REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
1	Benze C, Spruce L, Groah L. *Perioperative Nursing: Scope and Standards of Practice* . Denver, CO: AORN, Inc; 2021. Accessed February 7, 2024. https://aorn.org/docs/default-source/guidelines-resources/periop-nursing-scope-standards-of-practice.pdf	Consensus	n/a	n/a	n/a	n/a	Discussion of the scope and standards for perioperative nursing.	IVB
2	AORN Position Statement on Patient Safety. AORN, Inc. 2022. Accessed February 7, 2024. https://www.aorn.org/docs/default-source/guidelines-resources/position-statements/patient-workplace-safety/posstat-pt-safety-0303.pdf	Position Statement	n/a	n/a	n/a	n/a	Perioperative nursing position statement on cultivating a culture of safety.	IVB
3	Quintana D. *Surgical Conscience: A Concept Analysis for Perioperative Nurses* . AORN J. 2022;116(6):533-546.	Literature Review	n/a	n/a	n/a	n/a	Concept analysis for consensus of a definition and understanding of surgical conscience.	VA
4	Duff J, Bowen L, Gumuskaya O. What does surgical conscience mean to perioperative nurses: An interpretive description. *Collegian* . 2022;29(2):147-153.	Qualitative	15 Australian Perioperative RN interviews	n/a	n/a	Definition of surgical conscience	Surgical conscience is defined as 'the moral obligation to uphold and defend surgical asepsis and perioperative safety no matter the cost or consequence'. It is based on three constructs - consciousness (knowing), conscience (feeling), and agency (acting) and is moderated by contextual factors including education, training, mentorship, environment, culture, and support.	IIIB
5	Troughton R, Mariano V, Campbell A, Hettiaratchy S, Holmes A, Birgand G. Understanding determinants of infection control practices in surgery: the role of shared ownership and team hierarchy. *Antimicrobial Resistance & Infection Control* . 2019;8(1):116.	Qualitative	17 interviews of surgeons, nurses, OR personnel, and other health care professionals involved in surgery	n/a	n/a	Determinates of infection control practices	Infection control practices were linked to perceived patient risk of harm caused by SSIs (ie, sense of ownership) and is a team responsibility. Interventions for infection control may need to consider the social team structure and shared ownership to increase awareness and effectiveness.	IIIB
6	Guideline for team communication. In: *Guidelines for Perioperative Practice.* Denver, CO: AORN Inc, 2024:1085–1120.	Guideline	n/a	n/a	n/a	n/a	Recommendations for use of team communication in perioperative settings.	IVA
7	deKay K. Guideline for hand hygiene. In: Kyle E, ed. Guidelines for perioperative practice. eGL+ ed. Denver, CO: AORN, Inc; 2024.	Guideline	n/a	n/a	n/a	n/a	Recommendations for perioperative hand hygiene and surgical antisepsis.	IVA
8	Spruce L. Guideline for surgical attire. In: Wood A, ed. Guidelines for perioperative practice. eGL+ ed. Denver, CO: AORN, Inc.; 2024.	Guideline	n/a	n/a	n/a	n/a	Recommendations for surgical attire in perioperative settings.	IVA
9	Guideline for hand hygiene. In: *Guidelines for Perioperative Practice* . Denver, CO: AORN Inc, 2024:277–314.	Guideline	n/a	n/a	n/a	n/a	Recommendations for preventing transmission of infections in perioperative settings.	IVA

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10	Guideline for design and maintenance of the surgical suite. In: *Guidelines for Perioperative Practice.* Denver, CO: AORN, Inc; 2024:79–142.	Guideline	n/a	n/a	n/a	n/a	Recommendations for design and maintenance of the surgical suite.	IVA
11	Guideline for prevention of unplanned patient hypothermia. In: *Guidelines for Perioperative Practice* . Denver, CO: AORN Inc, 2024:339–364.	Guideline	n/a	n/a	n/a	n/a	Recommendations for preventing patient hypothermia in the perioperative setting.	IVA
12	Guideline for environmental cleaning. In: *Guidelines for Perioperative Practice.* Denver, CO: AORN, Inc; 2024:197–226.	Guideline	n/a	n/a	n/a	n/a	Recommendations for environmental cleaning in perioperative practice.	IVA
13	Guideline for medical device and product evaluation. In: *Guidelines for Perioperative Practice* . Denver, CO: AORN, Inc; 2024:755–764.	Guideline	n/a	n/a	n/a	n/a	Perioperative practice recommendations for medical device and product evaluation.	IVA
