REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
1	Munoz-Price LS, Birnbach DJ, Lubarsky DA, et al. Decreasing operating room environmental pathogen contamination through improved cleaning practice. Infect Control Hosp Epidemiol. 2012;33(9):897-904.	Quasi-experimental	194 ORs in teaching hospital, United States	Verbal and graphic educational programs for staff.	Baseline before feedback and education	Removal of UV markers; environmental cultures	Thoroughness of cleaning was improved by providing feedback obtained from UV markers and gram staining of environmental cultures.	IIA
2	Carling PC, Parry MM, Rupp ME, et al. Improving cleaning of the environment surrounding patients in 36 acute care hospitals. Infect Control Hosp Epidemiol. 2008;29(11):1035-1041.	Quasi-experimental	Environmental surfaces in rooms of 36 acute care hospitals, United States	Structured education that included hands-on demonstrations	Before education and hands-on demonstrations	Fluorescent marker removal	During terminal cleaning of 20,646 surfaces, only 48% were cleaned. After interventions, which included performance feedback, 77% of surfaces were cleaned.	IIA
3	Jefferson J, Whelan R, Dick B, Carling P. A novel technique for identifying opportunities to improve environmental hygiene in the operating room. AORN J. 2011;93(3):358-364	Nonexperimental	Terminal cleaning of 946 surfaces in implantation ORs of 6 hospitals, United States	n/a	n/a	Fluorescent marker removal	Mean overall thoroughness of cleaning was 25%, with wide variation in thoroughness between hospitals.	IIIB
4	Ibrahimi OA, Sharon V, Eisen DB. Surgical-site infections and routes of bacterial transfer: which ones are most plausible? Dermatol Surg. 2011;37(12):1709-1720.	Expert Opinion	n/a	n/a	n/a	n/a	Direct physical contact with surgical team's skin and contaminated fomites deliver greatest number of bacteria and are the most significant sources for iatrogenic bacterial transfer during surgery. Therefore, actions to minimize contact with infected fomites is best action for reducing surgical site infection incidence.	VB
5	Alexander JW, Van Sweringen H, Vanoss K, Hooker EA, Edwards MJ. Surveillance of bacterial colonization in operating rooms. Surg Infect (Larchmt). 2013;14(4):345-351.	Nonexperimental	517 cultures from surfaces in 33 ORs, United States	n/a	n/a	Colony-forming units (CFU)	CFUs highest on OR attire and high touch areas, such as telephone, computer mouse and patient warming blanket.	IIIB

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6	Yezli S, Barbut F, Otter JA. Surface contamination in operating rooms: a risk for transmission of pathogens? Surg Infect (Larchmt). 2014;15(6):694-699.	Literature Review	n/a	n/a	n/a	n/a	Inanimate objects in the OR can become contaminated with pathogens that can be transmitted.	VB
7	Link T, Kleiner C, Mancuso MP, Dziadkowiec O, Halverson-Carpenter K. Determining high touch areas in the operating room with levels of contamination. Am J Infect Control. 2016;44(11):1350-1355.	Nonexperimental	460 cultures of OR surfaces, United States	n/a	n/a	Aerobic colony counts (ACC) per centimeter squared	Low touch surfaces were less contaminated than high touch surfaces, with exception of OR bed.	IIIA
8	Sehulster L, Chinn RY, Arduino MJ, et al. Guidelines for Environmental Infection Control in Health-Care Facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Chicago, IL: American Society for Healthcare Engineering/American Hospital Association; 2004. https://www.cdc.gov/infectioncontrol/pdf/guidelines/environmental-guidelines-P.pdf. Updated July 2019. Accessed September 11, 2019.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for environmental infection control in health care facilities.	IVA
9	Armellino D. Minimizing sources of airborne, aerosolized, and contact contaminants in the OR environment. AORN J. 2017;106(6):494-501.	Literature Review	n/a	n/a	n/a	n/a	The physical environment, equipment and instruments can contribute to SSIs. Cleaning environment and hand hygiene can reduce microbial contamination, breaking chain of infection.	VA
10	Loftus RW, Brown JR, Koff MD, et al. Multiple reservoirs contribute to intraoperative bacterial transmission. Anesth Analg. 2012;114(6):1236.	Nonexperimental	548 surgical cases at 3 university hospitals, United States	n/a	n/a	Stopcock contamination and contamination reservoirs.	Contamination from patients, healthcare provider hands and the environment contributed to stopcock contamination. The anesthesia pressure valve and vaporizing dial were main reservoirs of contamination.	IIIA

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11	Loftus RW, Brown JR, Patel HM, et al. Transmission dynamics of gram-negative bacterial pathogens in the anesthesia work area. Anesth Analg. 2015;120(4):819-826.	Nonexperimental	548 surgical cases at 3 university hospitals, United States	n/a	n/a	Mode of transmission and link to 30-day postoperative infection.	Provider hands were less likely than contaminated environment or patient skin to be reservoir in transmission. Gram negative organisms were linked to 30-day postoperative infections.	IIIB
12	Loftus RW, Koff Brown JR, Patel HM, et al. The epidemiology of Staphylococcus aureus transmission in the anesthesia work area. Anesth Analg. 2015;120(4):807-818.	Nonexperimental	548 surgical cases at 3 university hospitals, United States	n/a	n/a	*S. aureus* transmission type and anesthesia reservoirs	Prevalent, virulent strain of *S aureus* more likely to be found on environmental surfaces and patient skin than provider hands.	IIIB
13	Loftus RW, Dexter F, Robinson ADM. High-risk Staphylococcus aureus transmission in the operating room: a call for widespread improvements in perioperative hand hygiene and patient decolonization practices. Am J Infect Control. 2018;46(10):1134-1141.	Nonexperimental	178 *S aureus* isolates from 548 surgical procedures, United States	n/a	n/a	Transmission of *S aureus* isolates	Transmission locations were provider hands, patient skin sites and environmental surfaces. Transmission occurred during procedures.	IIIA
14	Balkissoon R, Nayfeh T, Adams KL, Belkoff SM, Riedel S, Mears SC. Microbial surface contamination after standard operating room cleaning practices following surgical treatment of infection. Orthopedics. 2014;37(4):e339-e344.	Nonexperimental	270 surface samples from 14 infected and 16 noninfected surgeries at a academic medical center, United States	n/a	n/a	Microbial surface contamination (colony-forming units).	No significant difference was found in colony counts between surfaces in infected or noninfected cases. No relationship found between infected case organisms and OR surfaces.	IIIB
15	Dallolio L, Raggi A, Sanna T, et al. Surveillance of environmental and procedural measures of infection control in the operating theatre setting. Int J Environ Res Public Health. 2018;15(1):E46.	Nonexperimental	200 surface samples from 10 ORs in 2 hospitals, Italy	n/a	n/a	Total viable microbiological count on surfaces	Only 6 samples were slightly above recommended levels indicative of efficacy of the between case and end of day cleaning procedures.	IIIB

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16	van 't Veen A, van der Zee A, Nelson J, Speelberg B, Kluytmans JA, Buiting AG. Outbreak of infection with a multiresistant Klebsiella pneumoniae strain associated with contaminated roll boards in operating rooms. J Clin Microbiol. 2005;43(10):4961-4967.	Case Report	n/a	n/a	n/a	n/a	Roller boards contaminated with multiresistant *Klebsiella pneumoniae* used in 2 operating rooms resulted in 7 patients becoming colonized or infected with the strain.	VB
17	Loftus RW, Koff Brown JR, Patel HM, et al. The dynamics of enterococcus transmission from bacterial reservoirs commonly encountered by anesthesia providers. Anesth Analg. 2015;120(4):827-836.	Nonexperimental	548 surgical cases at 3 university hospitals, United States	n/a	n/a	*Enterococcus* transmission type and anesthesia reservoirs	Most common transmission reservoir of *Enterococcus* was anesthesia provider's hands.	IIIB
18	Guideline for a safe environment of care. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2019:137-172.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for a safe environment of care related to patients and perioperative personnel and the equipment used in the perioperative environment.	IVA
19	Guideline for transmission-based precautions. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2019:1093-1122.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for implementing standard and transmission-based precautions.	IVA
20	Guideline for hand hygiene. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2019:289-314.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for hand hygiene in the perioperative setting.	IVA
21	Association for the Healthcare Environment, American Hospital Association, American Society for Healthcare Environmental Services. Practice Guidance for Healthcare Environmental Cleaning: The Essential Resource for Environmental Cleaning and Disinfection. Chicago, IL: Association for the Healthcare Environment of the American Hospital Association; 2012.	Consensus	n/a	n/a	n/a	n/a	Provides guidance for environmental cleaning in the health care setting.	IVC

