

AORN Guideline for Design and Maintenance of the Surgical Suite
Evidence Table

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
1	Guideline for environmental cleaning. In: Guidelines for Perioperative Practice. Denver, CO: AORN Inc; 2017:7-28.	Guideline	n/a	n/a	n/a	n/a	Guideline for cleaning the perioperative suite.	IVA
2	Guideline for sterile technique. In: Guidelines for Perioperative Practice. Denver, CO: AORN Inc; 2018:75-104.	Guideline	n/a	n/a	n/a	n/a	Guideline for sterile technique.	IVA
3	Guideline for surgical smoke safety. In: Guidelines for Perioperative Practice. Denver, CO: AORN Inc; 2018:469-498.	Guideline	n/a	n/a	n/a	n/a	Guideline for smoke evacuation	IVA
4	Guideline for patient information management. In: Guidelines for Perioperative Practice. Denver, CO: AORN Inc; 2018:573-598.	Guideline	n/a	n/a	n/a	n/a	Guideline for information management.	IVA
5	Pelly N, Zeallear B, Reed M, Martin L. Utilizing integrated facility design to improve the quality of a pediatric ambulatory surgery center. Paediatr Anaesth. 2013;23(7):634-638.	Nonexperimental	Report on effectiveness of a process	n/a	n/a	Patient, family and provider flow	The use of integrated facility design in a pediatric ambulatory surgery center improved patient, family, and provider flow and reduced surgical and PACU times.	IIIB
6	Security Design Guidelines for Healthcare Facilities. Glendale Heights, IL: International Association for Healthcare Security & Safety (IAHSS); 2016.	Guideline	n/a	n/a	n/a	n/a	Provides recommendations regarding security for the entire facility.	IVC
7	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.	Expert Opinion	n/a	n/a	n/a	n/a	An individual project team should plan the hybrid OR and customize to the local needs and facilities.	VB
8	Clair JD, Colatrella S. Opening Pandora's (tool) box: health care construction and associated risk for nosocomial infection. Infect Disorder Drug Targets. 2013;13(3):177-183.	Expert Opinion	n/a	n/a	n/a	n/a	AN ICRA should be performed by the interdisciplinary team.	VC
9	Al-Benna S. Infection control in operating theatres. J Perioper Pract. 2012;22(10):318-322.	Literature Review	n/a	n/a	n/a	n/a	Infection control practitioners should be involved in all phases of the construction process and infection control measures should be "designed in" at the planning and design stages of a project.	VB

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10	Spagnolo AM, Ottria G, Amicizia D, Perdelli F, Cristina ML. Operating theatre quality and prevention of surgical site infections. J Prev Med Hyg. 2013;54(3):131-137.	Literature Review	n/a	n/a	n/a	n/a	A multidisciplinary approach should be taken to decrease surgical site infections including designers.	VA
11	Devine DA, Wenger B, Krugman M, et al. Part 1: Evidence-based facility design using Transforming Care at the Bedside principles. J Nurs Adm. 2015;45(2):74-83.	Organizational Experience	n/a	n/a	n/a	n/a	An interdisciplinary team approach should be used to assist with building design, Evidence based design philosophy should be used.	VA
12	Krugman M, Sanders C, Kinney LJ. Part 2: Evaluation and outcomes of an evidence-based facility design project. J Nurs Adm. 2015;45(2):84-92.	Organizational Experience	159 RNs pre-move; 176 RNs post-move	n/a	n/a	n/a	AN interdisciplinary team should be used when designing facilities.	VB
13	Facility Guidelines Institute, US Department of Health and Human Services, American Society for Healthcare Engineering. Guidelines for Design and Construction of Hospitals. Chicago, IL: American Society for Healthcare Engineering of the American Hospital Association; 2018.	Guideline	n/a	n/a	n/a	n/a	Guideline for constructing inpatient facilities.	IVC
14	Facility Guidelines Institute, US Department of Health and Human Services, American Society for Healthcare Engineering. Guidelines for Design and Construction of Outpatient Facilities. Chicago, IL: American Society for Healthcare Engineering of the American Hospital Association; 2018.	Guideline	n/a	n/a	n/a	n/a	Guideline for constructing outpatient facilities.	IVC
15	Criscitelli T, Goodwin W. Applying human-centered design thinking to enhance safety in the OR. AORN J. 2017;105(4):408-412.	Case Report	n/a	n/a	n/a	n/a	A human centered design process should be used.	VC
16	Guedon ACP, Wauben LSG, de Korne DF, Overvelde M, Dankelman J, van den Dobbelaars JJ. A RFID specific participatory design approach to support design and implementation of real-time location systems in the operating room. J Med Syst. 2015;39(1):168.	Case Report	n/a	n/a	n/a	n/a	The use of an interdisciplinary team provides insights in the social and the organizational context of the facility leading to a better fit between technology and the facility.	VB
17	Capolongo S, Bellini E, Nachiero D, Rebecchi A, Buffoli M. Soft qualities in healthcare. Method and tools for soft qualities design in hospitals' built environments. Ann Ig. 2014;26(4):391-399.	Case Report	n/a	n/a	n/a	n/a	A participatory approach should be used when designing a healthcare facility.	VB
18	Schaadt J, Landau B. Hybrid OR 101: a primer for the or nurse. AORN J. 2013;97(1):81-100.	Expert Opinion	n/a	n/a	n/a	n/a	Explains considerations when building a hybrid OR.	VC

