Evidence Table
Guideline for Safe use of Energy-Generating Devices
September 1, 2016

REFERENCE #	CITATION	CONCLUSIONS	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
1	van den Berg NJ, van den Dobbelsteen JJ, Jansen FW, Grimbergen CA, Dankelman J. Energetic soft-tissue treatment technologies: an overview of procedural fundamentals and safety factors. *Surg Endosc.* 2013;27(9):3085-3099.	Review of the literature describing various energy generating devices used in surgery.	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A
2	Sutton C, Abbott J. History of power sources in endoscopic surgery. *J Minim Invasive Gynecol* . 2013;20(3):271-278.	Historical perspective on energy devices for the OR.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
3	Law KS, Abbott JA, Lyons SD. Energy sources for gynecologic laparoscopic surgery: a review of the literature. *Obstet Gynecol Surv.* 2014;69(12):763-776.	Overview of the biophysics of energy sources, tissue effects, and the complications that may arise.	VA	Literature review	N/A	N/A	N/A	N/A	N/A
4	Gillespie MB, Stachiw ND, Way J, et al. Neural outcomes after plasma knife dissection: a pathologic study and clinical correlation. *Head Neck.* 2010;32(10):1321-1327.	Damage to rat nerves is less with the plasma knife compared to bipolar and the device can be used safely in patients have a parotidectomy.	IB	RCT involving rats and descriptive involving humans	Rats and humans having a parotidectomy	application of tripolar device	bipolar device	25 rats, 30 people	Amount of thermal injury. Facial nerve palsy.
5	Sankaranarayanan G, Resapu RR, Jones DB, Schwaitzberg S, De S. Common uses and cited complications of energy in surgery. *Surg Endosc.* 2013;27(9):3056-3072.	Review of the literature describing the indications, complications, mechanisms of operation for each type of energy generating device.	VA	Case report	N/A	N/A	N/A	N/A	N/A
6	Guideline for a safe environment of care, part 1. In: *Guidelines for Perioperative Practice* . Denver, CO: AORN, Inc; 2016:237-262.	Guideline for cleaning of perioperative setting	IVB	Clinical Guideline	N/A	N/A	N/A	N/A	N/A
7	Guideline for minimally invasive surgery. In: *Guidelines for Perioperative Practice* . Denver, CO: AORN, Inc; 2016:589-616.	Clinical guidelines for MIS	IVC	Clinical guidelines	N/A	N/A	N/A	N/A	N/A
8	Lee JY, Park CB, Cho EJ, et al. Airway fire injury during rigid bronchoscopy in a patient with a silicon stent—a case report. *Korean J Anesthesiol* . 2012;62(2):184-187.	Case report of an airway fire.	VC	N/A	N/A	N/A	N/A	N/A	N/A
9	Mehta SP, Bhananker SM, Posner KL, Domino KB. Operating room fires: a closed claims analysis. *Anesthesiology.* 2013;118(5):1133-1139.	Closed case analysis identifying the ignition sources for OR fires.	VB	Case report	N/A	N/A	N/A	N/A	N/A
10	Haith LR Jr, Santavasi W, Shapiro TK, et al. Burn center management of operating room fire injuries. *J Burn Care Res* . 2012;33(5):649-653.	Describes 5 cases of burns resulting from OR fires, and provides suggestions to decrease the potential of fires.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
11	Hudson DW, Guidry OF, Abernathy JH 3rd, Ehrenwerth J. Case 4-2012: intrathoracic fire during coronary artery bypass graft surgery. *J Cardiothorac Vasc Anesth.* 2012;26(3):520-521.	Case report and commentary on a surgical fire.	VC	Case report	N/A	N/A	N/A	N/A	N/A
12	Bansal A, Bhama JK, Varga JM, Toyoda Y. Airway fire during double-lung transplantation. *Interact Cardiovasc Thorac Surg.* 2013;17(6):1059-1060.	Case report of a surgical fire.	VC	Case report	N/A	N/A	N/A	N/A	N/A
13	Moskowitz M. Fire in the operating room during open heart surgery: a case report. *AANA J* . 2009;77(4):261-264.	Case report of an OR fire.	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A

14	Herman MA, Laudanski K, Berger J. Surgical fire during organ procurement. *Internet J Anesthesiol* . 2009;19(1):6.	Case report of a fire during organ procurement	VC	Case report	N/A	N/A	N/A	N/A	N/A
15	Overbey DM, Townsend NT, Chapman BC, et al. Surgical energy-based device injuries and fatalities reported to the Food and Drug Administration. *J Am Coll Surg* . 2015;221(1):197-205.	The risk of injury from surgical energy devices is significant and warrants further research and education	IIIA	Descriptive review	MAUDE database reports from 1/1/1994 - 12/31/2013 which related to energy-based devices	N/A	N/A	3,553 - Injury, 178 deaths	Number of injuries and deaths related to energy devices.
16	Raghavan K, Lagisetty KH, Butler KL, Cahalane MJ, Gupta A, Odom SR. Intraoperative fires during emergent colon surgery. *Am Surg* . 2015;81(2):E82-E83.	Case report of fire during bowel surgery.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
17	Tremaine AM, Avram MM. FDA MAUDE data on complications with lasers, light sources, and energy-based devices. *Lasers Surg Med* . 2015;47(2):133-140.	Review of the MAUDE database for events related to the dermatological setting including lasers and electrosurgical devices	VA	Review of the literature	N/A	N/A	N/A	N/A	N/A
18	Chae SB, Kim WK, Yoo CJ, Park CW. Fires and burns occurring in an electrocautery after skin preparation with alcohol during a neurosurgery. *J Korean Neurosurg Soc.* 2014;55(4):230-233.	Case report of a fire after use of an alcohol based product and not enough dry time.	VC	Case report	N/A	N/A	N/A	N/A	N/A
19	Chung SH, Lee HH, Kim TH, Kim JS. A patient who was burned in the operative field: a case report. *Ulus Travma Acil Cerrahi Derg.* 2012;18(3):274-276.	Report of a fire after use of alcohol to clean the site.	VC	Case report	N/A	N/A	N/A	N/A	N/A
20	Kim MS, Lee JH, Lee DH, Lee YU, Jung TE. Electrocautery-ignited surgical field fire caused by a high oxygen level during tracheostomy. *Korean J Thorac Cardiovasc Surg* . 2014;47(5):491-493.	Case report of a fire during a tracheostomy.	VC	Case report	N/A	N/A	N/A	N/A	N/A
21	Messenger D, Carter F, Francis N. Electrosurgery and energized dissection. *Surgery (United Kingdom).* 2014;32(3):126-130.	Report on precautions to take when using ESU in the patient with and without an CIED	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
22	Gunaruwan P, Barlow M. Diathermy-induced ventricular fibrillation with Riata high-voltage lead insulation failure. *Europace* . 2013;15(4):473.	Case report of patient v-fb after use of a electrosurgery device due to ICD lead insulation failure.	VC	Case report	N/A	N/A	N/A	N/A	N/A
23	Mumith A, Thuraisingham J, Gurunathan-Mani S. Ignition of free gas in the peritoneal cavity: an explosive complication. *Case Rep Surg* . 2013;2013:746430.	Report of a fire upon entering a pneumoperitoneum using monopolar electrosurgery	VC	Case report	N/A	N/A	N/A	N/A	N/A
24	Smith LP, Roy S. Operating room fires in otolaryngology: risk factors and prevention. *Am J Otolaryngol.* 2011;32(2):109-114.	Out of 349 responses to a survey, 88 surgeons experienced an OR fire. ESU was the most frequent source of ignition.	IIIB	Descriptive survey	8523 members of the American Academy of Otolaryngology—Head and Neck Surgery	N/A	N/A	349 responses	How many experienced OR fires and what was the characteristics of the fires.
25	Vo A, Bengezi O. Third-degree burns caused by ignition of chlorhexidine: a case report and systematic review of the literature. *Plast Surg (Oakv).* 2014;22(4):264-266.	Case report of a fire and a list of best practices obtained from a review of the literature	VA	Case report	N/A	N/A	N/A	N/A	N/A
26	Partanen E, Koljonen V, Salonen A, Back LJ, Vuola J. A patient with intraoral fire during tonsillectomy. *J Craniofac Surg* . 2014;25(5):1822-1824.	Use the lowest percentage of O2 possible and moisten sponges in the vicinity of the ignition device.	VA	Case report	N/A	N/A	N/A	N/A	N/A