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22	Rutala WA, Weber DJ. Selection of the ideal disinfectant. Infect Control Hosp Epidemiol. 2014;35(7):855-865.	Expert Opinion	n/a	n/a	n/a	n/a	As the perfect healthcare disinfecting product does not exist, a scoring system using 5 key factors should be used when selecting a disinfection product.	VA
23	Healthcare Infection Control Practices Advisory Committee, ed. Core Infection Prevention and Control Practices for Safe Healthcare Delivery in All Settings—Recommendations of the Healthcare Infection Control Practices Advisory Committee (HICPAC). Atlanta, GA: Centers for Disease Control and Prevention; 2017.	Guideline	n/a	n/a	n/a	n/a	Provides guidance on core practices to prevent infection in healthcare settings (eg aseptic technique, cleaning)	IVA
24	Leas BF, Sullivan N, Han JH, Pegues DA, Kaczmarek JL, Umscheid CA, eds. Environmental Cleaning for the Prevention of Healthcare-Associated Infections [Technical brief no. 22 (prepared by the ECRI Institute – Penn Medicine Evidence-Based Practice Center under contract no. 290-2012-00011-I). AHRQ publication no. 15-EHC020-EF]. Rockville, MD: Agency for Healthcare Research and Quality; 2015.	Systematic Review	n/a	n/a	n/a	n/a	Studies on effectiveness of disinfection methods and monitoring techniques are limited. Future research should focus on comparing emerging technologies, identifying surfaces with greatest transmission potential, a standard measurement for cleanliness, and when possible, using patient colonization and infection rates as outcome measures.	IIIA
25	Rutala WA, Weber DJ; Healthcare Infection Control Practices Advisory Committee. Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008. Update May 2019. Atlanta, GA: Centers for Disease Control and Prevention; 2008.	Guideline	n/a	n/a	n/a	n/a	Provides guidance on the preferred cleaning, disinfection and sterilization of patient care medical devices and the cleaning and disinfecting the healthcare environment.	IVA
26	ANSI/AAMI TIR68:2018. Low and Intermediate-Level Disinfection in Healthcare Settings for Medical Devices and Patient Care Equipment and Sterile Processing Environmental Surfaces. Arlington, VA: AAMI; 2018.	Expert Opinion	n/a	n/a	n/a	n/a	Provides guidance on selection and use of low and intermediate-level disinfectants and the processes for safe and effective disinfection.	VA

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27	Arif AA, Delclos GL. Association between cleaning-related chemicals and work-related asthma and asthma symptoms among healthcare professionals. Occup Environ Med. 2012;69(1):35-40.	Nonexperimental	Survey of 3650 healthcare professionals, United States	n/a	n/a	Exposure to cleaning substances; work related asthma (WRA)	Healthcare professionals who are exposed to cleaning chemicals are at risk of developing WRA, with prevalence being higher among females.	IIIB
28	Casey ML, Hawley B, Edwards N, Cox-Ganser JM, Cummings KJ. Health problems and disinfectant product exposure among staff at a large multispecialty hospital. Am J Infect Control. 2017;45(10):1133-1138.	Nonexperimental	9 departments in large hospital, United States	n/a	n/a	Air samples of Environmental Service worker breathing zones; work and health questionnaire	A higher prevalence of work-related wheeze and watery eyes was found among disinfectant product users. Respiratory risks should be considered when selecting disinfectants for hospital-acquired infection prevention.	IIIB
29	Su FC, Friesen MC, Stefaniak AB, et al. Exposures to volatile organic compounds among healthcare workers: modeling the effects of cleaning tasks and product use. Ann Work Expo Health. 2018;62(7):852-870.	Nonexperimental	100 healthcare workers at 4 hospitals, United States	n/a	n/a	Personal and mobile-area air measurements for 5 volatile organic compounds (VOC).	Product ingredient and disinfection task determines the type of VOC exposure to healthcare workers.	IIIB
30	Guideline for medical device and product evaluation. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2019:715-724.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for evaluating US Food and Drug Administration-cleared medical devices and products for use in the perioperative setting.	IVA
31	29 CFR 1910.1200: Hazard communication. Occupational Safety and Health Administration. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10099&p_table=STANDARDS. Accessed September 12, 2019.	Regulatory	n/a	n/a	n/a	n/a	Occupational Safety and Health Administration (OSHA) Hazard Communication standard which prescribes safeguards to protect workers against health hazards caused by chemicals.	n/a

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32	Hong Y, Teska PJ, Oliver HF. Effects of contact time and concentration on bactericidal efficacy of 3 disinfectants on hard nonporous surfaces. Am J Infect Control. 2017;45(11):1284-1285.	Nonexperimental	Stainless steel carriers in lab, United States	n/a	Accelerated hydrogen peroxide (AHP), quaternary ammonium compounds (Quats), sodium hypochlorite, no disinfectant	Bacterial reduction (log_{10})	Quat most affected by decrease in contact time and concentration, whereas sodium hypochlorite was least affected.	IIIB
33	West AM, Teska PJ, Oliver HF. There is no additional bactericidal efficacy of environmental protection agency–registered disinfectant towelettes after surface drying or beyond label contact time. Am J Infect Control. 2019;47(1):27-32.	Quasi-experimental	6 disinfectant towelettes tested in lab at 10 different contact times, United States	Application of disinfectant towelette	Dry wipe wetted with phosphate-buffered saline solution (PBS)	Bactericidal efficacy	No additional bactericidal efficacy occurred after disinfectant dried, indicating that extended contact beyond dry time does not improve disinfection.	IIB
34	Rutala WA, Barbee SL, Aguiar NC, Sobsey MD, Weber DJ. Antimicrobial activity of home disinfectants and natural products against potential human pathogens. Infect Control Hosp Epidemiol. 2000;21(1):33-38.	Quasi-experimental	*S aureus, E coli, Pseudomonas aeruginosa* , and *Salmonella choleraesuis*	3 hospital disinfectants (a phenolic, a quaternary ammonium compound, sodium hypochlorite)	n/a	Log reduction of test organism at 30 seconds and 5 minutes.	The log10 reductions at 30 seconds was identical to the log10 reduction at 5 minutes.	IIB
35	West AM, Nkemngong CA, Voorn MG, et al. Surface area wiped, product type, and target strain impact bactericidal efficacy of ready-to-use disinfectant towelettes. Antimicrob Resist Infection Control. 2018;7:122.	Nonexperimental	10 wipes on textured formica sheet divided into 8 one foot square areas (ft^2)	n/a	n/a	Amount of disinfectant released; efficacy over different sized areas	For optimal wipe performance there must be a balance between amount of disinfectant released and mechanical action.	IIIB

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36	Gonzalez EA, Nandy P, Lucas AD, Hitchins VM. Ability of cleaning-disinfecting wipes to remove bacteria from medical device surfaces. Am J Infect Control. 2015;43(12):1331-1335.	Quasi-experimental	2.5- x 2.5-cm squares on 1 anesthesia machine, flat caps and ridged caps inoculated with S. aureus, Bacillus atrophaeus spores and Clostridium spores	Wiping with 5 types of commercial disinfectant wipes, gauze with water, gauze with diluted 5% bleach (1:10)	No wiping with disinfectant wipes or gauze	Percentage of *S. aureus* , *Bacillus atrophaeu* s spores and *Clostridium* spores remaining measured in colony forming units (CFU)	The 5 commercial wipes and gauze with diluted bleach significantly reduced organisms compared to gauze with water. The wetter a wipe is does not equate to improved efficacy and can damage surfaces (eg, seeping into electronic crevices)	IIC
37	Engelbrecht K, Ambrose D, Sifuentes L, Gerba C, Weart I, Koenig D. Decreased activity of commercially available disinfectants containing quaternary ammonium compounds when exposed to cotton towels. Am J Infect Control. 2013;41(10):908-911.	Nonexperimental	Microfiber and cotton towels exposed to three quaternary ammonium compounds (QACs) for 0.5, 30, and 180 minutes.	n/a	n/a	Germicidal spray tests (GSTs); QAC concentration	Cotton towels exposed to disinfectants with QACs had an 85.3% reduction of QAC concentration and 96% GST failure of disinfectants.	IIIB
38	Rutala WA, Gergen MF, Weber DJ. Microbiologic evaluation of microfiber mops for surface disinfection. Am J Infect Control. 2007;35(9):569-573.	Quasi-experimental	General surgery ward rooms of hospital, United States	Microfiber mop	String mop	Microbial levels of floor utilizing RODAC plates	A microfiber mop used with detergent demonstrated superior microbial removal when compared with string mop. The addition of a disinfectant to microfiber material did not improve microbial elimination, however it did for the string mop.	IIB