14	Berrios-Torres SI, Umscheid CA, Bratzler DW, et al. Guideline for Prevention of Surgical Site Infection. *JAMA Surg* . 2017;152(8):784–791.	Guideline	n/a	n/a	n/a	n/a	CDC recommendations to prevent SSIs.	IVA
15	29 CFR 1910.132: Personal Protective Equipment. 7-1-21 ed. U.S. Government Publishing Office; 2021	Regulatory	n/a	n/a	n/a	n/a	States the regulatory requirements for PPE.	n/a
16	29 CFR 1910.1030: Bloodborne pathogens. Occupational Health and Safety Administration (OSHA) Web site. https://www.govinfo.gov/app/details/CFR-2022-title29-vol6/CFR-2022-title29-vol6-sec1910-1030. Updated 2021.	Regulatory	n/a	n/a	n/a	n/a	OSHA bloodborne pathogen standards.	n/a
17	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.	Guideline	n/a	n/a	n/a	n/a	States that masks are used by personnel as protection from infectious material and during procedures requiring sterile technique. Recommends mask use when performing high-risk procedures in the spinal canal and glove changes after each patient	IVA
18	Vincent M, Edwards P; Cochrane Wounds Group. Disposable surgical face masks for preventing surgical wound infection in clean surgery. *Cochrane Database Syst Rev.* 2016;(4):CD002929.	Systematic Review	n/a	n/a	n/a	n/a	The authors concluded that the level of evidence was low with a high risk of bias and that there is no clear evidence that masks decreased the rate of SSI in clean surgeries.	IA

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19	Marson BA, Craxford S, Valdes AM, Ollivere BJ. Are facemasks a priority for all staff in theatre to prevent surgical site infections during shortages of supply? A systematic review and meta-analysis. *Surg.* 2021;19(5):e132-e139.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	The intent of this study is to understand the evidence for prioritizing face mask use in surgery during shortages. Therefore, applicability outside of contingency and shortage status is unclear. Researchers recommend the mandatory use of surgical masks when using implants and for all scrubbed personnel at the sterile field. However, the recommendation for all scrubbed personnel relies on weak evidence. During a shortage, there is insufficient evidence to require the use of masks by non-scrubbed personnel.	IIIA
20	Webster J, Croger S, Lister C, Doidge M, Terry MJ, Jones I. Use of face masks by non-scrubbed operating room staff: a randomized controlled trial. *ANZ J Surg* . 2010;80(3):169-173.	RCT	811 surgical patients	No Mask	Mask	SSI	SSIs were 11.5% for the masked group and 9.0% for the non mask group (non-scrubbed personnel only) the difference was not significant.	IA
21	Berger SA, Kramer M, Nagar H, Finkelstein A, Frimmerman A, Miller HI. Effect of surgical mask position on bacterial contamination of the operative field. *J Hosp Infect.* 1993;23(1):51-54.	RCT	30 cardiac catheterization procedures	No mask use and mask use but placement below the level of the nose	Standard mask use over the mouth and nose	Bacterial contamination of settle plates	The settle plates had heavy growth associated with no mask usage. The results showed that a significantly higher number of bacteria were found when no mask was worn versus wearing a full mask. The study had small sample size and may be limited by a potential for a type 2 error.	IB
22	Orr NW. Is a mask necessary in the operating theatre? *Ann R Coll Surg Engl.* 1981;63(6):390-392	Nonexperimental	None reported.	No mask worn in 1 OR over a 6th month period.	n/a	SSI	SSI rates did not increase. When compared over a five year period there was a significant decrease in infection rates.	IIIC
23	29 CFR 1910.134: Respiratory protection. 7-1-21 ed. U.S. Government Publishing Office; 2021	Regulatory	n/a	n/a	n/a	n/a	Respiratory protection regulations in the OSHA standard.	n/a
24	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	States that respirators should not be used in the presence of the sterile field.	IVA