27	Dhar V, Young K, Nouraei SA, et al. Impact of oxygen concentration and laser power on occurrence of intraluminal fires during shared-airway surgery: an investigation. *J Laryngol Otol.* 2008;122(12):1335-1338.	Neurosurgical patties used during laser surgery should always be wet.	IIA	Quasi-experimental	Surgical patties	Wet patties	Dry patties	N/A	Time to ignition
28	Matt BH, Cottee LA. Reducing risk of fire in the operating room using coblation technology. *Otolaryngol Head Neck Surg* . 2010;143(3):454-455.	Shows that coblation technology produces lower temperatures therefore reduces risk of fire.	IIIC	Descriptive study	N/A	N/A	N/A	N/A	Ignition of fire
29	Dennis E. Decreasing airway fires. *OR Nurse.* 2012;6(2):37-40.	Provides guidance on OR fire prevention	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
30	González Ma CE, Fernández VO. Case report: airway burn. *Rev Colomb Anestesiol.* 2013;41(3):226-228.	Case report of an airway burn.	VC	Case report	N/A	N/A	N/A	N/A	N/A
31	Roy S, Smith LP. Device-related risk of fire in oropharyngeal surgery: a mechanical model. *Am J Otolaryngol* . 2010;31(5):356-359.	Use of a bipolar device decreases the risk of fire during open cavity surgery.	IIB	Descriptive study	Laboratory/degutted chickens	Bipolar RF ablation device	Monopolar cautery device	N/A	Time to ignition
32	Apfelbaum JL, Caplan RA, Connis RT, et al. Practice advisory for the prevention and management of operating room fires: an updated report by the American Society of Anesthesiologists Task Force on Operating Room Fires. *Anesthesiology.* 2013;118(2):271-290.	Evidence based guidelines for fire prevention and management from the ASA.	IVA	Clinical guidelines	N/A	N/A	N/A	N/A	N/A
33	Seifert PC, Peterson E, Graham K. Crisis management of fire in the OR. *AORN J.* 2015;101(2):250-263.	Describes actions to take to prevent and fight an OR fire.	VA	Review of he literature	N/A	N/A	N/A	N/A	N/A
34	Fire caused by improper disposal of a battery-powered electrocautery pen. *Health Devices.* 2013;42(10):346.	Case report of a fire caused by an electrocautery device.	VC	Case report	N/A	N/A	N/A	N/A	N/A
35	Axelrod EH, Kusnetz AB, Rosenberg MK. Operating room fires initiated by hot wire cautery. *Anesthesiology.* 1993;79(5):1123-1126.	All precautions used during monopolar surgery should also be used during electrocautery device use.	IIIB	Case report with a descriptive study	N/A	Attempted ignition of various operating room items with and without O2 enriched environment	Attempted ignition of moistened sponges and towel	N/A	flammability
36	Potty AG, Khan W, Tailor HD. Diathermy in perioperative practice. *J Perioper Pract* . 2010;20(11):402-405.	Description of principles of electrosurgery & precautions to take to prevent injury.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
37	Singh S, Gambhir RS, Kaur A, Singh G, Sharma S, Kakar H. Dental lasers: A review of safety essentials. *J Lasers Med Sci.* 2012;3(3): 91-96.	Report on precautions when using laser	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
38	De Felice E. Shedding light: laser physics and mechanism of action. *Phlebology.* 2010;25(1): 11-28.	Summarizes training required and laser precautions.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
39	Dudelzak J, Goldberg DJ. Laser safety. *Curr Probl Dermatol* . 2011;42: 35-39.	Summarizes precautions to take to prevent injury from laser use.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
40	Dhepe N. Minimum standard guidelines of care on requirements for setting up a laser room. *Indian J Dermatol Venereol Leprol* . 2009;75(Suppl 2):S101-S110.	Recommendations for setting up a laser room	IVB	Clinical Guidelines	N/A	N/A	N/A	N/A	N/A

41	Maurins U, Rabe E, Pannier F. Does laser power influence the results of endovenous laser ablation (EVLA) of incompetent saphenous veins with the 1 470-nm diode laser? A prospective randomized study comparing 15 and 25 W. *Int Angiol.* 2009;28(1):32-37.	Less pain medication was required when a lower power level was used	IA	Randomized controlled trial	Patients with incompetent greater saphenous veins	Endovenous laser ablation using a with a 1, 470 nm diode	Power settings of 15 or 25 W	40 (20 in 15W group, 20 in 25 W group)	Amount of analgesia required
42	Robinson TN, Pavlovsky KR, Looney H, Stiegmann GV, McGreevy FT. Surgeon-controlled factors that reduce monopolar electrosurgery capacitive coupling during laparoscopy. *Surg Laparosc Endosc Percutan Tech.* 2010;20(5):317-320.	Lower power settings should be used to decrease the amount of energy lost through capacitive coupling.	IIA	Quasi-experimental	Experimental laboratory setting	Power setting of 25,50,75,100 Watts	N/A	N/A	Wattage received via capacitive coupling
43	Jones EL, Robinson TN, McHenry JR, et al. Radiofrequency energy antenna coupling to common laparoscopic instruments: practical implications. *Surg Endosc.* 2012;26(11):3053-3057	The electrosurgical cords should be as far as possible from the light cords and the lowest power setting shoud be used.	IIIB	Qualitative bench study	bovine liver	Coag activation at 15 watts	Coag activation at30 watts	N/A	temperature at end of scope and grasper.
44	Martinek M, Bencsik G, Aichinger J, et al. Esophageal damage during radiofrequency ablation of atrial fibrillation: impact of energy settings, lesion sets, and esophageal visualization. *J Cardiovasc Electrophysiol* . 2009;20(7):726-733.	Lower energy levels is safer than higher levels	IIB	Quasi-experimental	patients having RFA	25 watts power, long duration	25 watts power short duration, 15 watts power long duration	170	presence of esophageal ulcerations
45	Robinson TN, Varosy PD, Guillaume G, et al. Effect of radiofrequency energy emitted from monopolar "Bovie" instruments on cardiac implantable electronic devices. *J Am Coll Surg* . 2014;219(3):399-406.	The lowest power should be used, the active electrode cord should be placed at the greatest distance possible from the CIED generator and the CIED generator should not be in pathway of the current from the active electrode to the dispersive electrode.	IIIB	Laboratory study	Pigs	Power at 30W, CIED in pathway of current, active electrode oriented over chest	Power at 60W, CIED not in pathway of current, active electrode oriented over feet	3	amount of EMI received by the CIED
46	Townsend NT, Jones EL, Paniccia A, Vandervelde J, McHenry JR, Robinson TN. Antenna coupling explains unintended thermal injury caused by common operating room monitoring devices. *Surg Laparosc Endosc Percutan Tech.* 2015;25(2):111-113.	To decrease the amount of antenna coupling decrease the power, separate the wires and utilize low voltage devices.	IIB	Quasi-expermental	Porcine model	Nonelectrically active neuromonitoring and cardiac-monitoring leads placed in proximity to the monopolar pencil and its cord.	Nonelectrically active neuromonitoring and cardiac-monitoring leads were placed away from the monopolar pencil and its cord.	N/A	Tissue temperature
47	Russo V, Rago A, DI Meo F, et al. Ventricular fibrillation induced by coagulating mode bipolar electrocautery during pacemaker implantation in Myotonic Dystrophy type 1 patient. *Acta Myologica* . 2014;33(3):149-151.	If use of ESU is required the lowest possible setting should be used.	VB	Case report	N/A	N/A	N/A	N/A	N/A
48	Sanders SM, Krowka S, Giacobbe A, Bisson LJ. Third-degree burn from a grounding pad during arthroscopy. *Arthroscopy* . 2009;25(10):1193-1197.	Case study reporting on a dispersive electrode burn	VB	Case Report	N/A	N/A	N/A	N/A	N/A
49	Brill AI. Electrosurgery: principles and practice to reduce risk and maximize efficacy. *Obstet Gynecol Clin North Am* . 2011;38(4):687-702.	The active electrode shoud be cleaned to prevent increasing the need for more power.	VB	Review of the literature	N/A	N/A	N/A	N/A	N/A