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39	Diab-Elschahawi M, Assadian O, Blacky A, et al. Evaluation of the decontamination efficacy of new and reprocessed microfiber cleaning cloth compared with other commonly used cleaning cloths in the hospital. Am J Infect Control. 2010;38(4):289-292.	Quasi-experimental	Tile contaminated with *S. aureus* and *E.coli* suspension	4 types of cleaning cloths (microfiber, cotton, sponge, paper)	n/a	Colony forming units (CFU)remaining after decontamination with new and washed cloths	Microfiber achieved significantly higher decontamination than other cloths, but microfiber's ability to clean declined after 20 washings.	IIB
40	Wiemken TL, Curran DR, Pacholski EB, et al. The value of ready-to-use disinfectant wipes: compliance, employee time, and costs. Am J Infect Control. 2014;42(3):329-330.	Quasi-experimental	9 hospital employees cleaning 6 designated room areas	Cleaning with disposable wipes	Cleaning with bucket and cloth	Time to complete; fluorescent marker removal; cost	Compared to traditional cleaning methods, ready to use wipes decrease time and cost and increase compliance with cleaning.	IIB
41	Sifuentes LY, Gerba CP, Weart I, Engelbrecht K, Koenig DW. Microbial contamination of hospital reusable cleaning towels. Am J Infect Control. 2013;41(10):912-915.	Nonexperimental	10 hospitals, United States	n/a	n/a	Microbial contamination measured in colony forming units (CFU)	Microfiber towels harbored greater number of bacteria compared to cotton towels	IIIB
42	Trajtman AN, Manickam K, Alfa MJ. Microfiber cloths reduce the transfer of Clostridium difficile spores to environmental surfaces compared with cotton cloths. Am J Infect Control. 2015;43(7):686-689.	Quasi-experimental	Ceramic carriers with *and* without *C. difficile* spores in lab, Canada	Microfiber cloth	Cotton cloth	*C. difficile* colony forming units (cfu)	When wiping a clean surface, microfiber cloths when compared to cotton cloths, released significantly fewer spores.	IIC
43	Rutala WA, Gergen MF, Weber DJ. Room decontamination with UV radiation. Infect Control Hosp Epidemiol. 2010;31(10):1025-1029.	Quasi-experimental	8 rooms of patients in contact precautions in tertiary hospital, United States	Ultraviolet light (wavelength 254 nm) disinfection device (UV-C)	None	Vegetative bacteria counts of surfaces (cfus)	In approximately 15 minutes, UV-C eliminated bacteria on surfaces within site line and behind objects. 50 minutes were necessary for elimination of *C. difficile* spores.	IIB

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44	Boyce JM, Havill NL, Moore BA. Terminal decontamination of patient rooms using an automated mobile UV light unit. Infect Control Hosp Epidemiol. 2011;32(8):737-742.	Quasi-experimental	25 patient rooms upon patient discharge in university hospital, United States	One stage administration of automated mobile ultraviolet unit	Two stage administrations of automated mobile ultraviolet unit	Aerobic colony counts (ACCs); *C. difficile* spores	Significant reduction of ACCs and *C. difficile* spores on contaminated surfaces in patient rooms.	IIB
45	Anderson DJ, Gergen MF, Smathers E, et al. Decontamination of targeted pathogens from patient rooms using an automated ultraviolet-C-emitting device. Infect Control Hosp Epidemiol. 2013;34(5):466-471.	Quasi-experimental	229 samples from 39 patient rooms of a discharged infected or colonized patient with 1 of 3 pathogens, United States	Ultraviolet-C- (UV-C)emitting device	Prior to use of UV-C device	9 environmental site cultures	Significant decrease in total CFUs of all 3 pathogens in all environmental sites, whether in direct or indirect line of site.	IIB
46	Nerandzic MM, Cadnum JL, Pultz MJ, Donskey CJ. Evaluation of an automated ultraviolet radiation device for decontamination of Clostridium difficile and other healthcare-associated pathogens in hospital rooms. BMC Infect Dis. 2010;10:197.	Quasi-experimental	Veterans Affairs Medical Center, United States	Specific reflected doses of UV-C radiation with Tru-D device	No treatment	High touch surface cultures for presence of *C. difficile* , MRSA and VRE	Tru-D significantly reduced *C. difficile* , VRE and MRSA on laboratory bench tops and patient rooms.	IIB
47	Umezawa K, Asai S, Inokuchi S, Miyachi H. A comparative study of the bactericidal activity and daily disinfection housekeeping surfaces by a new portable pulsed UV radiation device. Curr Microbiol. 2012;64(6):581-587.	Quasi-experimental	Intensive care unit and emergency care unit of university hospital, Japan	Daily disinfection with portable pulsed ultraviolet (UV) radiation device	Daily disinfection with continuous UV radiation	Bactericidal efficacy; labor burden	Bactericidal activity against critical nosocomial bacteria, including multi-drug resistant organisms, occurred when cleaning with portable pulsed UV radiation device. Average time spent was reduced from 43 minutes with ethanol wipes to 22 minutes with portable UV-C.	IIA

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48	Anderson DJ, Chen LF, Weber DJ, et al. Enhanced terminal room disinfection and acquisition and infection caused by multidrug-resistant organisms and Clostridium difficile (the benefits of enhanced terminal room disinfection study): a cluster-randomised, multicentre, crossover study. Lancet. 2017;389(10071):805-814.	RCT	Inpatient rooms of 9 hospitals, United States	3 Strategies: Quaternary ammonium (Quat) and disinfecting ultraviolet (UV-C), but if *C.difficile* then Bleach and UV-C, Bleach only	Quat, but bleach if *C-difficile*	Incidence of infection or colonization in exposed patients to methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), multidrug-resistant *Acinetobacter* or *C.difficile*	Addition of UV-C to terminal cleaning significantly lowered incidence of target organisms among exposed patients, however *C. difficile* incidence among exposed patients was not significant after adding UV-C to use of bleach.	IA
49	Nottingham M, Peterson G, Doern C, et al. Ultraviolet-C light as a means of disinfecting anesthesia workstations. Am J Infect Control. 2017;45(9):1011-1013.	Quasi-experimental	Anesthesia workstation (AW) in 1 OR and 1 small room, United States	Tru-D SmartUVC on "Vegetative Bacteria" setting	No Tru-D Smart UVC	Bioburden reduction (BR) using colony-forming units (CFU)	Significant BR on high-touch AW sites occurred regardless of room size or exposure type and could be supplement to manual cleaning.	IIC
50	Levin J, Riley LS, Parrish C, English D, Ahn S. The effect of portable pulsed xenon ultraviolet light after terminal cleaning on hospital-associated Clostridium difficile infection in a community hospital. Am J Infect Control. 2013;41(8):746-748.	Quasi-experimental	2010 and 2011 patient population of 140-bed community hospital, United States	Portable pulsed xenon ultraviolet light device (PPX-UV) following terminal clean of patient room	None	Reduction of hospital-associated *C. difficile (HA-CDI)* infection rate	The HA-CDI rate during the use of PPX-UV was significantly lower than previous year when it was not in use.	IIB
51	Catalanotti A, Abbe D, Simmons S, Stibich M. Influence of pulsed-xenon ultraviolet light-based environmental disinfection on surgical site infections. Am J Infect Control. 2016;44(6):e99-e101.	Quasi-experimental	13 operating rooms in community hospital, United States	2 Pulsed-xenon ultraviolet lights and standard terminal clean by dedicated housekeeper	Standard terminal clean by OR staff	Surgical site infection (SSI) rates for Class I and Class II procedures	Intervention significant reduced SSI rates for Class I procedures, but not Class II (clean-contaminated) procedures.	IIC

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52	Sampathkumar P, Folkert C, Barth JE, et al. A trial of pulsed xenon ultraviolet disinfection to reduce Clostridioides difficile infection. Am J Infect Control. 2019;47(4):406-408.	Quasi-experimental	3 units in large teaching hospital, United States	UV disinfection after patient discharge and terminal clean	No UV disinfection after patient discharge and terminal clean	Rate of healthcare-associated *Clostridium difficile* infection (CDI)	Addition of UV technology led to CDI reduction and sustainment over several months.	IIA
53	El Haddad L, Ghantoji SS, Stibich M, et al. Evaluation of a pulsed xenon ultraviolet disinfection system to decrease bacterial contamination in operating rooms. BMC Infect Dis. 2017;17(1):672.	Quasi-experimental	295 samples of high touch surfaces in 30 ORs of teaching hospital, United States	Pulsed xenon ultraviolet (PX-UV) germicidal device cycle ran for 1, 2, or 8 minutes after final case clean and before terminal clean	Manual cleaning with ready-to-use germicidal wipe or diluted solution	Microbial contamination (colony forming units)	2 and 8 minute cycles produced equivalent significant reduction of CFUs, indicating the 2 minute cycle could optimize efficacy and efficiency when combined with standard cleaning procedures.	IIB
54	Simmons S Jr, Dale C, Holt J, Passey DG, Stibich M. Environmental effectiveness of pulsed-xenon light in the operating room. Am J Infect Control. 2018;46(9):1003-1008.	Quasi-experimental	High touch surfaces in ORs of 23 hospitals, United States	Pulsed xenon ultraviolet (PX-UV) ran after terminal clean	Terminal clean without PX-UV	Microbial contamination (colony forming units)	Use of the PX-UV after terminal cleaning significantly reduced contamination of high-touch surfaces in OR.	IIB
55	Armellino D, Walsh TJ, Petraitis V, Kowalski W. Assessment of focused multivector ultraviolet disinfection with shadowless delivery using 5-point multisided sampling of patient care equipment without manual-chemical disinfection. Am J Infect Control. 2019;47(4):409-414.	Quasi-experimental	104 surgeries at one community and two teaching hospitals, United States	Focused multivector ultraviolet (FMUV) system	Manual cleaning and chemical disinfection following AORN Guidelines	Microbial burden using a 5-point multisided sampling method	FMUV system significantly reduced microbial contamination. Five-point multisided sampling is useful for evaluating disinfection on equipment sides.	IIB
56	Armellino D, Walsh TJ, Petraitis V, Kowalski W. Assessing the feasibility of a focused multivector ultraviolet system between surgery cases with a parallel protocol for enhanced disinfection capabilities. Am J Infect Control. 2019;47(8):1006-1008.	Quasi-experimental	2 orthopedic operating rooms in large teaching hospital, United States	Between case cleaning with focused multivector ultraviolet (FMUV) system, along with manual cleaning	Two stage administrations of automated mobile ultraviolet unit	Cleaning time; total turnover time; cleaning compliance	No significant difference in cleaning time when using FMUV and manual cleaning or just manual cleaning. FMUV could be used without affecting total turnover time.	IIB