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19	Baker JD. The Orwellian nature of radio-frequency identification in the perioperative setting. <i>AORN J.</i> 2016;104(4):281-284.	Expert Opinion	n/a	n/a	n/a	n/a	Technology has many uses in the perioperative setting and perioperative nurses should be a part of the selection team.	VB
20	Olmsted RN. Prevention by design: construction and renovation of health care facilities for patient safety and infection prevention. <i>Infect Dis Clin North Am.</i> 2016;30(3):713-728.	Expert Opinion	n/a	n/a	n/a	n/a	AN ICRA should be completed.	VA
21	Stichler JF. Using consultants in the design, construction, and occupancy of new healthcare facilities. <i>J Nurs Adm.</i> 2015;45(11):537-539.	Expert Opinion	n/a	n/a	n/a	n/a	Consultants may be hired when the facility does not have the expertise to manage any or all aspects of a construction project.	VB
22	Stichler JF. Healthy work environments for the ageing nursing workforce. <i>J Nurs Manag.</i> 2013;21(7):956-963.	Systematic Review	n/a	n/a	n/a	n/a	Healthcare facilities should be designed with considerations for older nurses including good lighting, ergonomics, small distance for travel between patient and supplies.	IIIB
23	Hoffman PN, Williams J, Stacey A, et al. Microbiological commissioning and monitoring of operating theatre suites. <i>J Hosp Infect.</i> 2002;52(1):1-28.	Guideline	n/a	n/a	n/a	n/a	The interdisciplinary team should participate in commissioning.	IVB
24	ANSI/ASHRAE/ASHE Addendum H to ANSI/ASHRAE/ASHE Standard 170-2017: Ventilation of Health Care Facilities. New York, NY: American Society of Heating, Refrigerating and Air-Conditioning Engineers; 2017.	Guideline	n/a	n/a	n/a	n/a	Guidelines for HVAC system settings.	IVC
25	ANSI/AAMI ST79:2017 Comprehensive Guide to Steam Sterilization and Sterility Assurance in Health Care Facilities. Arlington, VA: Association for the Advancement of Medical Instrumentation; 2017.	Guideline	n/a	n/a	n/a	n/a	Guideline for sterilization and building of sterile processing.	IVB
26	NFPA 101: Life Safety Code. Quincy, MA: National Fire Protection Association; 2018.	Guideline	n/a	n/a	n/a	n/a	Guideline for fire prevention.	IVC
27	NFPA 99: Health Care Facilities Code Handbook. Quincy, MA: National Fire Protection Association; 2018.	Guideline	n/a	n/a	n/a	n/a	Guidelines for medical gases, security and fire.	IVC

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28	NFPA 70: National Electrical Code. Quincy, MA: National Fire Protection Association; 2017.	Guideline	n/a	n/a	n/a	n/a	Guideline for electrical systems.	IVC
29	Guideline for safe patient handling and movement. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2018:e1-e48.	Guideline	n/a	n/a	n/a	n/a	Guideline for safe patient handling and movement.	IVA
30	Barzoloski-O'Connor B. Preventing infections during construction in the perioperative area. OR Nurse. 2013;7(1):10-12.	Expert Opinion	n/a	n/a	n/a	n/a	Conduct an ICRA before beginning the project. Create traffic plans for the construction workers and the personnel.	VC
31	Kanamori H, Rutala WA, Sickbert-Bennett EE, Weber DJ. Review of fungal outbreaks and infection prevention in healthcare settings during construction and renovation. Clin Infect Dis. 2015;61(3):433-444.	Systematic Review	n/a	n/a	n/a	n/a	Education should be provided to construction workers regarding infection prevention; an ICR+A should be performed, protective measures should be used to prevention contamination during construction.	IIIB
32	Chang CC, Ananda-Rajah M, Belcastro A, et al. Consensus guidelines for implementation of quality processes to prevent invasive fungal disease and enhanced surveillance measures during hospital building works, 2014. Intern Med J. 2014;44(12):1389-1397.	Guideline	n/a	n/a	n/a	n/a	Measures should be taken during construction to prevent airborne fungi from entering an existing facility.	IVC
33	Smith TA. Secure design. Health Facil Manage. 2012;25(9):55-58.	Expert Opinion	n/a	n/a	n/a	n/a	Describes security zones.	VC
34	Yow JA. The electronic security partnership of safety/security and information systems departments. J Healthc Prot Manage. 2012;28(1):108-111.	Expert Opinion	n/a	n/a	n/a	n/a	Closed circuit cameras have some advantages and disadvantages.	VC
35	McGain F, Naylor C. Environmental sustainability in hospitals—a systematic review and research agenda. J Health Serv Res Policy. 2014;19(4):245-252.	Systematic Review	n/a	n/a	n/a	n/a	At times there is a conflict between the environment and the needs of the patients, but at other times they coincide. More research is needed on sustainability.	IIIB
36	Beale C, Kittredge FD Jr. Current trends in health facility planning, design, and construction. Front Health Serv Manage. 2014;31(1):3-17.	Literature Review	n/a	n/a	n/a	n/a	Support use of a mock-up room, sustainability.	VC