50	Ubee SS, Kasi VS, Bello D, Manikandan R. Implications of pacemakers and implantable cardioverter defibrillators in urological practice. *J Urol* . 2011;186(4):1198-1205. [VA]	Summary of recommendations for care of the patient with an IED.	VA	Review of the literature	N/A	N/A	N/A	N/A	N/A
51	Alkatout I, Schollmeyer T, Hawaldar NA, Sharma N, Mettler L. Principles and safety measures of electrosurgery in laparoscopy. *JSLS* . 2012;16(1):130-139.	Summary of precautions to take when using electrosurgery	VC	Review of he literature	N/A	N/A	N/A	N/A	N/A
52	Misiri J, Kusumoto F, Goldschlager N. Electromagnetic interference and implanted cardiac devices: the medical environment (part II). *Clin Cardiol.* 2012;35(6):321-328.	Report on precautions to take on a patient with a CIED.	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A
53	Lowry TR, Workman JR. Avoiding oral burns during electrocautery tonsillectomy. *Ear Nose Throat J.* 2009;88(2):790-792.	Report on precautions to perform to reduce injuries while using ESU.	VC	Case Report	N/A	N/A	N/A	N/A	N/A
54	ECRI. Laser use and safety. *Operating Room Risk Management.* 2011:IA.	Describes precautions to take during laser use.	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A
55	Druzijanic N, Pogorelic Z, Perko Z, Mrklic I, Tomic S. Comparison of lateral thermal damage of the human peritoneum using monopolar diathermy, Harmonic scalpel and LigaSure. *Can J Surg.* 2012;55(5):317-321.	There is less thermal tissue damage with an output power of 3 than 5.	IIA	Quasi-experimental	Patients having peritoneal surgery	N/A	Output power of 3 or 5.	100	Thermal tissue damage
56	Munro MG. Mechanisms of thermal injury to the lower genital tract with radiofrequency resectoscopic surgery. *J Minim Invasive Gynecol* . 2006;13(1):36-42.	Higher ESU output power results in more injuries than lower output. Damage to the insulation on the active electrode results in injury to the tissue via coupling	IIIB	Laboratory comparative study	Simulated female lower genital tract	N/A	Output setting of (120 -300 Cut) and (60 to 120 Coag)	N/A	Presence and degree of burns
57	Mitchell ME, Kidd D, Lotto ML, et al. Determination of factors influencing tissue effect of thermal chondroplasty: an ex vivo investigation. *Arthroscopy.* 2006;22(4):351-355.	Lower power settings should be used.	IIB	Quasi-experimenta	Adult bovine patellae	N/A	Power setting of 50 W versus 110 W.	13 adult bovine patellae	Thickness of tissue effect
58	Lowe D, Cromwell DA, Lewsey JD, et al. Diathermy power settings as a risk factor for hemorrhage after tonsillectomy. *Otolaryngol Head Neck Surg* . 2009;140(1):23-28.	There is a lower rate of hemorrhage when a lower power setting is used in patients having a cold steel tonsil dissection using bipolar diathermy for hemostasis.	IIIA	Prospective cohort study	Patients having tonsillectomy	N/A	6 to 18+ watts of bipolar power.	8,465	Presence of hemorrhage
59	Kaspar S, Siller J, Cervinkova Z, Danek T. Standardisation of parameters during endovenous laser therapy of truncal varicose veins—experimental ex-vivo study. *Eur J Vasc Endovasc Surg* . 2007;34(2):224-228.	There were a greater number of perforations with the use of 15W power compared to lower settings.	IIB	Quasi-experimental	Harvested saphenous veins	15 W.	5,8,10,12 W.	98	Amount of shrinkage and number of perforations
60	Itoi T, Isayama H, Sofuni A, et al. Evaluation of effects of a novel endoscopically applied radiofrequency ablation biliary catheter using an ex-vivo pig liver. *J Hepatobiliary Pancreat Sci* . 2012;19(5):543-547.	The time of exposure and the power settings be based up the size of the masses using the present results as a base for the decision.	IIB	Descriptive laboratory study	Pig livers	5, 10, 15, and 20 W	60,90,120 seconds	N/A	Effects of RF ablation
61	Huang Y, Zhang Y, Ding X, Liu S, Sun T. Working conditions of bipolar radiofrequency on human articular cartilage repair following thermal injury during arthroscopy. *Chin Med J* . 2014;127(22):3881-3886.	A bipolar power level of 2 for 2 seconds should be used during arthroscopy	IIB	Quasi-experimental	Osteochondral explants	Bipolar power levels of 2, 4 and 6;	2, 5 and 10 seconds	28	percentage and depth of cell death

62	Goulet CJ, Disario JA, Emerson L, Hilden K, Holubkov R, Fang JC. In vivo evaluation of argon plasma coagulation in a porcine model. *Gastrointest Endosc* . 2007;65(3):457-462.	The lowest energy settings and the shortest duration of energy application have the lowest risk of deep tissue injury.	IIB	Blinded quasi-experimental	Swine	Argon plasma coagulation via colonoscopy at 10W, 20W, 40W, and 60W.	1,3,5, second application	146 specimens	Muscular injury
63	Sutton PA, Awad S, Perkins AC, Lobo DN. Comparison of lateral thermal spread using monopolar and bipolar diathermy, the Harmonic Scalpel and the Ligasure. *Br J Surg* . 2010;97(3):428-433. [IIB]	There is increased thermal spread with increased power settings .	IIB	Quasi-experimental	Porcine muscle	Monopolar at 20, 30 and 40 W), Ultrasonic scalpel at 1,3,5 power settings	5, 10 or 15 seconds	N/A	
64	Sananes N, Favre R, Koh CJ, et al. Urological fistulas after fetal cystoscopic laser ablation of posterior urethral valves: surgical technical aspects. *Ultrasound Obstet Gynecol* . 2015;45(2):183-189.	The lowest power setting possible should be used to help prevent complications	IIIB	Descriptive study	fetuses	N/A	N/A	40	Presence of complications after laser fulguration of the posterior urethral valves
65	Govekar HR, Robinson TN, Varosy PD, et al. Effect of monopolar radiofrequency energy on pacemaker function. *Surg Endosc* . 2012;26(10):2784-2788.	The lowest power setting should be used and the dispersive electrode should be placed so the current vector does not travel through the pacemaker.	IIIC	Laboratory study	Pig heart	Use of power settings of 30.	Use of power settings of 60.	N/A	Missed pacemaker beats
66	Robinson TN, Barnes KS, Govekar HR, Stiegmann GV, Dunn CL, McGreevy FT. Antenna coupling -a novel mechanism of radiofrequency electrosurgery complication: practical implications. *Ann Surg.* 2012;256(2):213-218.	The cords on the sterile field should be separated to decrease the amount of antenna coupling at the camera	IIB	Quasi-experimental	Porcine tissue	Cords in close proximity	cords placed apart	N/A	Thermal injury at the camera trocar incision
67	Devassy R, Gopalakrishnan S, De Wilde RL. Surgical efficacy among laparoscopic ultrasonic dissectors: are we advancing safely? A review of literature. *J Obstet Gynecol India* . 2015;65(5):293-300.	The lowest power setting should be used to decrease the amount of thermal damage	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
68	Peter NM, Ribes P, Khooshabeh R. Cardiac pacemakers and electrocautery in ophthalmic surgery. *Orbit.* 2012;31(6):408-411.	Recommendations for caring for patient with an IED.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
69	Rey JF, Beilenhoff U, Neumann CS, Dumonceau JM. European Society of Gastrointestinal Endoscopy (ESGE) guideline: the use of electrosurgical units. *Endoscopy* . 2010;42(9):764-771.	Clinical guideline on managing patients with and IED	IVC	Clinical guideline	N/A	N/A	N/A	N/A	N/A
70	American Society of Anesthesiologists. Practice advisory for the perioperative management of patients with cardiac implantable electronic devices: pacemakers and implantable cardioverter-defibrillators: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Implantable Electronic Devices. *Anesthesiology* . 2011;114(2):247-261.	Clinical guideline on managing patients with and IED	IVC	Clinical guideline	N/A	N/A	N/A	N/A	N/A
71	O'Riley M. Electrosurgery in perioperative practice. *J Perioper Pract* . 2010;20(9):329-333.	Description of principles of electrosurgery & precautions to take to prevent injury.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A