25	Implementing Respiratory Protection Programs in Hospitals: A Guide for Respirator Program Administrators. Occupational Health Branch: California Department of Public Health; 2015. https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/CDPH%20Document%20Library/HCResp-CARPPGuide.pdf http://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/RespSource.html	Expert Opinion	n/a	n/a	n/a	n/a	Program guide. States that there is insufficient evidence to support the use of PAPRs in the presence of the sterile field.	VA
26	Hospital Respiratory Protection Program Toolkit. Resources for Respirator Program Administrators . Occupational Safety and Health Administration; Department of Health and Human Services (NIOSH); 2015	Expert Opinion	n/a	n/a	n/a	n/a	States that there is insufficient evidence to support the safe use of PAPRs in the surgical environment.	VA

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27	Institute of Medicine (US) Committee on Quality of Health Care in America. The Use and Effectiveness of Powered Air Purifying Respirators in Health Care: Workshop Summary. The National Academies Press; 2015	Expert Opinion	n/a	n/a	n/a	n/a	Review of background information on PAPRs. current standards, limitations (ie, use of PAPRs in the presence of the sterile field), prospective design changes, and proposed priorities for increasing the use of PAPRs in health care.	VB
28	Howard RA, Lathrop GW, Powell N. Sterile field contamination from powered air-purifying respirators (PAPRs) versus contamination from surgical masks. *Am J Infect Control.* 2020;48(2):153-156.	Quasi-experimental	4 participants tested each of the devices separately for 10 minutes	Two PAPRs (one loose fitting hood and second one tight-fitting) and a surgical mask	No mask	Air contamination of CFUs	The surgical mask, and two PAPR devices each significantly reduced CFUs compared to the no mask group. PAPRs are as effective as surgical masks at reducing air contamination and protecting the sterile field.	IIA
29	Myers W, Ajewole S, Xu S, Yorio P, Hornbeck A, Zhuang Z. Laboratory assessment of bacterial contamination of a sterile environment when using respirators not traditionally used in a sterile field environment. *Infect Control Hosp Epidemiol.* 2022;43(12):1867-1872.	Quasi-experimental	18 participants in teams of 2	Five different types of NIOSH-approved respirators including 2 PAPRs, an N95 with and without an exhalation value, and a elastomeric half mask.	Surgical Mask	Air contamination of CFUs	Distance and respirator type affected air contamination. Respirators without exhalation values performed as well as surgical masks. Use of devices with exhalation valves (ie, N95s and elastomeric half mask) resulted in higher rates of air contamination. Greater distances resulted in less contamination.	IIB
30	Guidance on Personal Protective Equipment (PPE) To Be Used By Healthcare Workers during Management of Patients with Confirmed Ebola or Persons under Investigation (PUIs) for Ebola who are Clinically Unstable or Have Bleeding, Vomiting, or Diarrhea in U.S. Hospitals, Including Procedures for Donning and Doffing PPE. https://www.cdc.gov/vhf/ebola/healthcare-us/ppe/guidance.html. Updated 2015. Accessed 2/27, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	CDC guidance of protection of health care personnel caring for patients with confirmed or suspected Ebola. States that the PAPR belt-mounted blower is worn on the outside of the gown.	VA
31	Ng I, Lee K, Kave B, et al. HALO CleanSpace PAPR evaluation: Communication, respiratory protection, and usability. *Infect Control Hosp Epidemiol.* 2023;44(2):295-301.	Nonexperimental	8 participants in 3 part test	Modified Rhyme Test, word and phrase comprehension, use of HALO while on, use of Halso and headset, Quantitative Fit Test (bending, jogging, moving head), Simulated Workplace Protection factor, Usability and comfort	No HALO use	Communication performance, respiratory protection provided, and usability and comfort	The device meets minimum standards for speech intelligibility, it provides consistent and adequate levels of respiratory protection, and it rated favorably for comfort and usability.	IIIC
32	42 CFR 84: Approval Tests and Standards for Air-Purifying Particulate Respirators. Federal Register Web site. https://www.federalregister.gov/documents/2020/04/14/2020-07804/approval-tests-and-standards-for-air-purifying-particulate-respirators. Updated 2021	Expert Opinion	n/a	n/a	n/a	n/a	New PAPR standards and testing criteria have been added to help meet the needs of health care personnel.	VA

