that without visual feedback (since isolated at console), RAS increases the importance of verbal communication and confirmation (Catchpole 2019)?*	IIIA
133	Fearon MC, Spruce L, Conner R, Wood A. Guideline for team communication. In: Conner R, ed. *Guidelines for perioperative practice.* Denver, CO: AORN; 2022.	Guideline	n/a	n/a	n/a	n/a	Guidance for perioperative team communication.	IVA
134	Young PS, Findlay H, Patton JTS, Mahendra A. (Iii) computer assisted navigation in musculoskeletal oncology. *ORTHOP TRAUMA* . 2014;28(5):294-302 9p.	Expert Opinion	n/a	n/a	n/a	n/a	The use of computer navigation in musculoskeletal oncology allows three dimensional integration of local anatomy and tumor extent to identify bony transection points accurately, whilst preserving key structures. The author discussed the indications for navigation assistance in musculoskeletal oncology, along with the limitations and developments within this advancing field.	VB
135	Vaishnav AS, Merrill R, Sandhu H, et al. A review of techniques, time-demand, radiation exposure and outcomes of skin-anchored intra-operative 3D navigation in minimally invasive lumbar spinal surgery. *Spine (Phila Pa 1976)* . 2019.	Organizational Experience	326 spine surgery patients (232 in ION cohort, 94 in 2D fluoroscopy cohort)	n/a	n/a	Navigation-related time demand, radiation exposure, perioperative complications	Compared to 2D fluoroscopy group, skin-anchored ION navigation had shorter operative times, less blood loss, decreased radiation exposure.	VB
136	Jordan RS. The role of the RN circulator in a navigated posterior spinal fusion. *AORN J* . 2018;108(3):275-284.	Expert Opinion	n/a	n/a	n/a	n/a	Describes the RN circulator role in preparing for minimally invasive spine fusion with navigation.	VB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
137	Vaishnav A, Louie P, Gang C, et al. Technique, time demand, radiation exposure, and outcomes of skin-anchored intraoperative 3D navigation in minimally invasive posterior cervical laminoforaminotomy. Clin spine surg. 2021.	Organizational Experience	21 patients undergoing minimally invasive posterior cervical laminoforaminotomy using 3D intraoperative navigation with skin-anchored tracking	n/a	n/a	Navigation-related time demand, radiation exposure, perioperative complications	Skin-anchored ION for MI-PCLF is safe, feasible, short operative and setup times, low radiation exposure, minimal blood loss, no reported complications, short LOS.	VB
138	Karasin B, Hardinge T, Eskuchen L, Watkinson J. Care of the patient undergoing robotic-assisted brain biopsy with stereotactic navigation: An overview. AORN J. 2022;115(3):223-236.	Expert Opinion	n/a	n/a	n/a	n/a	Provides an overview of robotic-assisted brain biopsy with navigation and describes nursing considerations.	VA
139	Christie S. Electromagnetic navigational bronchoscopy and robotic-assisted thoracic surgery. *AORN J* . 2014;99(6):750-763.	Organizational Experience	n/a	n/a	n/a	n/a	Lung lesions can be diagnosed and resected during a single surgical procedure with the use of electromagnetic navigational bronchoscopy (ENB) and robotic-assisted thoracic surgery. Surgeons use ENB to identify and mark a thoracic tumor and then use robot technology to perform MIS resection and cancer staging. Periop RN considerations include instrumentation, OR setup, and positioning. These procedures need a dedicated team to optimize the sequence of events to improve patient outcomes.	VB
140	Khoo CY, Liew TYS, Mathur S. Systematic review of the efficacy of a hybrid operating theatre in the management of severe trauma. *World J Emerg Surg* . 2021;16(1):43-021-00390-z.	Systematic Review	n/a	n/a	n/a	n/a	5 cohort studies met inclusion criteria and were found to be heterogeneous in methodology. It is unclear whether the hybrid OR improves efficiency (ie, time to first intervention) and mortality, shortens procedure times, reduces need for transfusions, complication rates. Cost-benefit ratio is also unclear. Identified need for high functioning perioperative team. Further study that includes clinical trials is warranted to determine the usefulness and outcomes associated with the hybrid OR.	IIIA
141	Childs S, Bruch P. Successful management of risk in the hybrid OR. *AORN J* . 2015;101(2):223-234.	Organizational Experience	n/a	n/a	n/a	n/a	Implementation of an MRI/OR intervention suite has enhanced surgical care and outcomes at one facility. Interdisciplinary approach to design and layout of the hybrid OR and implementation of education and safety protocols contribute to patient benefits of intraoperative MRI. Personnel, including perioperative nurses, should have hands on training to successfully mitigate risk and provide care in the hybrid OR setting.	VA