72	Metzner A, Wissner E, Schoonderwoerd B, et al. The influence of varying energy settings on efficacy and safety of endoscopic pulmonary vein isolation. *Heart Rhythm* . 2012;9(9):1380-1385.	Higher energy levels are safe and are more effacious	IIIB	Descriptive	patients having pulmonary vein isolation	5.5 and 7.0 W,	7.0 and 8.5 W and 8.5 and 10.0 W	10 patients in each group	pulmonary vein isolation and possible side effects
73	Mantke R, Halangk W, Habermann A, et al. Efficacy and safety of 5-mm-diameter bipolar and ultrasonic shears for cutting carotid arteries of the hybrid pig. *Surg Endosc.* 2011;25(2):577-585.	There is a higher failure rate when using a higher power level on the harmonic generator.	IIIA	Descriptive study	Porcine carotid arteries	N/A	Output power of 1,3,5	108 at Level 1 power, 114 at 3 power level, 125 at 5 power level,	Vessel sealing failure rate
74	Hefermehl LJ, Largo RA, Hermanns T, Poyet C, Sulser T, Eberli D. Lateral temperature spread of monopolar, bipolar and ultrasonic instruments for robot-assisted laparoscopic surgery. *BJU Int* . 2014;114(2):245-252.	The heat spread increased with increasing power, therefore procedures should be started with the lowest power setting	IIIB	Descriptive	Pigs	N/A	Monopolar electrosurgery performed at 30, 60, 90 Watts	N/A	Amount of temperature spread
75	Hazard report. Internal wire breakage in reusable electrosurgical active electrode cables may cause sparking and surgical fires. *Health Devices.* 2009;38(7):228-229.	Report on procedure to follow to prevent injury from cables breaking	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
76	Shah AJ, Janes R, Holliday J, Thakur R. Radiofrequency transseptal catheter electrode fracture. *Pacing Clin Electrophysiol.* 2010;33(6):e57-e58.	Case report of a broken RFA catheter.	VB	Case report	N/A	N/A	N/A	N/A	N/A
77	El-Damaty A, Love M, Parkash R. Detached tip of a transseptal sheath during left atrial ablation. *Catheter Cardiovasc Interv* . 2012;79(3):444-447.	Case report of a broken transseptal sheath.	VC	Case report	N/A	N/A	N/A	N/A	N/A
78	Hospital eTools. Surgical suite—use of medical lasers. Occupational Safety and Health Administration. https://www.osha.gov/SLTC/etools/hospital/surgical/lasers.html. Accessed June 27, 2016.	Summary of laser hazards and precautions to take	VC	Case report	N/A	N/A	N/A	N/A	N/A
79	National Fire Protection Association Technical Committee on Laser Fire Protection. *NFPA 115: Standard for Laser Fire Protection.* Quincy, MA: National Fire Protection Association; 2008.	Guidelines from NFPA on Laser safety	IVC	Clinical Practice Guideline	N/A	N/A	N/A	N/A	N/A
80	Mary S. Laser safety: practical measures and latest legislative requirements. *J Perioper Pract* . 2011;21(9):299-303.	Summary of recommendations for laser safety in the UK.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
81	Plauntz L. Guidelines for staff administering laser therapy in an office setting. *Plast Surg Nurs.* 2013;33(1):29-35.	Guidelines on the required education of staff using lasers.	IVB	Clinical Guidelines	N/A	N/A	N/A	N/A	N/A
82	Z136.3: Safe use of lasers in health care. In: *ANSI Z136 Standards* . Orlando, FL. Laser Institute of America; 2011.	Guidelines on the use of laser in the healthcare setting.	IVC	Clinical guidelines	N/A	N/A	N/A	N/A	N/A
83	Smalley PJ. Laser safety: risks, hazards, and control measures. *Laser Ther* . 2011;20(2):95-106. [VB]	Summary of precautions to take with the use of lasers	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
84	Munro MG. Complications of hysteroscopic and uterine resectoscopic surgery. *Obstet Gynecol Clin North Am.* 2010;37(3):399-425.	Discusses types of solutions to be used for distention.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
85	Fonseca AZ, Santin S, Gomes LG, Waisberg J, Ribeiro MA Jr. Complications of radiofrequency ablation of hepatic tumors: frequency and risk factors. *World J Hepatol* . 2014;6(3):107-113.	Recommendations for dispersive electrode placement.	VB	Review of the literature	N/A	N/A	N/A	N/A	N/A
86	Gil Franco F, Bailard N. Peripheral nerve stimulator response triggered by proximity to electrosurgical unit. *Anesth Analg* . 2012;114(5):1142-1143.	Case report of a nerve stimulator misfiring every time the ESU on which it was setting was activated	VC	Case report	N/A	N/A	N/A	N/A	N/A