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37	Kagoma Y, Stall N, Rubinstein E, Naudie D. People, planet and profits: the case for greening operating rooms. CMAJ. 2012;184(17):1905-1911.	Literature Review	n/a	n/a	n/a	n/a	Components installed during construction of an OR should have a low environmental impact.	VB
38	Surgical lights: an illuminating look at the LED marketplace. Health Devices. 2010;39(11):390-402	Expert Opinion	n/a	n/a	n/a	n/a	LED lights cost more but produce less heat, use less energy, bulbs last a long time and the lights reduce shadows.	VC
39	Horn M, Patel N, MacLellan M, Millard N. Traditional canister-based open waste management system versus closed system: hazardous exposure prevention and operating theatre staff satisfaction. ACORN J. 2015;28(1):18-22.	Nonexperimental	Open system (arthroscopy n=9; urology n=2; orthopedic n=4); Closed system (arthroscopy n=5; urology n=4; orthopedic n=6)	n/a	n/a	Ease of use, number of potential exposures, times for set-up, maintenance during procedures, and post-procedure disposal of waste times.	The closed waste disposal system is easier to use, has less environmental impact, but cost comparisons are also needed.	IIIB
40	Finding ways to go green. Can Nurse. 2013;109(2):8-9.	Expert Opinion	n/a	n/a	n/a	n/a	Healthcare facilities use large amounts of energy and can decrease the use by purchasing low energy consuming devices and changing peoples behavior to decrease the amount of energy used.	VC
41	Ma H, Du N, Yu S, et al. Analysis of typical public building energy consumption in northern China. Energy Build. 2017;136:139-150.	Nonexperimental	119 public buildings	n/a	n/a	Energy use	Hospital use more energy than office buildings and schools.	IIIC
42	Whitson BA. The 50 percent solution to reducing energy costs. Healthc Financ Manage. 2012;66(11):132-138.	Case Report	n/a	n/a	n/a	n/a	Financial savings was realized the first year and years after installing various energy saving devices.	VC
43	Kaneko TD, Michael J. Use of the hybrid operating room in cardiovascular medicine. Circulation. 2014;130(11):910-917.	Expert Opinion	n/a	n/a	n/a	n/a	Lists considerations for construction of a hybrid OR.	VB

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44	Holmdahl T, Lanbeck P. Design for the post-antibiotic era: experiences from a new building for infectious diseases in Malmö, Sweden. <i>Health Environ Res Design J.</i> 2013;6(4):24-52.	Organizational Experience	n/a	n/a	n/a	n/a	A mock-up should be used. Design should be decided by a multidisciplinary team.	VB
45	Alfonsi E, Capolongo S, Buffoli M. Evidence based design and healthcare: an unconventional approach to hospital design. <i>Ann Ig.</i> 2014;26(2):137-143.	Literature Review	n/a	n/a	n/a	n/a	Use of evidence based design concepts assists with to reducing infections, reducing stress on medical personnel and improving patient healing.	VA
46	Brands CK, Hernandez RG, Stenberg A, et al. Complete self-sufficiency planning: designing and building disaster-ready hospitals. <i>South Med J.</i> 2013;106(1):63-68.	Organizational Experience	n/a	n/a	n/a	n/a	The self-sufficiency design process permits the interdisciplinary design team to adapt the design and construction of new hospitals for optimal disaster functionality based on lessons learned from internal and external institutional experiences.	VB
47	Guideline for surgical attire. In: <i>Guidelines for Perioperative Practice.</i> Denver, CO: AORN Inc; 2018:105-128.	Guideline	n/a	n/a	n/a	n/a	Guideline providing recommendations for attire in the perioperative area.	IVA
48	Allo MD, Tedesco M. Operating room management: operative suite considerations, infection control. <i>Surg Clin North Am.</i> 2005;85(6):1291-1297, xii.	Expert Opinion	n/a	n/a	n/a	n/a	Summary of recommendations for construction of an OR.	VC
49	State Operations Manual Appendix A: Survey Protocol, Regulations and Interpretive Guidelines for Hospitals. Rev 176; 2017. Centers for Medicare & Medicaid Services. https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_a_hospitals.pdf . Accessed June 7, 2018.	Regulatory	n/a	n/a	n/a	n/a	CMS requirements for hospitals.	n/a
50	Safe Patient Handling and Mobility: Interprofessional National Standards. Silver Spring, MD: American Nurses Association: 2013.	Position Statement	n/a	n/a	n/a	n/a	Guideline for safe patient handling and movement.	IVB