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57	Barbut F, Menuet D, Verachten M, Girou E. Comparison of the efficacy of a hydrogen peroxide dry-mist disinfection system and sodium hypochlorite solution for eradication of Clostridium difficile spores. Infect Control Hosp Epidemiol. 2009;30(6):507-514.	RCT	748 surface samples from discharged *C. difficile* patients in 2 university hospitals, France	Hydrogen peroxide (H2O2) dry mist	0.5% hypochlorite solution	*C. difficile* colonies (CFUs)	Eradication of C. difficile spores was significantly greater with use of H2O2 dry mist when compared to hypochlorite.	IB
58	Bartels MD, Kristoffersen K, Slotsbjerg T, Rohde SM, Lundgren B, Westh H. Environmental meticillin-resistant Staphylococcus aureus (MRSA) disinfection using dry-mist-generated hydrogen peroxide. J Hosp Infect. 2008;70(1):35-41.	Quasi-experimental	Experimental MRSA placed on hospital room and private home surfaces, The Netherlands	Hydrogen peroxide (H2O2) and silver cations diffused by dry mist	Before use of H2O2 and silver cations dry mist	MRSA detection and quantification	Sterinis, a dry mist hydrogen peroxide, could be used as a final cleaning supplement of MRSA isolation rooms, but is not recommended for private home disinfection.	IIB
59	Boyce JM, Havill NL, Otter JA, et al. Impact of hydrogen peroxide vapor room decontamination on clostridium difficile environmental contamination and transmission in a healthcare setting. Infect Control Hosp Epidemiol. 2008;29(8):723-729.	Quasi-experimental	5 wards with high incidence of *Clostridium difficile* in university hospital, United States	Hydrogen peroxide vapor (HPV) decontamination	Before use of HPV	*C. difficile* on contaminated surfaces; incidence of nosocomial *C. difficile* -associated disease (CDAD)	When used after terminal cleaning, hydrogen peroxide vapor eradicated *C. difficile* from contaminated surfaces.	IIB
60	Chan HT, White P, Sheorey H, Cocks J, Waters MJ. Evaluation of the biological efficacy of hydrogen peroxide vapour decontamination in wards of an Australian hospital. J Hosp Infect. 2011;79(2):125-128.	Quasi-experimental	High-touch zones in wards of 300 bed teaching hospital, Australia	Neutral detergent followed by dry hydrogen peroxide vapor decontamination	Manual clean with bleach or Det-Sol 500	Bacterial counts	Dry hydrogen peroxide vapor is highly effective in reducing bacterial counts on a range of surfaces with some surfaces allowing for easier measurement via contact plate method than others.	IIB

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61	Manian FA, Griesenauer S, Senkel D, et al. Isolation of Acinetobacter baumannii complex and methicillin-resistant Staphylococcus aureus from hospital rooms following terminal cleaning and disinfection: can we do better? Infect Control Hosp Epidemiol. 2011;32(7):667-672.	Quasi-experimental	Surfaces of 312 of hospital rooms newly vacated by patients with multi-drug resistant *Acinetobacter baumannii* complex (ABC(, United States	Hydrogen peroxide vapor (HPV) no-touch automated room decontamination following routine discharge clean	Routine discharge cleaning and disinfection (C/D)	Microbiological sampling for presence of *Acinetobacter baumannii* Complex (ABC); presence of Methicillin Resistant *Staphylococcus aureus* (MRSA)	When rooms vacated by multi-drug resistant ABC patients are terminally disinfected there may be a significant number of ABC- or MRSA-positive room surfaces that remain. Adding hydrogen peroxide vapor (HPV) to terminal clean reduced number of contaminated sites.	IIB
62	Passaretti CL, Otter JA, Reich NG, et al. An evaluation of environmental decontamination with hydrogen peroxide vapor for reducing the risk of patient acquisition of multidrug-resistant organisms. Clin Infect Dis. 2013;56(1):27-35.	Quasi-experimental	Rooms in 6 high-risk units of large tertiary hospital, which had a prior room occupant who was infected or colonized with MDRO, United States	Terminal clean with hydrogen peroxide vapor (HPV) on 3 units	Standard terminal clean on other 3 units	Environmental samples for multi-drug resistant organisms (MDROs)	HPV decontamination added to standard terminal clean reduced environmental contamination and the risk of acquiring MDROs.	IIA
63	Lemmen S, Scheithauer S, Häfner H, Yezli S, Mohr M, Otter JA. Evaluation of hydrogen peroxide vapor for the inactivation of nosocomial pathogens on porous and nonporous surfaces. Am J Infect Control. 2015;43(1):82-85.	Quasi-experimental	MDRO carriers and spore biological indicators (BI) placed inside and outside OR, Germany	Hydrogen peroxide vapor (HPV) no-touch automated room decontamination	No exposure to HPV no-touch automated room decontamination	Inactivation of BI and 3 different MDROs on stainless steel and cotton carriers	MRSA, VRE and multi-drug resistant *Acinetobacter baumann* i were eliminated from all carriers by hydrogen peroxide vapor	IIB
64	Dancer SJ. Hospital cleaning in the 21st century. Eur J Clinical Microbiol Infect Dis. 2011;30(12):1473-1481.	Expert Opinion	n/a	n/a	n/a	n/a	Cleaning with detergents, as opposed to disinfectants is cheaper and less toxic. Further investigation of routine and outbreak cleaning is necessary.	VA

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65	Donskey CJ. Decontamination devices in health care facilities: practical issues and emerging applications. Am J Infect Control. 2019;47S:A23-A28.	Literature Review	n/a	n/a	n/a	n/a	Benefits and limitations of decontamination devices, including need for future studies and regulation.	VB
66	Weber DJ, Rutala WA, Anderson DJ, Chen LF, Sickbert-Bennett E, Boyce JM. Effectiveness of ultraviolet devices and hydrogen peroxide systems for terminal room decontamination: focus on clinical trials. Am J Infect Control. 2016;44(5):e77-e84.	Literature Review	n/a	n/a	n/a	n/a	Both UV light and hydrogen peroxide when used after terminal cleaning reduce microorganisms and decrease infections.	VB
67	Marra AR, Schweizer ML, Edmond MB. No-touch disinfection methods to decrease multidrug-resistant organism infections: a systematic review and meta-analysis. Infect Control Hosp Epidemiol. 2018;39(1):20-31.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Enhanced environmental cleaning using ultraviolet light (UVL) no-touch technology can decrease *Clostridium difficile* and V*ancomycin resistant enterococci* hospital-acquired infections .	IIIA
68	Cobb TC. Methicillin-resistant Staphylococcus aureus decontamination: is ultraviolet radiation more effective than vapor-phase hydrogen peroxide? Rev Med Microbiol. 2017;28(2):69-74.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	An equally significant difference in MRSA log reduction on surfaces was achieved by both treatments.	IIIB
69	McDonald LC, Gerding DN, Johnson S, et al. Clinical practice guidelines for Clostridium difficile infection in adults and children: 2017 update by the Infectious Diseases Society of America (IDSA) and Society for Healthcare Epidemiology of America (SHEA). Clin Infect Dis. 2018;66(7):e1-e48.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for management and treatment of *Clostridium difficile* infection.	IVA
70	Hosein I, Madeloso R, Nagaratnam W, Villamaria F, Stock E, Jinadatha C. Evaluation of a pulsed xenon ultraviolet light device for isolation room disinfection in a United Kingdom hospital. Am J Infect Control. 2016;44(9):e157-e161.	Quasi-experimental	39 hospital rooms of post discharge isolation patients in university hospital, United Kingdom	Pulsed-xenon ultraviolet light (PX-UV)	Manual disinfection with 0.1% chlorine	Aerobic bacterial counts; time for disinfection; staff attitudes	Significant reduction of aerobic microbial counts. PX-UV was perceived as being easy to incorporate and did not adversely affect patient throughput.	IIB