87	Sabzi F, Niazi M, Ahmadi A. Rare case-series of electrocautery burn following off-pump coronary artery bypass grafting. *J Inj Violence Res* . 2014;6(1):44-49.	Case report of alternate site burns.	VB	Case report	N/A	N/A	N/A	N/A	N/A
88	Nelson G, Morris ML. Electrosurgery in the gastrointestinal suite: knowledge is power. *Gastroenterol Nurs.* 2015;38(6):430-439.	Summary of best practices for application of grounding pad and use of the ESU.	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A
89	Vilos GA, Rajakumar C. Electrosurgical generators and monopolar and bipolar electrosurgery. *J Minim Invasive Gynecol* . 2013;20(3):279-287.	Report on effects of electrosurgery including recommendations on handling of body piercings.	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A
90	Makedonov I, Lee J. An evaluation of potential for alternate return site burns due to capacitive coupling between active electrode and ground while using electrosurgery units. *J Clin Eng* . 2011;36(1):29-31.	The potential for an alternate site burn is very low because of current technology.	IIIC	Computer generated model to determine the potential for alternate site burns from and ESU	N/A	N/A	N/A	N/A	Amount of electrical current output
91	Robinson TN, Jones EL, Dunn CL, et al. Separating the laparoscopic camera cord from the monopolar "Bovie" cord reduces unintended thermal injury from antenna coupling: a randomized controlled trial. *Ann Surg.* 2015;261(6):1056-1060.	The laparoscopic camera cord and the active electrode cord should be separated to decrease the amount of antenna coupling at the camera trocar incision.	IA	RCT	patients undergoing laparoscopic cholecystectomy	Separated active electrode/camera cords	Active electrode/camera cords placed parallel and close together	84	Thermal injury at the camera trocar incision
92	Hammwohner M, Stachowitz J, Willich T, Goette A. Induction of ventricular tachycardia during radiofrequency ablation via pulmonary vein ablation catheter in a patient with an implanted pacemaker. *Europace* . 2012;14(2):298-299.	Case report of a patient with an ICD who developed v-tach resulting from antenna coupling between the lead and a monopolar electrosurgical device. Author recommends using bipolar energy.	VC	Case report	N/A	N/A	N/A	N/A	N/A
93	Goel AK, Korotkin S, Walsh D, Bess M, Frawley S. Monomorphic ventricular tachycardia caused by electrocautery during pacemaker generator change in a patient with normal left ventricular function. *Pacing Clin Electrophysiol* . 2009;32(7):957-958.	Case report of a patient with an ICD who developed v-fib after contact was made between the lead and a monopolar electrosurgical device.	VC	Case report	N/A	N/A	N/A	N/A	N/A
94	Cassagneau R, Hanninen M, Yee R. Electrocauteryinduced ventricular fibrillation during routine implantable cardioverter-defibrillator generator replacement. *Europace* . 2014;16(3):319.	Case report of a patient with an ICD developed v-fib after contact was made between the lead and a monopolar electrosurgical device.	VC	Case report	N/A	N/A	N/A	N/A	N/A
95	Schulman PM, Rozner MA. Use caution when applying magnets to pacemakers or defibrillators for surgery. *Anesth Analg* . 2013;117(2):422-427.	Case report of cases having complications after use of ESU in a patient having an CIED	VA	Case report	N/A	N/A	N/A	N/A	N/A
96	Mohammed I, Ratib K, Creamer J. An unusual intracardiac electrogram showing cause for false electrical discharge from an ICD. *BMJ Case Rep* . 2013;2013.	Case report of a patient having EMI sensed as v-fib.	VC	Case report	N/A	N/A	N/A	N/A	N/A
97	Castillo JG, Silvay G, Viles-Gonzalez J. Perioperative assessment of patients with cardiac implantable electronic devices. *Mt Sinai J Med* . 2012;79(1):25-33.	Summary of care for a patient with a CIED	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
98	King C. Endoscopic electrosurgery—an overview. *Gastrointest Nurs* . 2011;9(4):28-33.	Describes safety precaution to take when using an ESU	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A

99	Lomax A. Overview of the principles of electrosurgery and patient safety in the endoscopy room. *J GENCA* . 2009;19(3):14-34.	Provides general guidance on electrosurgical safety in the endoscopy unit	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
100	Crossley GH, Poole JE, Rozner MA, et al. The Heart Rhythm Society (HRS)/American Society of Anesthesiologists (ASA) Expert Consensus Statement on the perioperative management of patients with implantable defibrillators, pacemakers and arrhythmia monitors: facilities and patient management. This document was developed as a joint project with the American Society of Anesthesiologists (ASA), and in collaboration with the American Heart Association (AHA), and the Society of Thoracic Surgeons (STS). *Heart Rhythm.* 2011;8(7):1114-1154.	Guidelines describing treatment of a patient with CIEDs.	IVC	Clinical guidelines	N/A	N/A	N/A	N/A	N/A
101	Maheshwari KR, Nikdel K, Guillaume G, Letra AM, Silva RM, Dorn SO. Evaluating the effects of different dental devices on implantable cardioverter defibrillators. *J Endod* . 2015;41(5):692-695.	Monopolar cautery emits enough EMI to interfere with the operation of a CIED when used during dental procedures.	IIIB	Laboratory study	N/A	N/A	N/A	N/A	Misfiring of the CIED.
102	Stone ME, Salter B, Fischer A. Perioperative management of patients with cardiac implantable electronic devices. *Br J Anaesth* . 2011;107(Suppl 1):i16-i26.	Report on precautions to take when using ESU in the patient with an CIED	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A
103	Petersen BT, Hussain N, Marine JE, et al. Endoscopy in patients with implanted electronic devices. *Gastrointest Endosc* . 2007;65(4):561-568.	Recommendations for handling a patient with an IED in an endo suite	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
104	Navaratnam M, Dubin A. Pediatric pacemakers and ICDs: how to optimize perioperative care. *Paediatr Anaesth.* 2011;21(5):512-521.	Recommendations for handling a pediatric patient with an IED	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
105	Gallagher K, Dhinsa B, Miles J. Electrosurgery. *Surgery* . 2011;29(2):70-72.	Report on precautions to take to avoid burns during electrosurgery	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
106	Garcia Bracamonte B, Rodriguez J, Casado R, Vanaclocha F. Electrosurgery in patients with implantable electronic cardiac devices (pacemakers and defibrillators). *Actas Dermosifiliogr* . 2013;104(2):128-132.	Report on precautions to take when caring for a patient with an implantable electronic device.	VB	Expert opinion	N/A	N/A	NA	N/A	N/A
107	Can I, Aribas A, Dereli Y, Tholakanalli V. Inappropriate sensing events revealing electrocautery-induced implantable cardioverter-defibrillator lead failure. *Anatol J Cardiol.* 2015;15(10):E27.	Report of a patient who has a pacemaker and had complications after use of ESU.	V	Expert opinion	N/A	N/A	N/A	N/A	N/A
108	Chia PL, Foo D. A practical approach to perioperative management of cardiac implantable electronic devices. *Singapore Med J* . 2015;56(10):538-541.	Recommends that a multidisciplinary team evaluate patients with IEDs.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
109	Santini L, Forleo GB, Santini M. Implantable devices in the electromagnetic environment. *J Arrhythm* . 2013;29(6):325-333.	Report on precautions to take when using ESU in the patient with an CIED	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
110	Stone ME, Apinis A. Current perioperative management of the patient with a cardiac rhythm management device. *Semin Cardiothorac Vasc Anesth* . 2009;13(1):31-43.	Report on precautions to take when using ESU in the patient with an CIED	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A