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51	Cohen MH; 2010 Health Guidelines Revision Committee Specialty Subcommittee on Patient Movement. Patient Handling and Movement Assessments: A White Paper. Dallas, TX: Facility Guidelines Institute; 2010.	Expert Opinion	n/a	n/a	n/a	n/a	Guidance for implementation of the Safe Patient Handling and Movement assessment.	VA
52	Thomas-Olson L, Gee M, Harrison D, Helal N. Evaluating the use of ceiling lifts in the operating room. ORNAC J. 2015;33(1):13-28.	Qualitative	29 Staff members	n/a	n/a	Injury claims related to patient handling	Use of ceiling lifts decreased the rate of injury claims related to patient handling from 5 per year to less than one per year.	IIIC
53	Gormley T, Wagner J. Studying airflow in the OR: measuring the environmental quality indicators in a dynamic hospital operating room setting. Health Facil Manage. January 9, 2018. https://www.hfmmagazine.com/articles/3246-studying-airflow-in-the-or?utm_medium=email&utm_source=newsletter&utm_campaign=hfminsider&utm_content=20180116&eid=333111138&bid=1972574 . Accessed June 6, 2018.	Nonexperimental	30 mock surgical procedures	n/a	n/a	Air particle counts	20 air changes per hour is an effective rate.	IIIC
54	Wan G, Chung F, Tang C. Long-term surveillance of air quality in medical center operating rooms. Am J Infect Control. 2011;39(4):302-308.	Nonexperimental	33 air samples in each of 5 different types of ORs	n/a	n/a	particulate matter in the air and microorganisms	Increased air changes per hour (20 vs 15) decreased the particulate count and the airborne bacterial concentrations.	IIIB
55	Chapter IV. Subchapter G. Part 482. Conditions of Participation for Hospitals. Electronic Code of Federal Regulations. https://www.ecfr.gov/cgi-bin/text-idx?rgn=div5;node=42:5.0.1.1.1;cc=ecfr#se42.5.482_142 . Accessed June 7, 2018.	Regulatory	n/a	n/a	n/a	n/a	Requirements for emergency electrical safeguards.	n/a
56	Lighting for Hospitals and Health Care Facilities. New York, NY: Illuminating Engineering Society of North America; 2006.	Guideline	n/a	n/a	n/a	n/a	Guideline for lighting surgical suites.	IVC
57	Dianat I, Sedghi A, Bagherzade J, Jafarabadi MA, Stedmon AW. Objective and subjective assessments of lighting in a hospital setting: implications for health, safety and performance. Ergonomics. 2013;56(10):1535-1545.	Qualitative	208 employees	n/a	n/a	Employee satisfaction, job performance, safety and health.	Lighting levels contribute to employee satisfaction, job performance, safety and health.	IIIA

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58	Hinsa-Leasure SM, Nartey Q, Vaverka J, Schmidt MG. Copper alloy surfaces sustain terminal cleaning levels in a rural hospital. <i>Am J Infect Control</i> . 2016;44(11):e195-e203.	Quasi-experimental	18 different surfaces with and without copper alloy	Surfaces which contained copper alloys	Surfaces without copper alloy	Bacterial concentration on the surfaces after terminal cleaning.	Copper alloys should be used for surfaces in healthcare facilities.	IIC
59	Karpanen TJ, Casey AL, Lambert PA, et al. The antimicrobial efficacy of copper alloy furnishing in the clinical environment: a crossover study. <i>Infect Control Hosp Epidemiol</i> . 2012;33(1):3-9.	Nonexperimental	14 high touch surfaces cultured once a week for 24 weeks	n/a	n/a	Microbial counts	Use of copper in combination with optimal infection prevention strategies may reduce the risk of the patient acquiring an infection in the healthcare environment.	IIIB
60	O’Gorman J, Humphreys H. Application of copper to prevent and control infection: where are we now? <i>J Hosp Infect</i> . 2012;81(4):217-223.	Systematic Review	n/a	n/a	n/a	n/a	More research is required before widespread implementation of copper contact surfaces.	IIIB
61	Weber DJ, Rutala WA. Self-disinfecting surfaces: review of current methodologies and future prospects. <i>Am J Infect Control</i> . 2013;41(5 Suppl):S31-S35.	Literature Review	n/a	n/a	n/a	n/a	More research is needed to determine the benefits of heavy metal impregnated or coated surfaces.	VB
62	Palmer G 2nd, Abernathy JH 3rd, Swinton G, et al. Realizing improved patient care through human-centered operating room design: a human factors methodology for observing flow disruptions in the cardiothoracic operating room. <i>Anesthesiology</i> . 2013;119(5):1066-1077.	Nonexperimental	1,080 observations in 10 cardiac surgeries	n/a	n/a	workflow disruptions	33% of disturbances were related to OR layout and design.	IIIB
63	Nguyen DB, Gupta N, Abou-Daoud A, et al. A polymicrobial outbreak of surgical site infections following cardiac surgery at a community hospital in Florida, 2011-2012. <i>Am J Infect Control</i> . 2014;42(4):432-435.	Case Report	n/a	n/a	n/a	n/a	Lack of correct air pressure gradient, high humidity levels and lack of barriers between OR and construction site caused an SSI outbreak.	VB
64	Anesthetic gases: guidelines for workplace exposures. Occupational Safety and Health Administration. https://www.osha.gov/dts/osta/anestheticgases/index.html . Accessed June 7, 2018.	Guideline	n/a	n/a	n/a	n/a	Guideline for preventing exposure to waste anesthesia gases.	IVB
65	Yasny JS, White J. Environmental implications of anesthetic gases. <i>Anesth Prog</i> . 2012;59(4):154-158.	Literature Review	n/a	n/a	n/a	n/a	Waste anesthesia should be recycled.	VB