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33	Jain S, Rajfer RA, Melton-Kreft R, et al. Evaluation of bacterial presence on lead X-ray aprons utilised in the operating room via IBIS and standard culture methods. *J Infect Prev* . 2019;20(4):191-196.	Quasi-experimental	20 lead aprons swabbed at three time points (pre disinfection, post disinfection, 6 hours after disinfection and storage on a draped table in a closed OR) in three separate areas of the gown	Hospital grade disinfectant wipe	Six sterile scrub gowns swabbed as a control	Microbial contamination, mass spectrometry results (IBIS), and fluorescence in site hybridization (FISH)	All lead aprons were contaminated when examined with IBIS. The contamination was mostly Staphylococcus epidermidis and Propionibacterium acnes. However, MRSE, Neisseria meningitidis, and Pseudomonas species. After treatment bacterial contamination was significantly reduced especially when traditional culturing methods were used but IBIS still showed contamination of 13/20 lead gowns. There was some regrowth at the 6-hour mark with most being S. epidermidis and P. acnes. No MRSE was found after disinfection or at 6 hours. Disinfecting gowns before use is recommended to decrease bacterial load.	IIB
34	Gilat R, Mitchnik I, Beit Ner E, et al. Bacterial contamination of protective lead garments in an operating room setting. *J Infect Prev.* 2020;21(6):234-240.	Nonexperimental	Swabs from 20 lead aprons and 21 thyroid shields (Interior and Exterior)	n/a	n/a	Microbial contamination	87.8% of protective lead garments (aprons and thyroid shields) were contaminated. Thyroid shields were more contaminated than aprons and had significantly higher levels of *Staphylococcus epidermidis* . Recommended targeting interventions to reduce bacterial load and exposure to the sterile field including use of sterile surgical helmet systems when close to the sterile field.	IIIB
35	Ang L, Almasoud A, Palakodeti S, Mahmud E. Bacterial Contamination of Lead Aprons in a High-Volume Cardiac Catheterization Laboratory and Disinfection Using an Automated Ultraviolet-C Radiation System. *J Invasive Cardiol.* 2018;30(11):416-420.	Nonexperimental	10 routinely used lead aprons with standards and bacteria-resistant fabric that had not been sanitized in at least 12 months	UV-C Light Treatment in for a 15 minute decontamination cycle	n/a	Microbial Cultures	62.5% of lead aprons were contaminated. Thyroid shields were the most contaminated. Exposure to UV-C in an automated system reduced subsequent growth.	IIIB
36	McAleese T, Broderick JM, Stanley E, Curran R. Thyroid radiation shields: A potential source of intraoperative infection. *J Orthop.* 2020;22:300-303.	Nonexperimental	Samples from 29 thyroid shields used by multiple personnel from three teaching hospitals	Cleaning with a disinfectant and repeated microbial sampling after 5 minutes	n/a	Microbial contamination	All the thyroid shields were contaminated before use and many of the identified bacteria were commonly associated with SSIs . After cleanings the contamination was significantly reduced. Recommended education of personnel and reinforcement of policies related to disinfection these devices.	IIIB
37	Guideline for radiation safety. In: *Guidelines for Perioperative Practice.* Denver, CO: AORN, Inc; 2024:765–796.	Guideline	n/a	n/a	n/a	n/a	Recommendations for radiation safety in perioperative settings.	IVA
38	TIR11: Selection and use of protective apparel and surgical drapes in health care facilities. Vol TIR11. Association for the Advancement of Medical Instrumentation; 2015.	Expert Opinion	n/a	n/a	n/a	n/a	Provides guidance for the selection and use of protective apparel including surgical gowns and drapes.	VC

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39	Guideline for medication safety. In: *Guidelines for Perioperative Practice.* Denver, CO: AORN, Inc; 2024:477–530.	Guideline	n/a	n/a	n/a	n/a	Perioperative practice recommendations for medication safety.	IVA