111	Healey JS, Merchant R, Simpson C, et al. Canadian Cardiovascular Society/Canadian Anesthesiologists' Society/Canadian Heart Rhythm Society joint position statement on the perioperative management of patients with implanted pacemakers, defibrillators, and neurostimulating devices. *Can J Anesth.* 2012;59(4):394-407.	Clinical guideline on managing patients with and IED	IVB	Clinical guideline	N/A	N/A	N/A	N/A	N/A
112	Ogg MJ. Caring for patients with cardiovascular implantable electronic devices [Clinical Issues]. *AORN J.* 2013;98(2):196-197.	Report on procedure to follow to prevent injury from phacoemulsification.	VB	Review of the literature with a case report.	N/A	N/A	N/A	N/A	N/A
113	Howe N, Cherpelis B. Obtaining rapid and effective hemostasis: part II. electrosurgery in patients with implantable cardiac devices. *J Am Acad Dermatol.* 2013;69(5):677.e1-677.e9.	Report on precautions to use when patient has a IED	VC	Summary of the literature	N/A	N/A	N/A	N/A	N/A
114	Rozner MA. Perioperative care of the patient with a cardiac pacemaker or ICD. *Rev Mex Anestesiol* . 2009;32(Suppl 1):S190-S197.	Report on precautions to take when using ESU in the patient with an CIED	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
115	Ahrens PM, Siddiqui NA, Rakhit RD. Pacemaker placement and shoulder surgery: is there a risk? *Ann R Coll Surg Engl* . 2012;94(1):39-42.	Education is needed on risks associated with shoulder surgery in patients with a pacemaker	IIIC	Qualitative	Shoulder surgeons and residents	N/A	N/A	17 surgeons, 8 residents	Use of electrosurgery in the presence of a pacemaker
116	Pavlovic S, Milasinovic G, Zivkovic M. Approach to patients with implanted pacemaker and scheduled surgical or diagnostic procedure. *Acta Chir Iugosl.* 2011;58(2):25-29.	Recommendations for caring for patient with an IED.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
117	Voutsalath MA, Bichakjian CK, Pelosi F, Blum D, Johnson TM, Farrehi PM. Electrosurgery and implantable electronic devices: review and implications for officebased procedures. *Dermatol Surg.* 2011;37(7):889-899.	Report on types of Ides and care of these patients when electrosurgery is used	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A
118	Venkatraghavan L, Chinnapa V, Peng P, Brull R. Non-cardiac implantable electrical devices: brief review and implications for anesthesiologists. *Can J Anaesth.* 2009;56(4): 320-326.	Summary of recommendations for care of the patient with an IED.	VA	Review of the literature	N/A	N/A	N/A	N/A	N/A
119	Abdelmalak B, Jagannathan N, Arain FD, Cymbor S, McLain R, Tetzlaff JE. Electromagnetic interference in a cardiac pacemaker during cauterization with the coagulating, not cutting mode.*J Anaesth Clin Pharmacol.* 2011;27(4):527-530.	Case report of pacemaker interference caused by use of coagulation mode of an electrosurgical device.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
120	Paniccia A, Rozner M, Jones EL, et al. Electromagnetic interference caused by common surgical energy-based devices on an implanted cardiac defibrillator. *Am J Surg* . 2014;208(6): 932-936.	Describes the amount of EMI received by an ICD from various devices.	IIB	Quasi-experimental	Pig heart	Use of bipolar, advanced bipolar, ultrasonic shears, monopolar, monopolar instrument without dispersive electrode, plasma energy argon beam coagulator	Use of monopolar at 30 W. blend, 30W coagulation	N/A	Amount of EMI present with use of multiple energy devices

121	Bouyer B, Bachy M, Vermesch AI, Doummar D, Coubes P, Vialle R. The use of harmonic scalpel in spinal surgery with contraindication to the use of monopolar electrocautery: a case report in a 14-year-old girl with a primary generalized dystonia and a 100^{o} thoracic scoliosis. *Childs Nerv Syst.* 2012;28(8)1251-1255.	Case report covering use of a harmonic scalpel instead of a monopolar Electrosurgery device in the patient with neurostimulators.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
122	Weiss JP, Manwaring P. Freedom from electromagnetic interference between cardiac implantable electronic devices and the FMwand ferromagnetic surgical system. *J Clin Anesth* . 2013;25(8): 681-684.	Ferro magnetic wand does not use EMI with a CIED	IIC	Descriptive study	N/A	N/A	N/A	N/A	electromagnetic interference between pacer and electrosurgical device
123	Asensio EL, Lopez TG, Guerrero MH, et al. Radiofrequency ablation of a hepatic neoplasm in a patient with an abdominal pacemaker. *Cardiol J.* 2009;16(3): 264-268.	Describes the precautions taken when using monopolar radiofrequency ablation in a patient with a pacemaker	VB	Review of the literature	N/A	N/A	N/A	N/A	N/A
124	Radolec MM, Beerman LB, Arora G. Radiofrequency energy ablation in a child with an implanted vagus nerve stimulator. *Cardiol Young* . 2015;25(7): 1379-1381.	Case report which found no interaction between a nerve stimulator that was turned off and the energy from a radio frequency ablation catheter.	VB	Case report	N/A	N/A	N/A	N/A	N/A
125	Jeyakumar A, Wilson M, Sorrel JE, et al. Monopolar cautery and adverse effects on cochlear implants. *JAMA Otolaryngol Head Neck Surg* . 2013;139(7): 694-697.	No damage or temperature increase occurred but before changing the current practice as stated in the intervention further study is required.	IIIB	Descriptive caderivic study	N/A	N/A	N/A	N/A	Increase in temperature or damage to cochlear implant
126	Frampton SJ, Ismail-Koch H, Mitchell TE. How safe is diathermy in patients with cochlear implants? *Ann R Coll Surg Engl* . 2012;94(8): 585-587.	Additional education is needed on proper use of devices for endometrial ablation.	IIIB	Qualitative	Surgeons who work in the head and neck area	N/A	N/A	36	Amount of knowledge on the interaction of cochlear implant and electrosurgery
127	Frampton SJ, Mitchell TE. Surgical safety issues relating to the use of diathermy in patients with cochlear implants: the patient's perspective. *Cochlear Implants Int* . 2014;15(1): 48-52.	Supports patients, families and staff receiving education.	IIIB	Qualitative	Adults with cochlear implants and parents of children with cochlear implants	N/A	N/A	50 of each category of population	Amount of knowledge on the interaction of cochlear implant and electrosurgery
128	Alternate-site burns from improperly seated or damaged electrosurgical pencil active electrodes. *Health Devices.* 2012;41(10):334,	Case report of a burn from an improperly seated active electrode tip.	VB	Case report	N/A	N/A	N/A	N/A	N/A
129	Flowers J. Fire Safety in procedural areas. *J Radiol Nurs.* 2012;31(1): 13-19.	Provides guidance on OR fire prevention	VB	Organizational experience	N/A	N/A	N/A	N/A	N/A
130	Kwon H-J, Kim PN, Byun JH, et al. Various complications of percutaneous radiofrequency ablation for hepatic tumors: Radiologic findings and technical tips. *Acta Radiol* . 2014;55(9): 1082-1092.	Recommends inspection of the RF device shaft for insulation failure and using the correct size dispersive electrode.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
131	Pompili M, Riccardi L, Garcovich M, Sollazzi L, Seccia A, Rapaccini G. Severe skin burn at needle entry point complicating radiofrequency ablation for hepatocellular carcinoma. *Ultraschall Med.* 2012;33(7): E359-E360.	Case study reporting on a burn at the site of RFA needle insertion.	VB	Case report	N/A	N/A	N/A	N/A	N/A
132	Ogake K, Yasui C, Aihara T, et al. Analysis of tissue impedance waveform reflecting in a grounding pad burn during radiofrequency ablation. *Acta Hepato Jpn* . 2011;52(6): 361-367.	Case report describing a skin burn at the grounding pad site which occurred during RFA.	VC	Case report	N/A	N/A	N/A	N/A	N/A