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66	Bosenberg M. Anaesthetic gases: environmental impact and alternatives. <i>South Afr J Anaesth Analg.</i> 2011;17(5):345-348.	Expert Opinion	n/a	n/a	n/a	n/a	Waste anesthesia gases impact the atmosphere and should be removed for recycling.	VC
67	Wang F, Hung J, Chen Y, Hsu C. Performance evaluation for operation rooms by numerical simulation and field measurement. <i>Int J Vent.</i> 2017;16(3):189-199.	Nonexperimental	One unoccupied OR with 5,10,&20 air changes per hour	n/a	n/a	Changes in humidity and temperature when ACH was lowered	The temperature and humidity levels were maintained in the unoccupied OR when the ACH was lowered to 10 or 5 changes per hour.	IIIC
68	Wang F, Lee M, Chang T, Hsu C. Evaluation of indoor environment parameters and energy-efficient HVAC system for an unoccupied operating room. In: <i>Indoor Air 2014—13th International Conference on Indoor Air Quality and Climate</i> . Santa Cruz, CA: International Society of Indoor Air Quality and Climate; 2014:769-776.	Nonexperimental	10 operating rooms with 20,10, and 5 air changes per hour	n/a	n/a	Temperature and humidity	Air changes may be decreased to 5 when the OR is unoccupied.	IIIB
69	Thiel CL, Eckelman M, Guido R, et al. Environmental impacts of surgical procedures: life cycle assessment of hysterectomy in the United States. <i>Environ Sci Technol.</i> 2015;49(3):1779-1786.	Nonexperimental	A vaginal, an abdominal, a laparoscopic, and a robotic hysterectomy	n/a	n/a	Environmental emissions	Use of an ventilation set-back strategy lessens the environmental impact of the facility by using less energy for heating and cooling.	IIIA
70	Aydin Çakir N, Ucar FB, Haliki Uztan A, Corbaci C, Akpınar O. Determination and comparison of microbial loads in atmospheres of two hospitals in Izmir, Turkey. <i>Ann Agric Environ Med.</i> 2013;20(1):106-110.	Nonexperimental	Air samples from two facilities taken over a three month period of time	n/a	n/a	Microbial counts in air samples	A disinfection protocol did not lower counts in one of the OR's because the air handling system had been turned off.	IIIB
71	Operating Room HVAC Setback Strategies. Chicago, IL: American Society for Healthcare Engineering; 2011.	Expert Opinion	n/a	n/a	n/a	n/a	Recommends use of an HVAC set-back system for energy savings when the room is not occupied.	VB
72	Cockram A. Correct lighting of hospital buildings. 1976. <i>Health Estate.</i> 2007;61(4):21-23.	Expert Opinion	n/a	n/a	n/a	n/a	Summarizes qualities of a surgical light.	VC
73	Verrinder J. Use of right lighting levels essential. <i>Health Estate.</i> 2007;61(6):31-32.	Expert Opinion	n/a	n/a	n/a	n/a	Summarizes qualities of OR lighting.	VC
74	Knulst AJ, Mooijweer R, Jansen FW, Stassen LP, Dankelman J. Indicating shortcomings in surgical lighting systems. <i>Minim Invasive Ther Allied Technol.</i> 2011;20(5):267-275.	Organizational Experience	Light use during 46 hours of surgery	n/a	n/a	n/a	Lights should be very easy to position and if not requires a large amount of effort and may result in injuries.	VC

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75	Baillie J. Stars of the theatre show true colours. Health Estate. 2012;66(1):31-36.	Expert Opinion	n/a	n/a	n/a	n/a	Suggestions for components for lighting systems.	VC
76	ECRI Institute. Hazard report. Overlap of surgical lighthouse beams may present burn risk. Health Devices. 2009;38(10):341-342.	Case Report	n/a	n/a	n/a	n/a	Describes a case where a burn resulted from two lights being aimed at the same location.	VC
77	Zhou Z, Hu B, Gao X, Bao R, Chen M, Li H. Sources of sporadic <i>Pseudomonas aeruginosa</i> colonizations/infections in surgical ICUs: association with contaminated sink trap. J Infect Chemother. 2016;22(7):450-455.	Nonexperimental	244 samples from sinks in two surgical intensive care units over a 27 week period	n/a	n/a	Presence of and strain of <i>Pseudomonas aeruginosa</i> in sink drains and in infected patients.	The same strain of <i>Pseudomonas aeruginosa</i> was found in the sink trap and in the infected patients.	IIIC
78	Bédard E, Laferrière C, Charron D, et al. Post-outbreak investigation of <i>Pseudomonas aeruginosa</i> faucet contamination by quantitative polymerase chain reaction and environmental factors affecting positivity. Infect Control Hospital Epidemiol. 2015;36(11):1337-1343	Nonexperimental	28 drain swabs	n/a	n/a	Presence of <i>Pseudomonas</i>	<i>Pseudomonas</i> is found in sink drains and a regular maintenance program should be in place.	IIIC
79	Eder SP, Register JL. 10 management considerations for implementing an endovascular hybrid OR. AORN J. 2014;100(3):260-270.	Expert Opinion	n/a	n/a	n/a	n/a	Explains ten management considerations when building a hybrid OR.	VB
80	Guideline for minimally invasive surgery. In: Guidelines for Perioperative Practice. Denver, CO: AORN Inc; 2018:611-640.	Guideline	n/a	n/a	n/a	n/a	Guideline describing the requirements for a hybrid OR.	IVA
81	Expert Panel on MR Safety; Kanal E, Barkovich AJ, Bell, C, et al. ACR guidance document on MR safe practices: 2013. J Magn Reson Imaging. 2013;37(3):501-530.	Guideline	n/a	n/a	n/a	n/a	Guideline describing the requirements for magnetic resonance imaging system in a hybrid OR or any other location.	IVB