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71	Jinadatha C, Villamaria FC, Restrepo MI, et al. Is the pulsed xenon ultraviolet light no-touch disinfection system effective on methicillin-resistant Staphylococcus aureus in the absence of manual cleaning? Am J Infect Control. 2015;43(8):878-881.	Quasi-experimental	14 hospital rooms of post discharged MRSA patients in Veteran Affairs (VA) hospital, United States	Pulsed-xenon ultraviolet light (PX-UV)	No manual disinfection	MRSA colony counts	Significant reduction of MRSA colony counts in the absence of disinfection.	IIC
72	Zeber JE, Pfeiffer C, Baddley JW, et al. Effect of pulsed xenon ultraviolet room disinfection devices on microbial counts for methicillin-resistant Staphylococcus aureus and aerobic bacterial colonies. Am J Infect Control. 2018;46(6):668-673.	Quasi-experimental	Patient rooms post discharge in 4 Veterans Affairs hospitals, United States	Manual disinfection with EPA registered disinfectant and pulsed-xenon ultraviolet light (PX-UV)	Manual disinfection with EPA registered disinfectant	Colony counts of MRSA and aerobic bacteria	Significant reduction of MRSA and aerobic bacteria colonies on high touch surfaces.	IIB
73	Vianna PG, Dale CR Jr, Simmons S, Stibich M, Licitra CM. Impact of pulsed xenon ultraviolet light on hospital-acquired infection rates in a community hospital. Am J Infect Control. 2016;44(3):299-303.	Quasi-experimental	All discharged ICU rooms and *C. diff* discharged non-ICU rooms in community hospital, United States	Pulsed-xenon ultraviolet light (PX-UV)	Manual disinfection	Hospital-acquired *C. difficil* e, MRSA and VRE infection rates	Significant reduction in *C. difficile* rates in non-ICU areas. Significant reduction in VRE rates in ICU areas. Significant facility wide reduction in all 3 rates(*C. difficile* , MRSA, VRE).	IIB
74	Nagaraja A, Visintainer P, Haas JP, Menz J, Wormser GP, Montecalvo MA. Clostridium difficile infections before and during use of ultraviolet disinfection. Am J Infect Control. 2015;43(9):940-945.	Quasi-experimental	Adult ICU contact isolation rooms in large medical center, United States	Pulsed-xenon ultraviolet light (PX-UV)	Manual disinfection	Hospital-acquired C. difficile infection(CDI)	Significant reduction in hospital-acquired C. difficile infections (CDI) when PX-UV was used for discharge cleans in adult ICUs.	IIA
75	75.29 CFR 1910.1030: Bloodborne pathogens. Occupational Safety and Health Administration. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10051&p_table=STANDARDS. Accessed September 12, 2019.	Regulatory	n/a	n/a	n/a	n/a	Occupational Safety and Health Administration (OSHA) Bloodborne Pathogens standard as amended pursuant to the Needlestick Safety and Prevention Act of 2000, which prescribes safeguards to protect workers against health hazards caused by bloodborne pathogens.	n/a

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76	Havill NL. Best practices in disinfection of noncritical surfaces in the health care setting: creating a bundle for success. Am J Infect Control. 2013;41(5 Suppl):S26-S30.	Expert Opinion	n/a	n/a	n/a	n/a	Written policies, appropriate disinfectants and application methods, staff education, monitoring and feedback are all necessary for sustainment of a successful environmental cleaning program.	VB
77	Dancer SJ. The role of environmental cleaning in the control of hospital-acquired infection. J Hosp Infect. 2009;73(4):378-385.	Literature Review	n/a	n/a	n/a	n/a	Discusses links between hospital environment and pathogens (MRS, VRE, C diff). Discusses emphasis of cleaning high touch surfaces and defining what clean is.	VB
78	Richard RD, Bowen TR. What orthopaedic operating room surfaces are contaminated with bioburden? A study using the ATP bioluminescence assay. Clin Orthop. 2017;475(7):1819-1824.	Nonexperimental	Surfaces in 6 orthopaedic OR's in large medical center, United States	n/a	n/a	ATP bioluminescence assay	ATP bioluminescence can identify uncleaned areas of OR that could potentially lead to increased infection rates.	IIIC
79	Guh A, Carling P; Environmental Evaluation Workgroup. Options for Evaluating Environmental Cleaning Toolkit. Centers for Disease Control and Prevention; 2010. https://www.cdc.gov/hai/toolkits/evaluating-environmental-cleaning.html. Accessed September 12, 2019.	Expert Opinion	n/a	n/a	n/a	n/a	Outlines 3 different programs, based on facility resources, to objectively monitor thoroughness of high touch surface room cleaning upon discharge in hospital settings.	VB
80	Pedersen A, Getty Ritter E, Beaton M, Gibbons D. Remote video auditing in the surgical setting. AORN J. 2017;105(2):159-169.	Organizational Experience	17 room OR of tertiary hospital, United States	n/a	n/a	n/a	Video monitoring of environmental cleaning protocol adherence, along with immediate feedback increased compliance to 93% and a 10% decrease in SSIs from previous year.	VA
81	Bergen LK, Meyer M, Hog M, Rubenhagen B, Andersen LP. Spread of bacteria on surfaces when cleaning with microfibre cloths. J Hosp Infect. 2009;71(2):132-137.	Nonexperimental	Sixteen 50x50 surface areas, contaminated with *B. cereus* and *E. faecalis,* Denmark	n/a	n/a	Bacterial surface reduction; bacterial surface spread	Contaminated surface had an overall bacterial reduction, but bacteria were spread to other cleaned surfaces.	IIIB

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82	Andersen BM, Rasch M, Kvist J, et al. Floor cleaning: effect on bacteria and organic materials in hospital rooms. J Hosp Infect. 2009;71(1):57-65.	Nonexperimental	Vinyl covered floors in four double occupancy rooms of geriatric university hospital, Norway	n/a	n/a	Residual organic soil; floor and air microbiologic samples	Organic soil and bacteria on floor were reduced by all cleaning methods, with wet and moist methods most effective. Bacteria in air increased after all types of mopping.	IIIB
83	Deshpande A, Cadnum JL, Fertelli D, et al. Are hospital floors an underappreciated reservoir for transmission of health care-associated pathogens? Am J Infect Control. 2017;45(3):336-338.	Nonexperimental	Isolation patient rooms in 5 hospitals, United States	n/a	n/a	Cultured floor for *C-diff* , MRSA and VRE growth; observation of number and type of objects present on floor.	Floors of patient rooms during admission and after discharge cleaning were frequently contaminated with health care-associated pathogens and high-touch objects very often touched floor.	IIIB
84	Munoz-Price LS, Bowdle A, Johnston BL, et al. Infection prevention in the operating room anesthesia work area. Infect Control Hosp Epidemiol. 2018;December 11:1-17. Epub ahead of print.	Consensus	n/a	n/a	n/a	n/a	Provides recommendations for anesthesia work area infection prevention that include hand hygiene, environmental disinfection and implementing effective improvement efforts.	IVA
85	Das A, Conti J, Hanrahan J, Kaelber DC. Comparison of keyboard colonization before and after use in an inpatient setting and the effect of keyboard covers. Am J Infect Control. 2018;46(4):474-476.	Quasi-experimental	Adult medicine inpatient rooms, United States	Soft typeable keyboard cover	Uncovered keyboard	Bacterial count; bacterial type: nonpathogenic (NPB) or potentially pathogenic (PPB)	Keyboards with covers were colonized by NPF and PPB more often than keyboards without covers.	IIB
86	2019 Top 10 Health Technology Hazards; Executive Brief. Plymouth Meeting, PA: ECRI Institute; 2018.	Expert Opinion	n/a	n/a	n/a	n/a	Describes problems and recommendations for improvement when using 10 different medical device and systems, one of which is mattresses and mattress covers.	VB

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87	Siegel JD, Rhinehart E, Jackson M, Chiarello L; Health Care Infection Control Practices Advisory Committee. 2007 guideline for isolation precautions: preventing transmission of infectious agents in health care settings. Am J Infect Control. 2007;35(10 Suppl 2):S65-S164.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for preventing transmission of infectious agents to patient and healthcare works in the United States.	IVA
88	ANSI/AAMI TIR67:2018. Promoting Safe Practices Pertaining to the Use of Sterilant and Disinfectant Chemicals in Health Care Facilities. Arlington, VA: Association for the Advancement of Medical Instrumentation; 2018.	Expert Opinion	n/a	n/a	n/a	n/a	Provides guidance on occupational safety when utilizing sterilant and disinfectant chemicals by providing relevant regulatory and general actions to ensure their safe use .	VA
89	Horn M, Patel N, MacLellan DM, Millard N. Traditional canister-based open waste management system versus closed system: hazardous exposure prevention and operating theatre staff satisfaction. ORNAC J. 2016;34(2):36-50.	Nonexperimental	30 arthroscopy, urology and orthopaedic cases in 6 ORs, Australia	n/a	n/a	Time to change canisters and number of fluid spills or exposures	When compared to open system, closed system is less hazardous and more efficient way to dispose of fluid waste.	IIIC
90	42 CFR 416: Ambulatory surgical services. Government Publishing Office. https://www.govinfo.gov/app/details/CFR-2011-title42-vol3/CFR-2011-title42-vol3-part416 . Accessed September 12, 2019.	Regulatory	n/a	n/a	n/a	n/a	Guidance on what may be included during a survey for ambulatory surgical centers (ASCs). Includes sanitary environment	n/a
91	42 CFR 482: Conditions of participation for hospitals. Government Publishing Office. https://www.govinfo.gov/app/details/CFR-2011-title42-vol5/CFR-2011-title42-vol5-part482. Accessed September 12, 2019.	Regulatory	n/a	n/a	n/a	n/a	Provides guidance for services hospitals should provide if participating in Medicare.	n/a