142	Knudson L. Hybrid ORs set the stage for cutting-edge care. *AORN J* . 2012;96(2):1,8-9.	Organizational Experience	n/a	n/a	n/a	n/a	Hybrid ORs are becoming more common throughout the U.S. and are transforming the standard of care.	VC
143	Odle TG. Managing transition to a hybrid operating room. *Radiol Technol* . 2011;83(2):165181.	Literature Review	n/a	n/a	n/a	n/a	This article presents an overview of the transition to hybrid procedures and designs, the benefits and challenges of the new delivery method, and change management issues for managers of cardiovascular and vascular interventional departments.	VB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
144	Carver D, Kirkpatrick AW, D'Amours S, Hameed SM, Beveridge J, Ball CG. A prospective evaluation of the utility of a hybrid operating suite for severely injured patients: Overstated or underutilized? *Ann Surg* . 2020;271(5):958-961.	Organizational Experience	169 trauma patients treated in RAPTOR suite; 169 consecutive retrospective (pre-RAPTOR) cohort	Hybrid RAPTOR (resuscitation with angiography, percutaneous techniques and operative repair) suite	Pre-RAPTOR suite patient flow (angiography suite and/or operating theater)	time to procedure, procedure duration, blood product transfusions	Using the hybrid suite reduced time to procedure, procedure duration, blood product transfusions for trauma patients at one facility compared to pre-RAPTOR cohort, which is important for those least likely to survive.	VB
145	*AORN position statement on perioperative registered nurse circulator dedicated to every patient undergoing an operative or other invasive procedure.* Denver, CO: AORN, Inc.; 2019.	Position Statement	n/a	n/a	n/a	n/a	States AORN's support for one perioperative RN dedicated to each patient undergoing an operative or other invasive procedure.	IVA
146	*ACR manual on MR safety.* 1.0th ed. Reston, VA: American College of Radiology: ACR Committee on MR Safety; 2020.	Consensus	n/a	n/a	n/a	n/a	Guidance on best practices for MRI safety.	IVB
147	Hiatt C. Care of the patient undergoing a neurosurgical procedure in an intraoperative magnetic resonance imaging suite. *AORN J* . 2018;108(2):141-146.	Organizational Experience	n/a	n/a	n/a	n/a	Describes implementation of a standardized intraoperative MR program for neurosurgical procedures, including description of intraoperative nursing care and the implementation of safety interventions for the safety of the patient and the perioperative team.	VA
148	Practice advisory on anesthetic care for magnetic resonance imaging: An updated report by the american society of anesthesiologists task force on anesthetic care for magnetic resonance imaging. *Anesthesiology* . 2015;122(3):495-520.	Consensus	n/a	n/a	n/a	n/a	Provides advisory statements for the anesthetic care of patients in the MRI environment.	IVA
149	Maybody M, Taslakian B, Durack JC,et al. Feasibility of intermittent pneumatic compression for venous thromboembolism prophylaxis during magnetic resonance imaging-guided interventions. *Eur J Radiol* . 2015;84(4):668-670.	Nonexperimental	38 patients undergoing MR-guided ablations	n/a	n/a	Intermittent pneumatic compression (IPC) device function	Determined that the sleeves and tubing of the IPC device were MR-safe but the control unit was MR-unsafe. To meet MR safety requirements, tubing extensions were used to connect the compression sleeves to the control unit which was kept in the MR control room. The tubing extensions did not interfere with device function or the procedure.	IIIB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
150	McBride KE, Steffens D, Duncan K, Bannon PG, Solomon MJ. Knowledge and attitudes of theatre staff prior to the implementation of robotic-assisted surgery in the public sector. *PLoS ONE* . 2019;14(3):e0213840.	Qualitative	164 OR staff (nurses, medical staff, support staff)	n/a	n/a	Attitudes and knowledge regarding benefits to patients and staff, workplace environment, facilitators	The three groups of operating theatre staff had different knowledge and attitudes before implementation of a robotic surgery program. Most of the respondents agreed that theoretical and practical training, educational guides, and support staff would facilitate introduction of new technology.	IIIB