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82	Cowperthwaite L, Fearon MC. Guideline implementation: minimally invasive surgery, part 2—hybrid ORs. AORN J. 2017;106(2):145-153.	Expert Opinion	n/a	n/a	n/a	n/a	A hybrid OR may be located as a part of a surgical suite, a cardiac catheterization suite, a cardiac catheterization suite, or an interventional radiology suite. Signage should be present listing precautions to be taken based upon the type of imaging device used. Hybrid OR's should meet the requirements of an imaging suite and an OR. Equipment should be placed to maximize efficiencies, allow easy patient access, and provide ergonomic comfort.	VC
83	Childs S, Bruch P. Successful management of risk in the hybrid OR. AORN J. 2015;101(2):223-237.	Expert Opinion	n/a	n/a	n/a	n/a	MRI hybrid rooms require certain safety precautions such as lines in the floor marking the gauss zones.	VB
84	Ley-Chavez A, Hmar-Lagroun T, Douglas-Ntagha P, Cumbo CL. Layout improvement study to reduce staff walking distance in a large health care facility: how to not walk an extra 4740 miles. Qual Manag Health Care. 2016;25(3):134-140.	Organizational Experience	Patient escort staff who transport patients with limited mobility to more than 200 locations, at a cancer hospital consisting of 3 million square feet which is divided into 5 zones, spread over 18 floors.	n/a	n/a	Number of steps saved per year	4,740 miles of walking distance and a 30% reduction of time waiting for elevators was noted after relocation of 4 areas in which frequently used resources were stored.	VB

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85	Gurses AP, Kim G, Martinez EA, et al. Identifying and categorising patient safety hazards in cardiovascular operating rooms using an interdisciplinary approach: a multisite study. <i>BMJ Qual Saf.</i> 2012;21(10):810-818.	Nonexperimental	Cardiac operating rooms at 5 different facilities	n/a	n/a	Safety hazards	Lack of storage areas are a safety hazard resulting in restricted hallways causing difficulty when transferring patients into and out of the OR. Lack of horizontal work spaces led to items being stored in a disorderly fashion and items being difficult to locate and falling on the floor.	IIIA
86	NFPA 13: Standard for the Installation of Sprinkler Systems. Quincy, MA: National Fire Protection Association; 2016:488.	Guideline	n/a	n/a	n/a	n/a	Guideline for clearance around sprinkler systems.	IVC
87	Loschi M, Thill C, Gray C, et al. Invasive aspergillosis in neutropenic patients during hospital renovation: effectiveness of mechanical preventive measures in a prospective cohort of 438 patients. <i>Mycopathologia.</i> 2015;179(5-6):337-345.	Nonexperimental	438 patients with 705 hospitalizations over 5 years	n/a	n/a	the incidence of invasive pulmonary aspergillosis	No increase was seen in the incidence of invasive pulmonary aspergillosis because the precautions taken.	IIIB
88	Lee L. Clean construction: infection control during building and renovation projects. <i>Health Facil Manage.</i> 2010;23(4):36-8; quiz 39.	Expert Opinion	n/a	n/a	n/a	n/a	The interdisciplinary team should be involved early on in the design phase. Barriers are needed to keep dust and unfiltered air out of the existing structure.	VB
89	Apisarnthanarak A, Mundy LM, Khawcharoenporn T, Mayhall CG. Hospital infection prevention and control issues relevant to extensive floods. <i>Infect Control Hosp Epidemiol.</i> 2013;34(2):200-206.	Expert Opinion	n/a	n/a	n/a	n/a	Precautions to take before reopening a building after flooding.	VA
90	Scarlett HP, Postlethwait E, Delzell E, Sathiakumar N, Oestenstad RK. Asbestos in public hospitals: are employees at risk? <i>J Environ Health.</i> 2012;74(6):22-26.	Nonexperimental	152 samples from 26 hospitals	n/a	n/a	Presence of asbestos	A plan should be developed for containing the asbestos.	IIIB

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91	Boix-Palop L, Nicolás C, Xercavins M, et al. Bacillus species pseudo-outbreak: construction works and collateral damage. J Hosp Infect. 2017;95(1):118-122.	Organizational Experience	Cultures of materials in room, surfaces in room and air. Period 1: construction work period.(n=56) Period 2: one month after cleaning.(n=45) Period 3: two months after cleaning (n=37).	n/a	n/a	n/a	The application of a bundle of infection control measures including building a barrier between facility and construction zone assisted in decreasing the rate of positive cultures.	VB
92	Semchuk P. Breathing easy during building projects. Health Estate. 2015;69(2):17-20.	Case Report	n/a	n/a	n/a	n/a	Performing various infection control and internal air quality measures resulted in fewer issues of materials being rejected from the site, less shrinkage of gypsum wallboard and flooring installations , cleaner site, easier turnover, and improved serviceability.	VC
93	Brace MD, Stevens E, Taylor SM, et al. "The air that we breathe": Assessment of laser and electrosurgical dissection devices on operating theater air quality. J Otolaryngol Head Neck Surg. 2014;43(1):39-57.	Nonexperimental	Continuous air quality monitoring over a period of 80 days outside, in semi-restricted hallway and in an OR	n/a	n/a	Air particulate counts	The air particulate counts in the OR are less than the outdoor air related to the amount of filtration accomplished by the HEPA filtration system.	IIIB
94	Brun CP, Miron D, Silla LMR, Pasqualotto AC. Fungal spore concentrations in two haematopoietic stem cell transplantation (HSCT) units containing distinct air control systems. Epidemiol Infect. 2013;141(4):875-879.	Nonexperimental	117 air samples from patient room, corridor and toilet in two different hospitals	n/a	n/a	Presence of fungi	Hepa filtration decreases the amount of fungi present in the air.	IIIB
95	Saliou P, Uguen M, Le Bars H, Le Clech L, Baron R. Fungal outbreaks and infection prevention during demolition: influence of high-efficiency particulate air filtration. Clin Infect Dis. 2016;62(7):950-951.	Case Report	n/a	n/a	n/a	n/a	During demolition use of hepa filtration is effective in preventing fungal infections in patients with hematological malignancies.	VC