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92	State Operations Manual Appendix A: Survey Protocol, Regulations and Interpretive Guidelines for Hospitals. Rev. 183; 2018. Centers for Medicare & Medicaid Services. https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_a_hospitals.pdf. Accessed September 12, 2019.	Regulatory	n/a	n/a	n/a	n/a	Provides guidance on what may be evaluated during a hospital survey.	n/a
93	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 September 12, 2019.	Regulatory	n/a	n/a	n/a	n/a	Provides guidance on what may be evaluated during a survey for Ambulatory Surgery Centers (ASCs).	n/a
94	Goebel U, Gebele N, Ebner W, et al. Bacterial contamination of the anesthesia workplace and efficiency of routine cleaning procedures: a prospective cohort study. Anesth Analg. 2016;122(5):1444-1447.	Nonexperimental	200 orthopedic surgeries in university hospital, Germany	n/a	n/a	Decontamination time, visible marker and bacterial load of anesthesia workplace	Significant difference found in all 3 outcome measures in trained housekeeping staff compared to anesthesia nurses, supporting the need for specialized training.	IIIB
95	Clark C, Taenzer A, Charette K, Whitty M. Decreasing contamination of the anesthesia environment. Am J Infect Control. 2014;42(11):1223-1225.	Quasi-experimental	Anesthesia environment samples from 105 first morning surgeries in large teaching hospital, United States	Education and visual cues for separation of clean and dirty supplies.	Baseline swabs	Contamination measured as 100 or more colonies per surface area sampled (CPSS)	Focus on maintaining a clean anesthesia environment decreased the amount of contamination over the course of a case.	IIB

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96	Birnbach DJ, Rosen LF, Fitzpatrick M, Carling P, Munoz-Price LS. The use of a novel technology to study dynamics of pathogen transmission in the operating room. Anesth Analg. 2015;120(4):844-847.	Nonexperimental	10 anesthesiology residents in simulated induction and intubation, United States	n/a	n/a	Presence of fluorescent marker from mannequin's mouth on other surfaces	Fluorescent marker found on a large number of items in environment illustrating that anesthesia providers may be contributing to spread of pathogens.	IIIC
97	Berrios-Torres SI, Umscheid CA, Bratzler DW, et al; Healthcare Infection Control Practices Advisory Committee. 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	Re-emphasis of select 1999 CDC and HICPAC recommendations for prevention of SSIs.	IVA
98	Abolghasemian M, Sternheim A, Shakib A, Safir OA, Backstein D. Is arthroplasty immediately after an infected case a risk factor for infection? Clin Orthop. 2013;471(7):2253-2258.	Quasi-experimental	83 arthroplasties following an infected arthroplasty at large hospital, Canada	Surgery following an infected case	Surgery not following an infected case	Incidence of infection within 12 months following surgery	A deep infection will no more likely occur in a patient following an infected case than a non-infected case.	IIB
99	Harnoss JC, Assadian O, Diener MK, et al. Microbial load in septic and aseptic procedure rooms. Dtsch Arztebl Int. 2017;114(27-28):465-475.	Nonexperimental	16 septic and 14 aseptic operations at university hospital, Germany	n/a	n/a	Microbial room air concentration and microbial sedimentation	Septic and aseptic procedures do not need to be spatially separated, even if a ventilation system is not present.	IIIC
100	Kalava A, Midha M, Kurnutala LN, SchianodiCola J, Yarmush JM. How clean are the overhead lights in operating rooms? Am J Infect Control. 2013;41(4):387-388.	Organizational Experience	5 ORS in ambulatory surgery department, United States	n/a	n/a	n/a	New gloves and new antiseptic wipe should be used along with sufficient time to clean entire overhead light at end of case.	VB

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101	Hess AS, Shardell M, Johnson JK, et al. A randomized controlled trial of enhanced cleaning to reduce contamination of healthcare worker gowns and gloves with multidrug-resistant bacteria. Infect Control Hosp Epidemiol. 2013;34(5):487-493.	RCT	MRSA and multidrug-resistant *Acinetobacter baumannii (MDRAB)* patient occupied rooms in 4 ICUs of a teaching hospital, United States	Standard room cleaning along with extra enhanced daily cleaning of high touch surfaces	Standard room cleaning	Isolation of MRSA or MDRAB from disposable gown and gloves of healthcare workers (HCW) after routine care activity	A significant reduction in contamination of HCW gowns and gloves after routine patient care did not occur as a result of intense enhanced daily cleaning.	IA
102	Boyce JM, Havill NL, Dumigan DG, Golebiewski M, Balogun O, Rizvani R. Monitoring the effectiveness of hospital cleaning practices by use of an adenosine triphosphate bioluminescence assay. Infect Control Hosp Epidemiol. 2009;30(7):678-684.	Quasi-experimental	High touch surfaces of 20 patient rooms of university hospital, United States	Educational sessions on daily cleaning	Daily cleaning without educational sessions	Aerobic colony counts (ACCs); adenosine triphosphate (ATP) bioluminescence assay	ATP readings provided quantitative evidence of improved high-touch surface cleaning.	IIB
103	Boyce JM, Havill NL, Havill HL, Mangione E, Dumigan DG, Moore BA. Comparison of fluorescent marker systems with 2 quantitative methods of assessing terminal cleaning practices. Infect Control Hosp Epidemiol. 2011;32(12):1187-1193.	Nonexperimental	High touch surfaces of 100 patient rooms of community teaching hospital, United States	n/a	n/a	Fluorescent markers; aerobic colony counts (ACCs); adenosine triphosphate (ATP) bioluminescence assay	When used to evaluate terminal cleaning, fluorescent markers reveal how often a high-touch surface is wiped. However these same surfaces evaluated with ACC and ATP, were significantly less likely to be considered clean.	IIIA
104	Carling PC, Parry MF, Bruno-Murtha LA, Dick B. Improving environmental hygiene in 27 intensive care units to decrease multidrug-resistant bacterial transmission. Crit Care Med. 2010;38(4):1054-1059.	Quasi-experimental	Environmental surfaces in 260 intensive care units rooms of 27 acute care hospitals, United States	Structured educational, procedural and administrative actions	No structured educational, procedural or administrative actions	Fluorescent marker removal	Interventions with consistent feedback led to significant improvement in thoroughness of terminal cleaning.	IIA

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105	Carling PC, Parry MF, Von Beheren SM; Healthcare Environmental Hygiene Study G. Identifying opportunities to enhance environmental cleaning in 23 acute care hospitals. Infect Control Hosp Epidemiol. 2008;29(1):1-7.	Nonexperimental	Environmental surfaces in rooms of 23 acute care hospitals, United States	n/a	n/a	Fluorescent marker removal	The overall thoroughness of cleaning frequently touched objects during a terminal clean was 49%, revealing a significant opportunity for improvement.	IIIB
106	Watanabe R, Shimoda T, Yano R, et al. Visualization of hospital cleanliness in three Japanese hospitals with a tendency toward long-term care. BMC Res Notes. 2014;7:121.	Nonexperimental	752 surfaces in 3 hospitals, Japan	n/a	n/a	ATP bioluminescence and stamp agar method	The variability of cleanliness noted is suggestive of insufficient daily cleaning. Additional cleaning, sharing of tasks and new technology should be considered.	IIIA
107	Alfa MJ, Lo E, Olson N, MacRae M, Buelow-Smith L. Use of a daily disinfectant cleaner instead of a daily cleaner reduced hospital-acquired infection rates. Am J Infect Control. 2015;43(2):141-146.	Quasi-experimental	538-bed acute care tertiary hospital, Canada	Disinfectant cleaner wipe (DCW)	Cleaner with cotton rags (CCR)	Hospital acquired incidence of methicillin-resistant *Staphylococcus aureu* s (MRSA), vancomycin-resistant enterococci (VRE), *Clostridium difficile* per 10,000 patient days; Cleaning compliance (CC)	When DCW was applied to high touch surfaces on a daily basis, with a minimum of 80% compliance C. diff, MRSA and VRE HAI rate were significantly decreased.	IIB
108	ANSI/AAMI ST79:2010 & A1:2010 & A2:2011 & A3:2012: Comprehensive Guide to Steam Sterilization and Sterility Assurance in Health Care Facilities. Arlington, VA: Association for the Advancement of Medical Instrumentation; 2012:250-254.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for steam sterilization in health care facilities. The recommendations are intended to promote sterility assurance and to guide health care personnel in the proper use of processing equipment and care of the environment.	IVC