40	21 CFR 878.4040: Surgical apparel. Code of Federal Regulations. Accessed February 27, 2024. https://www.ecfr.gov/current/title-21/chapter-I/subchapter-H/part-878/subpart-E/section-878.4040	Regulatory	n/a	n/a	n/a	n/a	Code of federal regulations language on surgical apparel.	n/a
41	McQuerry M, Easter E, Cao A. Disposable versus reusable medical gowns: A performance comparison. *Am J Infect Control.* 2021;49(5):563-570.	Quasi-experimental	At least 5 gowns of each type (surgical and isolation) and AAMI levels 1, 2, and 3.	Reusable gowns	Disposable gowns	Ability of the gowns to provide adequate protection, durability and comfort based on standardized test methods	Reusable gowns provide superior protection and performance except in comfort to the wearer. Some disposable gowns are not meeting AAMI PB70 performance requirements. Level 4 gowns were not included in the study. The study was funded by a university grant.	IIB
42	Infection Control Devices Branch, Division of General and Restorative Devices. Guidance on Premarket Notification [510(k)] Submissions for Surgical Gowns and Surgical Drapes. US Food and Drug Administration. 1993. Accessed February 7, 2024. https://www.fda.gov/media/72369/download	Regulatory	n/a	n/a	n/a	n/a	501(k) clearance and premarket notification document for surgical gowns and drapes.	n/a
43	AAMI PB70: 2022. liquid barrier performance and classification of protective apparel and drapes intended for use in health care facilities . Arlington, VA: Association for the Advancement of Medical Instrumentation; 2022:49.	Consensus	n/a	n/a	n/a	n/a	Establishes a system of classification for protective apparel used in health care facilities based on their liquid barrier performance to ultimately assist end-users in determining the type(s) of protective product most appropriate for a particular task or situation.	IVC
44	ASTM F2407/ F2407-22: Standard Specification for Surgical Gowns Intended for Use in Healthcare Facilities. American Society for Testing and Materials (ASTM); 2022.	Consensus	n/a	n/a	n/a	n/a	Describes the requirements for the performance, documentation and labeling of medical gowns used in healthcare facilities. Four level barrier properties for these gowns are included in the ANSI / AAMI PB70 standard. The ANSI / AAMI PB70 standard evaluates the barrier properties of medical gowns using only Level 1, 2 and 3 water. When these gowns are exposed to blood and other fluids of different surface tensions, the performance of additional tests, Level 4 gown requires barrier levels against simulated biological	n/a
45	Considerations for Selecting Protective Clothing used in Healthcare for Protection against Microorganisms in in Blood and Body Fluids. Centers for Disease Control and Prevention (CDC) Web site. https://www.cdc.gov/niosh/npptl/topics/protectiveclothing/default.html. Updated 2020	Expert Opinion	n/a	n/a	n/a	n/a	CDC NIOSH NPPTL information on selecting protective clothing.	VA

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46	Kahveci Z, Selcen Kilinc-Balci F, Yorio PL. Critical investigation of glove–gown interface barrier performance in simulated surgical settings. *J Occup Environ Hyg.* 2019;16(7):498-506.	Quasi-experimental	10 experiments with each of the three gowns and each of the 6 glove configurations, with two configurations of double gloving (n=180)	1 hour of spraying, soaking, and pressure on the gown and glove configurations	3 types of commonly used surgical gowns and 4 types of surgical gloves	Fluid leakage at the glove-gown interface	Double gloving significantly reduces fluid leakage at the glove-gown interface. The type of gown and glove configuration used can significantly impact the potential for fluid leakage at the glove-gown interface.	IIA
47	Noguchi C, Koseki H, Horiuchi H, et al. Factors contributing to airborne particle dispersal in the operating room. *BMC Surg.* 2017;17:1-6. doi:10.1186/s12893-017-0275-1.	Nonexperimental	Preparing the instrument table, gowning, removing gloves, and draping a knee were each performed five times	n/a	n/a	particle counts	Donning gowns and removing gloves were correlated to high particle dispersal rates. The researchers concluded that donning sterile gowns and removing sterile gloves should be completed away from the sterile field.	IIIB