133	Demircin S, Aslan F, Karagoz YM, Atilgan M. Medicolegal aspects of surgical diathermy burns: A case report and review of the literature. *Rom J Leg Med.* 2013;21(3): 173-176.	Case report which recommends the proper placement of the grounding pad and other electrosurgery precautions.	VB	Regulatory document	N/A	N/A	N/A	N/A	N/A
134	Nguyen DT, Barham W, Zheng L, Dinegar S, Tzou WS, Sauer WH. Effect of radiofrequency energy delivery in proximity to metallic medical device components. *Heart Rhythm* . 2015;12(10): 2162-2169.	The grounding pad shoud be placed to avoid metal between it and the RF ablation active electrode.	IIIB	Descriptive study	N/A	N/A	N/A	N/A	Thermal changes near the site of the implanted metal objects.
135	Saaiq M, Zaib S, Ahmad S. Electrocautery burns: experience with three cases and review of literature. *Ann Burns Fire Disasters* . 2012;25(4): 203-206.	Case study reporting on a dispersive electrode burn.	VB	Case report	N/A	N/A	N/A	N/A	N/A
136	Ertugrul I, Karagoz T, Aykan HH. A rare complication of radiofrequency ablation: skin burn. *Cardiol Young* . 2015;25(7): 1385-1386.	Report of a burn under the dispersive electrode	VC	Case report	N/A	N/A	N/A	N/A	N/A
137	Dhillon PS, Gonna H, Li A, Wong T, Ward DE. Skin Burns associated with radiofrequency catheter ablation of cardiac arrhythmias. *Pacing Clin Electrophysiol* . 2013;36(6): 764-767.	Case study reporting on a dispersive electrode burn	VC	Case report	N/A	N/A	N/A	N/A	N/A
138	Huffman SD, Huffman NP, Lewandowski RJ, Brown DB. Radiofrequency ablation complicated by skin burn. *Semin Intervent Radiol* . 2011;28(2): 179-182.	Case study reporting on a dispersive electrode burn.	VC	Case report	N/A	N/A	N/A	N/A	N/A
139	Hachach-Haram N, Saour S, Alamouti R, Constantinides J, Mohanna PN. Labelling of diathermy consoles when multiple systems are used: should this be part of the WHO checklist? *BMJ Qual Saf* . 2013;22(9): 775-776.	Recommends labeling of ESU and corresponding accessories when more than one ESU is used.	VB	Organizational experience	N/A	N/A	N/A	N/A	N/A
140	Odell RC. Surgical complications specific to monopolar electrosurgical energy: engineering changes that have made electrosurgery safer. *J Minim Invasive Gynecol.* 2013;20(3): 288-298.	Supports the use of CQM and AEM.	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
141	Liu Q, Sun XB. Indirect electrical injuries from capacitive coupling: a rarely mentioned electrosurgical complication in monopolar laparoscopy. *Acta Obstet Gynecol Scand* . 2013;92(2): 238-241.	Case report describing cases of complications resulting from laparoscopy monopolar electrosurgery use.	VC	Case report	N/A	N/A	N/A	N/A	N/A
142	Brown J, Blank K. Minimally invasive endometrial ablation device complications and use outside of the manufacturers' instructions. *Obstet Gynecol.* 2012;120(4): 865-870.	Additional education is needed on proper use of devices for endometrial ablation	VC	Case report	N/A	N/A	N/A	N/A	N/A
143	Feldman LS, Fuchshuber P, Jones DB, Mischna J, Schwaitzberg SD, FUSE (Fundamental Use of Surgical Energy™) Task Force. Surgeons don't know what they don't know about the safe use of energy in surgery. *Surg Endosc* . 2012;26(10): 2735-2739.	Surgeons have a knowledge gap regarding the safe use of electrosurgery devices and education is needed.	IIB	Qualitative	Surgeons and residents	Pretest before education	Post test after education	48 surgeons and 27 residents	Correct answers on test regarding electrosurgery and associated complications.
144	AlNomair N, Nazarian R, Marmur E. Complications in lasers, lights, and radiofrequency devices. *Facial Plast Surg.* 2012;28(3):340-346.	Education is needed to prevent the complications associated with improper use of energy devices	VB	Expert opinion	Maude database reports	N/A	N/A	829	Complications resulting from use of device beyond manufacturer IFU.
145	Surve R, Madhusudan S, Sriganesh K. Electrocautery interference with intraoperative capnography during neurosurgery. *J Clin Monit Comput.* 2014;28(4): 429-430.	Education on electrocautery induced artifact will help prevent diagnostic confusion and unneeded treatments.	VB	Case report	N/A	N/A	N/A	N/A	N/A

146	Guideline for health care information management. In: *Guidelines for Perioperative Practice.* Denver, CO: AORN; 2016:577-588.	Guidelines for documentation	IVC	Clinical Guideline	N/A	N/A	N/A	N/A	N/A
147	Abu-Rafea B, Vilos GA, Al-Obeed O, AlSheikh A, Vilos AG, Al-Mandeel H. Monopolar electrosurgery through single-port laparoscopy: a potential hidden hazard for bowel burns. *J Minim Invasive Gynecol.* 2011;18(6):734-740.	Burns result from capacitive and direct coupling in simulated single port laparoscopic surgery performed using mono-polar electrosurgery	IIIB	Descriptive	sheep liver, pig bowel, dog bowel	N/A	N/A	N/A	Presence of capacitive or direct coupled burns
148	Cassaro S. Delayed manifestations of laparoscopic bowel injury. *Am Surg* . 2015;81(5): 478-482.	trocar incision.	VA	Case report	N/A	N/A	N/A	N/A	N/A
149	Humes DJ, Ahmed I, Lobo DN. The pedicle effect and direct coupling: delayed thermal injuries to the bile duct after laparoscopic cholecystectomy. *Arch Surg.* 2010;145(1): 96-98.	Case report of injuries from pedicle effect and direct coupling.	VC	Case report	N/A	N/A	N/A	N/A	N/A
150	Cormier B, Nezhat F, Sternchos J, Sonoda Y, Leitao MM Jr. Electrocautery-associated vascular injury during robotic-assisted surgery. *Obstet Gynecol.* 2012;120(2 Pt 2): 491-493.	Case report of 3 woman injured by capacitive coupling.	VB	Case report	N/A	N/A	N/A	N/A	N/A
151	Montero PN, Robinson TN, Weaver JS, Stiegmann GV. Insulation failure in laparoscopic instruments. *Surg Endos.* 2010;24(2): 462-465.	Insulation failure is frequently present and surgeons should adopt practices to minimize complications related to it.	IIIB	Descriptive study	laparoscopic instruments	N/A	N/A	165	Presence of insulation failure
152	Mendez-Probst CE, Vilos G, Fuller A, et al. Stray electrical currents in laparoscopic instruments used in da Vinci robot-assisted surgery: an in vitro study. *J Endourol.* 2011;25(9): 1513-1517.	Active electrode monitoring shoud be employed on robotic instruments.	IIIB	Descriptive study	Robotic instruments	N/A	N/A	37	amount of current leakage
153	Espada M, Munoz R, Noble BN, Magrina JF. Insulation failure in robotic and laparoscopic instrumentation: a prospective evaluation. *Am J Obstet Gynecol.* 2011;205(2): 121.e1-121.e5.	There is a high incidence of insulation failure in robotic and laparoscopic instruments. Routine testing should be performed.	IIIB	Descriptive study	Robotic and laparoscopic instruments	Phase A:Tested at 20 W and 2.64 kV; Phase B 20 W/1 kV and 20 W/4.2 kV,	N/A	Phase A 78 robotic and 298 laparoscopic instruments; Phase B: 60 robotic and 308 laparoscopic instruments	Insulation failure
154	Z136.1: Safe use of lasers. In: *ANSI Z136 Standards.* Orlando, FL: Laser Institute of America;2014.	Clinical Guidelines covering use of the laser.	IVC	Clinical practice guideline	N/A	N/A	N/A	N/A	N/A
155	Dhar P, Malik A. Anesthesia for laser surgery in ENT and the various ventilatory techniques. *Trends Anaesth Crit Care.* 2011;1(2): 60-66.	Various recommendations for laser safety practices	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
156	Kyoukai KH. Safety guidelines for the laser removal of dental calculus. *Laser Ther* . 2012;21(2): 137-145.	Laser safety should be appointed and other laser safety precautions.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
157	Thomas G, Isaacs R. Basic principles of lasers. *Anaesth Intensive Care Med.* 2011;12(12): 574-577.	Outlines the precautions to be taken when using a laser.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
158	Kang Y, Rabie AB, Wong RW. A review of laser applications in orthodontics. *Int J Orthod* . 2014;25(1): 47-56.	Details eye and skin injury prevention recommendations.	VA	Expert opinion	N/A	N/A	N/A	N/A	N/A
159	Kaneko S. Safety guidelines for diagnostic and therapeutic laser applications in the neurosurgical field. *Laser Ther* . 2012;21(2): 129-136.	Japanese guidelines for use of laser	IVC	Clinical guidelines	N/A	N/A	N/A	N/A	N/A
160	Edwards B, Sams B. Overview of the Board of Laser Safety's professional certification programs for laser safety officers. *Med Laser Appl.* 2010;25(2): 70-74.	Describes the requirements for CLSO education.	VB	Case report	N/A	N/A	N/A	N/A	N/A