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96	Barreiros G, Akiti T, Magalhães ACG, Nouér SA, Nucci M. Effect of the implosion and demolition of a hospital building on the concentration of fungi in the air. <i>Mycoses</i> . 2015;58(12):707-713.	Case Report	n/a	n/a	n/a	n/a	During demolition use of hepa filtration is effective in decreasing fungal concentrations within the facility even when the exterior level is high.	VB
97	Healthcare water system repair and recovery following a boil water alert or disruption of water supply. Centers for Disease Control and Prevention. https://www.cdc.gov/disasters/watersystemrepair.html . Accessed June 7, 2018.	Guideline	n/a	n/a	n/a	n/a	Guidance for handling disruption of the water system.	IVC
98	Centers for Disease Control and Prevention, American Water Works Association, eds. <i>Emergency Water Supply Planning Guide for Hospitals and Health Care Facilities</i> . Atlanta, GA: US Department of Health and Human Services; 2012.	Guideline	n/a	n/a	n/a	n/a	A plan should be developed for an outage of the water supply.	IVC
99	Klinger C, Landeg O, Murray V. Power outages, extreme events and health: a systematic review of the literature from 2011-2012. <i>PLoS Curr</i> . 2014;6. doi: 10.1371/currents.dis.04eb1dc5e73dd1377e05a10e9edd673.	Systematic Review	n/a	n/a	n/a	n/a	Loss of electricity can impact most other utilities and healthcare organizations should develop plans to handle utility outages.	IIIB
100	Working without technology: how hospitals and healthcare organizations can manage communication failure. Public Health Emergency. http://www.phe.gov/Preparedness/planning/cip/Documents/workingwithouttechnology.pdf . Accessed June 7, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	Provides considerations when planning for a communications system failure.	VC
101	Mitchell L, Anderle D, Nastally K, Sarver T, Hafner-Burton T, Owens S. Lessons learned from hurricane Ike. <i>AORN J</i> . 2009;89(6):1073-1078.	Case Report	n/a	n/a	n/a	n/a	Describes steps to take after a disaster.	VB
102	Remediation and infection control considerations for reopening healthcare facilities closed due to extensive water and wind damage. Centers for Disease Control and Prevention. https://www.cdc.gov/disasters/reopen_healthfacilities.html . Accessed June 7, 2018.	Guideline	n/a	n/a	n/a	n/a	Guidance for handling disruption of the water system.	IVC

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103	Storm, flood, and hurricane response. Centers for Disease Control and Prevention. https://www.cdc.gov/niosh/topics/emres/cleaning-flood-hvac.html . Accessed June 7, 2018.	Guideline	n/a	n/a	n/a	n/a	Guideline containing the steps for cleaning and remediation of flood-contaminated HVAC systems.	IVC
104	Boubour J, Jenson K, Richter H, Yarbrough J, Oden ZM, Schuler DA. A shipping container-based sterile processing unit for low resources settings. PLoS One. 2016;11(3):e0149624.	Nonexperimental	61 sterilization trials	n/a	n/a	Sterility of instruments as shown by changes in the autoclave tape, indicator strip, biological, and time and temperature.	This mobile sterile processing department could be safely used in times of need.	IIIC
105	Carpenter T, Robinson ST. Case reports: response to a partial power failure in the operating room. Anesth Analg. 2010;110(6):1644-1646.	Case Report	n/a	n/a	n/a	n/a	A plan should be developed for an outage of the electrical supply.	VA
106	National Fire Protection Association, American National Standards Institute. NFPA 110: Standard for Emergency and Standby Power Systems. Quincy, MA: National Fire Protection Association; 2016.	Guideline	n/a	n/a	n/a	n/a	Guidelines for emergency and standby power systems.	IVC
107	NIOSH alert: preventing occupational respiratory disease from exposures caused by dampness in office buildings, schools, and other nonindustrial buildings. November 2012. Centers for Disease Control and Prevention. https://www.cdc.gov/niosh/docs/2013-102/default.html . Accessed June 7, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	HVAC systems should be maintained and inspected. Humidity levels should be kept low to decrease mold growth. Guidelines for remediation should be followed after utility failures. Employees should report any moist areas in buildings. Employees may have reactions in buildings which are damp for prolonged periods of time.	VA
108	Eichhorn JH, Hessel EA 2nd. Electrical power failure in the operating room: a neglected topic in anesthesia safety. Anesth Analg. 2010;110(6):1519-1521.	Expert Opinion	n/a	n/a	n/a	n/a	Life saving equipment should be plugged into emergency power outlets.	VB