151	Dubeck D. Robotic-assisted surgery: focus on training and credentialing**.** PennPatient Saf Advis. 2014;11(3):93–101.	Literature Review	n/a	n/a	n/a	n/a	Between 2005-2014, healthcare facilities reported 722 safety events involving robotic-assisted surgery (RAS) to the Pennsylvania Patient Safety Authority. 545 were categorized as not resulting in patient harm and of those, 344 were categorized as complications of a procedure/treatment/test or related errors. 177 events were serious events resulting in patient injury, and 10 of these resulted in fatalities. The rapid growth of RAS has presented new challenges as this technology has emerged as an alternative treatment option to many laparoscopic and open procedures. Concluded that surgeons experience a steep learning curve in developing skills needed to perform robotic surgery and that facilities will need to ensure surgeon and team proficiency and competency in performing robotic procedures.	VA
152	Corrigan K. Pediatric robotic surgery program requires multidisciplinary team collaboration. *AORN J* . 2014;99(3):7-8.	Organizational Experience	n/a	n/a	n/a	n/a	Perioperative RNs at one hospital reported feeling valued as team members because of leadership emphasis on interdisciplinary collaboration and effective communication. This led to reductions in operating time and improved outcomes for pediatric patients undergoing robotic-assisted laparoscopic surgery, which influenced the acceptance of new technology. Improved outcomes over 7 years, showed that a dedicated and properly trained team could achieve long-term results safely and efficiently.	VB
153	Nayeemuddin M, Daley SC, Ellsworth P. Modifiable factors to decrease the cost of robotic-assisted procedures. *AORN J* . 2013;98(4):343-352.	Organizational Experience	n/a	n/a	n/a	n/a	Describes the cost of robotic surgery for various procedures. Two modifiable factors that contribute to increasing the annual caseload are increasing the number of surgeons capable of using the system and having a properly educated perioperative nursing team. An educated surgical team decreases turnover time, facilitates proper flow of each surgical procedure, and is able to actively and passively solve intraoperative problems.	VB
154	Mavrogenis AF, Savvidou OD, Mimidis G, et al. Computer-assisted navigation in orthopedic surgery. *Orthopedics* . 2013;36(8):631-642 12p.	Literature Review	n/a	n/a	n/a	n/a	Computer-assisted navigation has a role in some orthopedic procedures. This article reviews the available types of computer-assisted navigation; summarizes the clinical applications and reviews the results of using navigation; and informs surgeons of the disadvantages and pitfalls of computer assisted navigation in orthopedic surgery.	VA
155	Occupational radiation hazards in hybrid ORs. hazard #7: Top 10 health technology hazards for 2017. *Health Devices* . 2016.	Expert Opinion	n/a	n/a	n/a	n/a	Hybrid OR personnel may be at particular risk of unnecessary occupational exposure to ionizing radiation because they may be less knowledgeable than radiology or interventional radiology staff about the risks of radiation exposure and less experienced at taking appropriate precautions.	VB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
156	Centers for Medicare & Medicaid Services, ed. *State operations manual appendix A: Survey protocol, regulations and interpretive guidelines for hospitals.* Rev. 200 ed. Centers for Medicare and Medicaid (CMS); 2020.	Regulatory	n/a	n/a	n/a	n/a	CMS manual for hospital facilities	n/a
157	Centers for Medicare & Medicaid Services, ed. *State operations manual appendix L- guidance for surveyors: Ambulatory surgical centers.* Rev. 200 ed. Centers for Medicare and Medicaid Services (CMS); 2020.	Regulatory	n/a	n/a	n/a	n/a	CMS manual for ambulatory facilities.	n/a
158	Medical device reporting (MDR): How to report medical device problems. https://www.fda.gov/medical-devices/medical-device-safety/medical-device-reporting-mdr-how-report-medical-device-problems#:~:text=Patients%2C%20healthcare%20professionals%20and%20consumers%20who%20find%20a,FDA%20Safety%20Information%20and%20Adverse%20Event%20Reporting%20Program.?msclkid=b49f593fc0e011ec93feb45aa9414d20. Updated 2022. Accessed 4/20, 2022.	Regulatory	n/a	n/a	n/a	n/a	Requirements for medical device reporting.	n/a
159	Benze C, Spruce L, Groah L, eds. *Perioperative nursing: Scope and standards of practice.* Denver, CO: AORN, Inc.	Guideline	n/a	n/a	n/a	n/a	AORN standards for perioperative nursing.	IVA