161	Osti D, Ferri E, Caggese G, Rinaldi S, Guberti A, Zoppellari R. Probable case of vascular air embolism during endonasal CO2 laser surgery. *Minerva Anestesiol.* 2009;75(5): 275-279.	Case report of a venous air embolism and recommends education of the perioperative team.	VC	Case report	N/A	N/A	N/A	N/A	N/A
162	29 CFR 1910. Subpart I--personal protective equipment. Occupational Safet and Health Administration. Https://www.osha.gov/pls/oshaweb/owastand.display_standard_group?p_toc_level=1&p_part_number=1910.Accessed June 27, 2016.	Regulatory requirements for laser eye protection	R	Regulatory document	N/A	N/A	N/A	N/A	N/A
163	Wöllmer W, Schade G, Kessler G. Endotracheal tube fires still happen--a short overview. *Med Laser Appl.* 2010;25(2):118-125.	Perioperative team members including anesthesia and physicians should receive education on laser fire prevention techniques.	VA	Case report	N/A	N/A	N/A	N/A	N/A
164	Russi M, Buchta WG, Swift M, et al. Guidance for occupational health services in medical centers. *J Occup Environ Med.* 2009;51(11): 1e-18e.	Supports use of safety eye wear and eye exam when near laser	VC	Case report and review of the literature	1212 reports of events	N/A	N/A	N/A	N/A
165	Pierce JS, Lacey SE, Lippert JF, Lopez R, Franke JE, Colvard MD. An assessment of the occupational hazards related to medical lasers. *J Occup Environ Med.* 2011;53(11): 1302-1309.	There are risks to the staff and patients in the room when a laser is used.	IIIB	Review of the literature	N/A	N/A	N/A	N/A	N/A
166	Althunayan AM, Elkoushy MA, Elhilali MM. Andonian S. Adverse events resulting from lasers used in urology. *J Endourol.* 2014;28(2):256-260.	Recommends use of eye wear during laser procedures and provides data on the frequency of adverse events	VC	Review of the literature	N/A	N/A	N/A	N/A	N/A
167	29 CFR 1926: Safety and health regulations for construction. Occupational Safety and Health Administration. Https://www.osha.gov/pls/oshaweb/owastand.display_standard_group?p_toc_level=1&p_part_number=1926. Accessed June 27, 2016.	OSHA Requirements for construction	R	Regulatory document	N/A	N/A	N/A	N/A	N/A
168	Public Law 91-596: Occupational Safety and Health Act of 1970. December 29, 1970, as amended through January 1, 2004. Occupational Safety and Health Administration. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=OSHACT&p_id=2743. Accessed June 27, 2016.	OSHA Requirements for public law	R	Regulatory document	N/A	N/A	N/A	N/A	N/A
169	Paulausky C. Laser safety: the eyes have it! *Occup Health Saf.* 2014;83(8): 10-12.	Guidelines for laser surgery.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
170	Ohshiro T, Ohshiro T, Sasaki K, et al. Correct calibration procedure for the Q-switched ruby laser and checking the treatment irradiation pattern. *Laser Ther.* 2013;22(3): 171-180.	Describes steps and the rationale for calibration of lasers	VB	Expert opinion	N/A	N/A	N/A	N/A	N/A
171	Crossley B. New equipment, new challenges: managing a laser safety program. *Biomed Instrum Technol.* 2009;43(4): 294.	Recommendations for setting up a laser.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A
172	Hammons MA, Ramey NA, Stinnett S, Woodward JA. Effects of reflected CO2 laser energy on operative field materials: risks to patients and operating room personnel. *Ophthal Plast Reconstr Surg.* 2010;26(5): 386-388.	Wet gauze and non-reflective surfaces shoud be used to prevent burns from reflected laser beams.	IIIB	Descriptive study	N/A	N/A	N/A	N/A	Burns from reflected laser beams.
173	Li S, Chen L, Tan F. Laryngeal surgery using a CO2 laser: is a polyvinylchloride endotracheal tube safe? *Am J Otolaryngol.* 2012;33(6): 714-717.	Endotracheal tubes should be inflated with water when a laser is used in the vicinity of the endotracheal tube.	IIIA	Descriptive study	Laboratory	Endotracheal tube filled with water	Endotracheal tube filled with air	N/A	Endotracheal tube cuff bursting

174	Roy S, Smith LP, Prevention of airway fires: testing the safety of endotracheal tubes and surgical devices in a mechanical model. *Am J Otolaryngol.* 2015;36(1):63-66.	CO2 lasers should be used with a reinforced laser safe endotracheal tube. Fires can be ignited faster at higher concentrations of O2.	IIB	Descriptive study	Laboratory	Traditional endotracheal tube	Reinforced "laser safe" endotracheal tube	N/A	Time to ignition
175	Roy S, Smith LP. Surgical fires in laser laryngeal surgery: are we safe enough? *Otolaryngol Head Neck Surg.* 2015:152(1):67-72.	Study supports use of wet packs around endotracheal tube when using laser close to endotracheal tube.	IIB	Qualitative laboratory study	intubation mannequin	FiO2 at 100%,40%,29%	N/A	N/A	Ignition of fire
176	Lekich C, Hannah P. Retained laser fibre: insights and management. *PHLEBOLOGY.* 2014;29(5): 318-324.	Case report of a retained laser fiber with recommendations for precautions to take to prevent it from occurring.	VB	Case report	N/A	N/A	N/A	N/A	N/A
177	van den Bos RR, Neumann M, Nijsten T. Laser fibre stabs the catheter: a serious complication of endovenous laser ablation. *Phlebology.* 2011;26(3): 119-120.	Laser fibers can puncture the cannulas	VB	Case report	N/A	N/A	N/A	N/A	N/A
178	Bozoglan O, Mese B, Inci MF, Eroglu E. A rare complication of endovenous laser ablation: intravascular laser catheter breakage. *BMJ Case Rep.* 2013;2013.	Case report of a broken and retained laser fiber tip.	VC	Case report	N/A	N/A	N/A	N/A	N/A
179	Shum JWH, Chan KSK, Wong D, Li KKW. Intraoperative fracture of phacoemulsification sleeve. *BMC Ophthalmol* . 2010;10: 29-29.	Case report of a fractured phacoemulsification sleeve	VB	Case report	N/A	N/A	N/A	N/A	N/A
180	Ogg M. Thermal burns during phacoemulsification [Clinical Issues]. *AORN J.* 2010;92(3):358-359.	Report on procedure to follow to prevent injury from phacoemulsification.	VB	Review of the literature with a case report.	N/A	N/A	N/A	N/A	N/A
181	Abulafia A, Michaeli A, Belkin A, Assia EI. Temperature profiles of sleeveless and coaxial phacoemulsification. *J Cataract Refract Surg.* 2013;39(11): 1742-1748.	Irrigation flow prevented burns	IIB	Quasi-experimental	Porcine eyes	Occluded irrigation system	Open irrigation system.	36 eyes	Temperature of eye tissue
182	Shaw Y, Yoneda KY, Chan AL. Cerebral gas embolism from bronchoscopic argon plasma coagulation: a case report. *Respiration* . 2012;83(3): 267-270.	Reports case of a patient who expired from cerebral systemic gas embolization from bronchoscopic APC use.	VA	Case report	N/A	N/A	N/A	N/A	N/A
183	Law SC, Wong JC, Cheung HY, Chung CC, Li MK. Colonic injury from electric arcing: a significant complication of argon plasma coagulation. *Hong Kong Med J.* 2009;15(3): 227-229.	Describes a case of capacitive coupling using APC.	VC	Expert opinion	N/A	N/A	N/A	N/A	N/A