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109	The Joint Commission. Preventing adverse events caused by emergency electrical power system failures. Sentinel Event Alert. September 6, 2006;37. https://www.jointcommission.org/sentinel_event_alert_issue_37_preventing_adverse_events_caused_by_emergency_electrical_power_system_failures/ . Accessed June 7, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	Should provide education on power failure plan.	VC
110	Stymiest DL. Power up: best practices for hospital power system reliability. Advice for planning, design, installation, inspection, maintenance and more. Health Facil Manage. 2016;29(3):25-29.	Expert Opinion	n/a	n/a	n/a	n/a	Clinicians should be educated on emergency backup power systems.	VC
111	Stymiest DL. After the storm. expanding the concept of emergency power reliability. Health Facil Manage. 2013;26(1):21-24.	Expert Opinion	n/a	n/a	n/a	n/a	Recommends education on power system failure.	VC
112	American Society of Heating, Refrigerating and Air-Conditioning Engineers. Infection control. In: HVAC Design Manual for Hospitals and Clinics. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc (ASHRAE); 2013:19-34.	Guideline	n/a	n/a	n/a	n/a	Guideline for HVAC systems.	IVC
113	Berrios-Torres SI, Umscheid CA, Bratzler DW, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. JAMA Surg. 2017;152(8):784-791.	Guideline	n/a	n/a	n/a	n/a	Maintain positive pressure and the HVAC settings set forth by FGI.	IVB
114	State Operations Manual Appendix L—Guidance for Surveyors: Ambulatory Surgical Centers. Rev 137; 2015. Centers for Medicare & Medicaid Services. https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_l_ambulatory.pdf . Accessed June 7, 2018.	Regulatory	n/a	n/a	n/a	n/a	CMS requirements for ambulatory surgery centers.	n/a
115	Guideline for prevention of unplanned patient hypothermia. In: Guidelines for Perioperative Practice. Denver, CO: AORN Inc; 2018:549-572.	Guideline	n/a	n/a	n/a	n/a	Guideline for prevention of hypothermia.	IVA

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116	Traversari AA, Bottenheft C, van Heumen SP, Goedhart CA, Vos MC. Effect of switching off unidirectional downflow systems of operating theaters during prolonged inactivity on the period before the operating theater can safely be used. <i>Am J Infect Control</i> . 2017;45(2):139-144.	Quasi-experimental	3 Operating rooms	Air quality before switching off system	Air quality after reactivating system	Temperature and particle counts	After restarting the HVAC system a 30 minutes period of time is required to return the air to the levels achieved during normal operating conditions.	IIB
117	Dettenkofer M, Scherrer M, Hoch V, et al. Shutting down operating theater ventilation when the theater is not in use: infection control and environmental aspects. <i>Infect Control Hosp Epidemiol</i> . 2003;24(8):596-600.	Nonexperimental	Samples were taken in 3 operating rooms at 0, 10, 15, and 20 minutes after startup. Thirteen total samples were taken at each time frame	n/a	n/a	Air particle counts	Thirty minutes of time should lapse between restarting the system and beginning surgical activity.	IIIB
118	Gniadek A, Macura AB. Air-conditioning vs. presence of pathogenic fungi in hospital operating theatre environment. <i>Wiad Parazytol</i> . 2011;57(2):103-106.	Nonexperimental	50 air samples; 25 wall samples	n/a	n/a	Presence of fungal growth	The HVAC system should be properly maintained to ensure adequate air cleanliness.	IIIB
119	Berthelot P, Carricajo A, Aubert G, Akhavan H, Gazielly D, Lucht F. Outbreak of postoperative shoulder arthritis due to <i>Propionibacterium acnes</i> infection in nondebilitated patients. <i>Infect Control Hosp Epidemiol</i> . 2006;27(9):987-990.	Case Report	n/a	n/a	n/a	n/a	An outbreak of postoperative shoulder arthritis due to <i>P. acnes</i> infection was related to inadequate cleaning methods and the bad design and efficiency of the OR ventilation system.	VB
120	Yiallourous PK, Papadouri T, Karaoli C, et al. First outbreak of nosocomial <i>Legionella</i> infection in term neonates caused by a cold mist ultrasonic humidifier. <i>Clin Infect Dis</i> . 2013;57(1):48-56.	Case Report	n/a	n/a	n/a	n/a	Humidifiers should not be used because they have been identified as a source for <i>legionella</i> .	VB
121	Vladut G, Sbirna LS, Sbirna S, Codresi C, Martin L. CFD simulation of the airflow pattern within a three-bed hospital room with or without a portable air conditioner in use. In: 2014 18th International Conference on System Theory, Control and Computing, ICSTCC. Piscataway, NJ: IEEE; 2014:243-248.	Nonexperimental	One hospital room	n/a	n/a	Amount of air mixing and air flow direction	Use of a portable air conditioner in a room alters the flow of the air and increases the mixing of the air through out the room.	IIIB

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122	Casha AR, Manche A, Camilleri L, Gauci M, Grima, JN, Borg MA. A novel method of personnel cooling in an operating theatre environment. Interact Cardiovasc Thorac Surg. 2014;19(4):687-689.	Nonexperimental	One simulated thoracic surgery	n/a	n/a	Particle and bacterial counts.	The use of a bladeless fan for personnel cooling led to a minor, not statistically significant, lowering of both the particle and bacterial counts and maintained the clean room conditions of the OR.	IIIB