48	Holst DC, Angerame MR, Dennis DA, Jennings JM. Does the Method of Sterile Glove-Opening Influence Back Table Contamination? A Fluorescent Particle Study. *J Arthroplasty* . 2019;34(9):2075-2079.	Quasi-experimental	20 pains of sterile gloves	10 pairs of sterile glove packages covered with fluorescent powder opened directly to the sterile field	10 pairs of sterile glove packages covered with fluorescent powder opened and directly handed off to a scrubbed person	Rates of fluorescent powder contamination to the sterile field and gloves of the scrubbed person	Levels of contamination were higher in the group where the gloves were opened directly onto the sterile field. Opening the gloves and handing them to a scrubbed person did not result in significant contamination to the gloves the scrubbed person was wearing.	IIB
49	Heal JS, Blom AW, Titcomb D, Taylor A, Bowker K, Hardy JR. Bacterial contamination of surgical gloves by water droplets spilt after scrubbing. *J Hosp Infect* . 2003;53(2):136-139.	Nonexperimental	2 stages. Stage 1 looked at the bacterial content of water droplets from the upper limbs of 15 surgeons who had scrubbed. Stage 2 reviewed the paper glove wrapper (of 2 types) for permeability to	n/a	n/a	Bacterial contamination	Overall, 6 of the 15 scrubbed surgeons grew bacteria. The paper trials showed that after 2 minutes of being wet, gram-positive organisms can strike through the paper glove wrappers. The researchers concluded that impermeable glove wrapper should be used and that the gloves should not be opened on the gown.	IIIC
50	Panas K, Wojcik J, Falcon S, Hollabaugh K, Hickerson LE. Surgical Gowning Technique: Are We Contaminated Before We Cut? *J Orthop Trauma.* 2019;33(2):59-63.	Nonexperimental	27 assisted gowning events with scrub persons and physicians of different heights	n/a	n/a	Number and amount of simulated gown contamination from florescent powder	Most (66.7%) surgeon gown sleeves were contaminated after assisted gowning. The researchers recommended single person gowning and strict monitoring of assisted gowning when used.	IIIB

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51	Bible JE, Biswas D, Whang PG, Simpson AK, Grauer JN. Which regions of the operating gown should be considered most sterile? *CLIN ORTHOP RELATED RES* . 2009;467(3):825-830.	Quasi-experimental	100 sterile gowns	Cultures taken in 6" increments down the front of 50 sterile disposable sterile gowns. Also cultured both elbow crease from two inches below to two inches above the elbow.	Assessed another 50 sterile gowns as negative controls. The negative control samples were obtained after donning but prior to entering the sterile field area.	Bacterial contamination	All 50 of the intervention gowns were positive for bacterial contamination. Overall bacterial contamination was most prevalent above the chest and below the level of the sterile table.	IIC
52	Kilinc-Balci S, Kahveci Z, Yorio PL. Novel Test Method for the Evaluation of Fluid Leakage at the Glove-Gown Interface and Investigation of Test Parameters. *J Am Coll Surg.* 2018;227(6).	Quasi-experimental	4 movement cycles with the spray, soak or pressure applied at the beginning of the cycle	Gown wearing for 15, 30, 0r 60 minutes and exposure of spray, soak, or pressure for 2, 5, or 10 seconds using all movement cycles (n=150).	Exposure or pressure without applied arm movements	Fluid penetration	This article reviewed a new test method for quantifying liquid penetration of glove-gown interface from spraying, soaking, and applied pressure. The degree of movement, exposure type, exposure duration, pressure all highly influenced the amount of fluid penetration at the glove-gown interface. The procedure duration did not influence fluid penetration.	IIB