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
109	Candida auris. Infection prevention and control: environmental disinfection. Centers for Disease Control and Prevention. https://www.cdc.gov/fungal/candida-auris/c-auris-infection-control.html#disinfection. Accessed September 12, 2019.	Expert Opinion	n/a	n/a	n/a	n/a	Current recommendation for environmental disinfection of hospital areas with *C. auris* patient	VA
110	Siegel JD, Rhinehart E, Jackson M, Chiarello L; Healthcare Infection Control Practices Advisory Committee. Management of Multidrug-Resistant Organisms in Healthcare Settings. Atlanta, GA: Centers for Disease Control and Prevention; 2006.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for management of MRSA, VRE, and other MDROs in health care organizations in the United States.	IVA
111	Datta R, Platt R, Yokoe DS, Huang SS. Environmental cleaning intervention and risk of acquiring multidrug-resistant organisms from prior room occupants. Arch Intern Med. 2011;171(6):491-494.	Quasi-experimental	10 intensive care units of a academic medical center, United States	Black light marker with feedback, frequent bucket immersion of cloth in disinfectant, education	Pouring disinfectant onto cleaning cloth	MRSA and VRE acquisition	Enhanced cleaning with feedback and cloth immersion may reduce MRSA and VRE transmission and MRSA acquisition from prior room occupant.	IIB
112	Landman D, Babu E, Shah N, et al. Transmission of carbapenem-resistant pathogens in New York City hospitals: progress and frustration. J Antimicrob Chemother. 2012;67(6):1427-1431.	Nonexperimental	Single patient isolates of *K .pneumoniae, A. baumannii and P. aeruginosa* from 14 hospitals, United States	n/a	n/a	Presence of genes encoding carbapenemases; comparison to similar 2006 study	Reduction in *K. pneumoniae* with carbapenemase (KPC) , but carbapenem resistance worsened in *A. baumannii* and *P. aeruginosa* . Environmental cleaning and respiratory isolation need to be utilized.	IIIA
113	Morgan DJ, Rogawski E, Thom KA, et al. Transfer of multidrug-resistant bacteria to healthcare workers' gloves and gowns after patient contact increases with environmental contamination. Crit Care Med. 2012;40(4):1045-1051.	Nonexperimental	Healthcare workers (HCW) in 6 intensive care units of tertiary care hospital, United States	n/a	n/a	Cultures of gown, gloves, hands and 9 environmental room surfaces	When caring for patients with multi-drug resistant organisms, HCW's protective clothing becomes contaminated most often with *A. baumannii* . Source of transmission to gowns and gloves was through environment, suggesting that more aggressive cleaning and contact precautions may decrease transmission.	IIIA

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114	Mitchell BG, Hall L, White N, et al. An environmental cleaning bundle and health-care-associated infections in hospitals (REACH): a multicentre, randomised trial. Lancet Infect Dis. 2019;19(4):410-418.	Quasi-experimental	Patient wards in 11 hospitals, Australia	Sequential roll-out of environmental cleaning bundle over 62-week period	Current environmental cleaning practices	Incidence of health-care associated VRE, C. diff and *S. aureus* infections; high touch object cleaning thoroughness	Significant reduction in Vancomycin-resistant enterococci infections. Frequency of cleaning high touch objects in bathroom increased from 55% to 76% and in bedrooms from 64% to 86%.	IIB
115	Ohl M, Schweizer M, Graham M, Heilmann K, Boyken L, Diekema D. Hospital privacy curtains are frequently and rapidly contaminated with potentially pathogenic bacteria. Am J Infect Control. 2012;40(10):904-906.	Nonexperimental	43 privacy curtains in rooms of two intensive care units at a university hospital, United States	n/a	n/a	Twice weekly swab cultures from leading edge of curtain	Privacy curtains become contaminated rapidly with potentially pathogenic bacteria. Further studies on their role in transmission and interventions to prevent contamination are needed.	IIIB
116	Shek K, Patidar R, Kohja Z, et al. Rate of contamination of hospital privacy curtains in a burns/plastic ward: a longitudinal study. Am J Infect Control. 2018;46(9):1019-1021.	Nonexperimental	Regional Burns/Plastic Unit in university hospital, Canada	n/a	n/a	Microbial contamination (CFUs); MRSA presence	Curtains became progressively contaminated with bacteria, including MRSA. Between day 10 and 14, MRSA presence increased.	IIIB
117	Rutala WA, Kanamori H, Gergen MF, Sickbert-Bennett E, Weber DJ. Susceptibility of Candida auris and Candida albicans to 21 germicides used in healthcare facilities. Infect Control Hosp Epidemiol. 2019;40(3):380-382.	Quasi-experimental	*C. auris* and *C. albicans* placed on stainless steel discs	21 germicides	No exposure to germicide	Log reduction of test organism	Several commonly used surface disinfectants (ie, a phenolic, 1.4% improved hydrogen peroxide, and alcohol-quaternary ammonium compounds are as effective against *C. auris* as chlorine based products.	IIB
118	Jensen PA, Lambert LA, Iademarco MF, Ridzon R; CDC. Guidelines for preventing the transmission of Mycobacterium tuberculosis in health-care settings, 2005. MMWR Recomm Rep. 2005;54(RR-17):1-141.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for preventing the transmission of Mycobacterium tuberculosis (TB) in health care settings.	IVA

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119	Rutala WA, Weber DJ; Society for Healthcare Epidemiology of America. Guideline for disinfection and sterilization of prion-contaminated medical instruments. Infect Control Hosp Epidemiol. 2010;31(2):107-117.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for cleaning and disinfection of non-critical environmental surfaces contaminated with Creutzfeldt-Jakob disease (CJD) patient tissue. The recommendations are intended to prevent transmission of CJD and to guide health care personnel in the proper application of disinfectant.	IVB
120	Balm MN, Jureen R, Teo C, et al. Hot and steamy: outbreak of Bacillus cereus in Singapore associated with construction work and laundry practices. J Hosp Infect. 2012;81(4):224-230.	Case Report	n/a	n/a	n/a	n/a	Construction next to a Singapore hospital resulted in heavy *Bacillus supp* . contamination of hospital air and environment, with organism recovered from 171 patients during timeframe.	VA
121	Campbell JR, Hulten K, Baker CJ. Cluster of Bacillus species bacteremia cases in neonates during a hospital construction project. Infect Control Hosp Epidemiol. 2011;32(10):1035-1038.	Case Report	n/a	n/a	n/a	n/a	Environmental contamination from adjacent construction may have contributed to outbreak, as once cleaning of unit, changing of air filters, relocation of loading dock and hand hygiene was implemented no further cases occurred.	VA
122	Fournel I, Sautour M, Lafon I, et al. Airborne Aspergillus contamination during hospital construction works: efficacy of protective measures. Am J Infect Control. 2010;38(3):189-194.	Nonexperimental	3 hospital units of university hospital, France	n/a	n/a	Air and surface sampling	Hospital construction does not affect airborne *Aspergillus* contamination when proper protective measures are in place, including education on importance of environmental cleaning.	IIIB

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123	Gibb AP, Fleck BW, Kempton-Smith L. A cluster of deep bacterial infections following eye surgery associated with construction dust. J Hosp Infect. 2006;63(2):197-200.	Case Report	n/a	n/a	n/a	n/a	Presence of foreign material, such as dust from construction can contribute to intra-ocular fluid organisms, possibly contributing to endophthalmitis.	VB
124	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.	Literature Review	n/a	n/a	n/a	n/a	Construction-related fungal cases are declining possibly due to guidelines and policies on infection prevention and control.	VA
125	Olmsted RN. Prevention by design: construction and renovation of health care facilities for patient safety and infection prevention. Infect Dis Clin North Am. 2016;30(3):713-728.	Literature Review	n/a	n/a	n/a	n/a	When performing hospital construction or renovation, an infection control risk assessment (ICRA) is essential to limiting exposure of patients and disease outbreaks.	VB
126	The Health Research & Educational Trust of the American Hospital Association, American Society for Health Care Engineering, Association for Professionals in Infection Control and Epidemiology, Society of Hospital Medicine, University of Michigan. Using the Health Care Physical Environment to Prevent and Control Infection. Chicago, IL: The American Society for Health Care Engineering of the American Hospital Association; 2015.	Expert Opinion	n/a	n/a	n/a	n/a	a	VB