160	Mason SL, Kuruvilla S, Riga CV, et al. Design and validation of an error capture tool for quality evaluation in the vascular and endovascular surgical theatre. *European Journal of Vascular and Endovascular Surgery* . 2013;45(3):248-254.	Nonexperimental	12 vascular surgery team members	n/a	n/a	Communication, equipment, procedure independent pressure, technical, safety awareness, and patient related; 20 subcategories for errors	The ICECAP may be a valid instrument for the identification of errors in the vascular and endovascular OR environment when used by an observer as a contemporaneous record. This information can help the team develop efficiencies and assess the impact of interventions to reduce error rates.	IIIA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
161	Blikkendaal MD, Driessen SRC, Rodrigues SP, et al. Measuring surgical safety during minimally invasive surgical procedures: A validation study. *Surg Endosc* . 2018;32(7):3087-3095.	Nonexperimental	40 laparoscopic hysterectomy procedures	n/a	n/a	Surgical safety concerns, surgical flow disturbances	Potential safety concerns were reported in particular during cases in which there were a high number of surgical flow disturbances observed and during cases using new instruments or devices. The Surgical Safety Questionnaire was developed and validated through comparison to 40 recorded laparoscopic hysterectomies. The Surgical Safety Questionnaire is a validated tool to assess surgical safety during minimally invasive procedures, especially when something new is introduced.	IIIA
162	Yurteri-Kaplan L, Andriani L, Kumar A, Saunders PA, Mete MM, Sokol AI. Minimally invasive surgery survey: A survey of surgical team members' perceptions for successful minimally invasive surgery. *J Minim Invasive Gynecol* . 2017;24(7):1152-1157.e3.	Qualitative	17 focus group participants for survey development; 197 respondents for initial factor analysis; 43 respondents for test-retest reliability	n/a	n/a	Internal consistency, correlation	The minimally invasive surgery survey (MISS) was validated as a reliable tool to evaluate the surgical team's perceptions of MIS at their institution. It is intended for use by hospital administrators to gain understanding of team members' expectations for MIS and may help improve the quality of care delivered to MIS patients.	IIIB
163	Benham E, Richardson W, Dort J, et al. What is the value of the SAGES/AORN MIS checklist? A multi-institutional practical assessment. *Surg Endosc* . 2017;31(4):1821-1827.	Organizational Experience	checklist implemented in 114 MIS cases across 4 hospitals	n/a	n/a	n/a	Describes implementation and usability evaluation of the SAGES/AORN MIS checklist at four health systems. The authors concluded that the checklist was effective in identifying problems to prevent delays in MIS cases, easy to use, and could contribute to improved perioperative workflow.	VB
164	Jing J, Honey ML. Using a checklist in robotic-assisted laparoscopic radical prostatectomy procedures. *AORN J* . 2016;104(2):145-152.	Organizational Experience	21 checklists completed and analyzed. 9 staff participated in two focus groups.	n/a	n/a	Checklist completeness, perceptions of using the checklist and effects on performance and safety	Description of development and implementation of a checklist to assist OR personnel with room setup for robotic-assisted laparoscopic radical prostatectomy. Checklist compliance was 100%. Based on focus group feedback, the project facilitators concluded that implementation of the checklist improved staff confidence in new team members, reduced time spent on setups and improved efficiency because of OR readiness, and that a lower compliance in the last phase might be mitigated by having dedicated personnel responsible for completion of that section. Limitations included single-site small number of participants, which limits generalizability of the project results and that the project facilitator was a staff member in the department so that may have influenced participants' feedback and compliance. Final recommendation was to continue using the checklist, implement strategies for its sustained use, and track compliance as well as evaluate the effects of its use.	VB
165	Zullo MD, McCarroll ML, Mendise TM, et al. Safety culture in the gynecology robotics operating room. *Journal of Minimally Invasive Gynecology* . 2014;21(5):893-900.	Quasi-experimental	32 gynecologic surgical staff (STs, CRNAs, scrub RNs, surgeons) pre-implementation; 14 gynecologic surgical staff responses post-implementation	Safety checklist	No safety checklist	Safety Attitudes Questionnaire	Quality of communication and collaboration in the gynecology robotics operating room is high between most positions; however, safety attitude responses are low overall. No differences after RORCC implementation and low response rates may highlight lack of staff support.	IIB