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127	Faulde M, Spiesberger M. Role of the moth fly Clogmia albipunctata (Diptera: Psychodinae) as a mechanical vector of bacterial pathogens in German hospitals. J Hosp Infect. 2013;83(1):51-60.	Nonexperimental	271 adult moth flies collected from 4 infested hospitals, Germany	n/a	n/a	Bacterial colonization; antimicrobial susceptibility	*C. albipunctata* adult moth flies can be a mechanical vector for nosocomial infections.	IIIB
128	Munoz-Price LS, Safdar N, Beier JC, Doggett SL. Bed bugs in healthcare settings. Infect Control Hosp Epidemiol. 2012;33(11):1137-1142.	Expert Opinion	n/a	n/a	n/a	n/a	Bed bugs have reemerged in past decade and hospitals should have policies in place before infestation occurs. Further research needed on their role in horizontal transmission of pathogenic bacteria.	VB
129	Abdolmaleki Z, Mashak Z, Safarpoor Dehkordi F. Phenotypic and genotypic characterization of antibiotic resistance in the methicillin-resistant Staphylococcus aureus strains isolated from hospital cockroaches. Antimicrob Resist Infect Control. 2019;8(1):54.	Nonexperimental	536 cockroaches collected from hospitals, Iran	n/a	n/a	Isolation of *Staphylococcus aureus* and methicillin-resistant *S. aureus* strains	Hospital cockroaches harbor virulent and resistant MRSA strains and can act as a vector for transmission of these strains.	IIIB
130	Schulz-Stübner S, Danner K, Hauer T, Tabori E. Psychodidae (drain fly) infestation in an operating room. Infect Control Hosp Epidemiol. 2015;36(3):366-367.	Case Report	n/a	n/a	n/a	n/a	Complete separation of drain pipes and electrical wiring, along with sufficient sealing of flood-prone areas are key to preventing drain fly infestation.	VA
131	Schouest JM, Heinrich L, Nicholas B, Drach F. Fly rounds: validation and pilot of a novel epidemiologic tool to guide infection control response to an infestation of Sarcophagidae flies in a community hospital's perioperative department. Am J Infect Control. 2017;45(9):e91-e93.	Case Report	n/a	n/a	n/a	n/a	Development of a pest surveillance methodology allowed hourly tracking of fly prevalence per room, assisting incident command system in making timely operational decisions.	VB
132	Joint Statement on Bed Bug Control in the United States from the U.S. Centers For Disease Control And Prevention (CDC) and the U.S. Environmental Protection Agency (EPA). Atlanta, GA: Centers for Disease Control and Prevention, US Environmental Protection Agency; 2010.	Expert Opinion	n/a	n/a	n/a	n/a	Some bed bugs have developed resistance to pesticides, therefore integrated pest management (IPM) which uses information on life cycles of pests and interaction with environment are key to control.	VA

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133	Hota B, Blom DW, Lyle EA, Weinstein RA, Hayden MK. Interventional evaluation of environmental contamination by vancomycin-resistant enterococci: failure of personnel, product, or procedure? J Hosp Infect. 2009;71(2):123-131.	Quasi-experimental	Medical intensive-care and respiratory step-down unit of tertiary hospital, United States	Educational sessions, housekeeping observations	Before education and housekeeping observations	Percentage of environmental sites cleaned; environmental cultures	Contamination of surfaces with vancomycin-resistant enterococci (VRE) is a result of insufficient cleaning by personnel, rather than the product or procedure.	IIB
134	Armellino D, Dowling O, Newman SB, et al. Remote video auditing to verify OR cleaning: a quality improvement project. AORN J. 2018;108(6):634-642.	Organizational Experience	31 ORs in 2 hospitals, United States	n/a	n/a	n/a	Remote video auditing was economic efficient way to assess, improve and maintain optimal cleaning standards.	VA
135	Kak N, Burkhalter B, Cooper M. Measuring the Competence of Healthcare Providers. Operations Research Issue Paper 2(1). Bethesda, MD: US Agency for International Development (USAID), Quality Assurance (QA) Project; 2001.	Literature Review	n/a	n/a	n/a	n/a	Observation by trained or expert personnel, reports from patients who have been trained and a structured objective clinical examinations are all effective ways to measure competency.	VA
136	Matlow AG, Wray R, Richardson SE. Attitudes and beliefs, not just knowledge, influence the effectiveness of environmental cleaning by environmental service workers. Am J Infect Control. 2012;40(3):260-262.	Nonexperimental	Environmental service workers (ESW) from intensive care unit of pediatric hospital, Canada	n/a	n/a	Survey to assess perceptions and predictors of behavioral intentions	The beliefs and attitudes of ESWs about their job may affect their intent to clean and cleaning thoroughness. By understanding and addressing these beliefs and attitudes strategies can be developed to improve and sustain environmental cleaning efforts.	IIIC
137	Mitchell BG, White N, Farrington A, et al. Changes in knowledge and attitudes of hospital environmental services staff: the researching effective approaches to cleaning in hospitals (REACH) study. Am J Infect Control. 2018;46(9):980-985.	Nonexperimental	Environmental services staff members at 11 hospitals, Australia	n/a	Cleaning bundle comprised of 5 interdependent components	Knowledge, reported practice, attitudes, roles and perceived organizational support	Environmental service staff have a high level of knowledge regarding cleaning practices and also understand the importance of their roles.	IIIA

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138	Knelson LP, Ramadanovic GK, Chen LF, et al. Self-monitoring by environmental services may not accurately measure thoroughness of hospital room cleaning. Infect Control Hosp Epidemiol. 2017;38(11):1371-1373.	Nonexperimental	Patient room surfaces in 2 hospitals, United States	n/a	n/a	Fluorescent markers	Significant difference in reported clean surfaces between Environmental Services supervisor and study personnel. Use of independent observers is most objective approach for cleaning validation.	IIIA
139	Havill NL, Havill HL, Mangione E, Dumigan DG, Boyce JM. Cleanliness of portable medical equipment disinfected by nursing staff. Am J Infect Control. 2011;39(7):602-604.	Nonexperimental	Mobile equipment on medical and surgical wards of university hospital, United States	n/a	n/a	Adenosine triphosphate (ATP) bioluminescence assays; aerobic colony counts (ACCs)	Proper disinfection of equipment did not occur. Education, along with feedback when proper disinfection does not occur are vital for improving processes.	IIIB
140	Amodio E, Dino C. Use of ATP bioluminescence for assessing the cleanliness of hospital surfaces: a review of the published literature (1990–2012). J Infect Public Health. 2014;7(2):92-98.	Literature Review	n/a	n/a	n/a	n/a	ATP bioluminescence is quick and objective method to evaluate hospital cleanliness. However, poor standardization exists at national and international level.	VA
141	Saito Y, Yasuhara H, Murakoshi S, Komatsu T, Fukatsu K, Uetera Y. Time-dependent influence on assessment of contaminated environmental surfaces in operating rooms. Am J Infect Control. 2015;43(9):951-955.	Nonexperimental	Surfaces in 6 ORs of university hospital, Japan	n/a	n/a	Degree of contamination using ATP and microbial counts	ATP is an indicator of surface contamination, but not of viable microbes as the microbes decrease over time.	IIIB

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142	Ellis O, Godwin H, David M, Morse DJ, Humphries R, Uslan DZ. How to better monitor and clean irregular surfaces in operating rooms: insights gained by using both ATP luminescence and RODAC assays. Am J Infect Control. 2018;46(8):906-912.	Nonexperimental	5 high touch surfaces in operating rooms of large teaching hospital , United States	n/a	n/a	ATP, RODAC, and mass spectrometry for presence of viable organisms before and after room cleaning.	Irregular surfaces such as keyboards, door handles and overhead lights may need enhanced cleaning, covering and monitoring.	IIIB
143	Alfonso-Sanchez JL, Martinez IM, Martín-Moreno JM, González RS, Botía F. Analyzing the risk factors influencing surgical site infections: the site of environmental factors. Can J Surg. 2017;60(3):155-161.	Nonexperimental	18,910 patients from 8 similar size hospitals, Spain	n/a	n/a	SSIs and related risk factors	Superficial SSIs associated with environmental contamination; deep and organ/space SSIs associated with patient factors and surgery type.	IIIA
144	Gibbs SG, Sayles H, Colbert EM, Hewlett A, Chaika O, Smith PW. Evaluation of the relationship between the adenosine triphosphate (ATP) bioluminescence assay and the presence of Bacillus anthracis spores and vegetative cells. Int J Environ Res Public Health. 2014;11(6):5708-5719.	Nonexperimental	17 surfaces inoculated with three different concentrations of *B. anthracis*	n/a	n/a	CFU and ATP bioluminescence (RLU)	RLU/ATP is not a good indication of contamination by spore forming bacteria.	IIIB
145	Burian BK, Clebone A, Dismukes K, Ruskin KJ. More than a tick box: medical checklist development, design, and use. Anesth Analg. 2018;126(1):223-232.	Literature Review	n/a	n/a	n/a	n/a	A checklist should be designed for the specific setting and flow work in that area. There are five stages to follow when developing a checklist.	VA