53	Klaber I, Ruiz P, Schweitzer D, Lira MJ, Botello E, Wozniak A. Contamination rate of the surgical gowns during total hip arthroplasty. *Arch Orthop Trauma Surg* . 2019;139(7):1015-1019.	Nonexperimental	133 surgical gowns from 69 orthopedic procedures	n/a	n/a	Surgical gown contamination, length of procedural duration, and surgeon experience level	12% of surgical gowns from all gowns tested were found to be contaminated after the dressing was placed. Spine and knee procedures had more contaminated gowns than arthroplasty procedures. Hip arthroplasty procedures lasting less than two hours did not have gown contamination. Six gowns swabbed after setting up the sterile field (ie, draping) as controls were found to be contaminated.	IIIB
54	Jones C, Brooker B, Genon M. Comparison of open and closed staff-assisted glove donning on the nature of surgical glove cuff contamination. *ANZ J Surg.* 2010;80(3):174-177.	RCT	Two surgeons were gloved 20 times after their fingers and hands were covered with an ultraviolet powder.	Closed-assisted gloving	Open-assisted gloving	Ultraviolet powder contamination	When open-assisted gloving was used there was significantly more ultraviolet contamination of the glove cuff area than when closed-assisted gloving was used.	IB
55	Mischke C, Verbeek Jos H, Saarto A, Lavoie M, Pahwa M, Ijaz S. Gloves, extra gloves or special types of gloves for preventing percutaneous exposure injuries in healthcare personnel. *Cochrane Database of Systematic Reviews.* 2014(3).	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Double gloving significantly reduces the risk of glove perforations and is a recommended practice. Indicator systems reduce the number of perforations per glove.	IA
56	Zhang Z, Gao X, Ruan X, Zheng B. Effectiveness of double-gloving method on prevention of surgical glove perforations and blood contamination: A systematic review and meta-analysis. *J Adv Nurs.* 2021;77(9):3630-3643.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Use of double gloves was associated with reduce rates of glove perforation compared to use of single-gloves.	IA

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57	Jahangiri M, Choobineh A, Malakoutikhah M, Hassanipour S, Zare A. The global incidence and associated factors of surgical gloves perforation: A systematic review and meta-analysis. *Work.* 2022;71(4):859-869.	Systematic Review w/ Meta-Analysis	109 articles with 130 datasets	n/a	n/a	n/a	Incidence of glove perforation was 14.44% with surgeons as the most likely to experience a perforation. Increases in surgical duration increased the odds of perforation. Most (68.58%) of glove perforations were not identified.	IIIC
58	Karakus O, Sari AS. At what point during total knee arthroplasty operations are gloves most frequently torn? *J ORTHOP SURG.* 2020;28(3):2309499020959167.	Nonexperimental	Gloves from 300 total knee arthroplasty procedures by 10 surgeons. Number of gloves not reported.	n/a	n/a	Glove perforations	The rate of glove tears was 37.6%. Inner glove tears were only identified in 4 procedures (1.3%).Most glove tears occurred at the stage of trial component reduction or placement of the prosthesis. Recommendations included double gloving and consideration of glove changes during the two identified times when tears may be more likely to occur.	IIIA
59	Anand S, Pogorelić Z, Singh A, et al. Comparison of Unnoticed Glove Perforations during Minimally Invasive versus Open Surgeries: A Systematic Review and Meta-Analysis. *Children.* 2022;9(2):179.	Systematic Review w/ Meta-	4 comparative studies	n/a	n/a	n/a	The incidence of macroscopic glove perforations was the same in MIS and open surgery. However, open surgery was associated with significantly higher numbers of microscopic glove perforations.	IIIA
60	Osodin TE, Akadiri OA, Akinmoladun VI. Evaluation of Surgical Glove Perforation and Sharps Injury in Oral and Maxillofacial Surgery. *J West Afr Coll Surg.* 2022;12(4):1-5.	Nonexperimental	895 gloves from oral and maxillofacial procedures (564 = wired, 331 = nonwired).	n/a	n/a	Glove perforations	Glove perforations were 13.1%. Double gloving was recommended due to risk of sharps injury but may increase the risk of glove perforation. Surgical duration equal to or more than 61 minutes increased the risk of perforation.	IIIB
61	International Safety Center. Moving the Sharps Safety in Healthcare Agenda Forward in the United States: 2020 Consensus Statement and Call to Action. American College of Surgeons. Accessed February 27, 2024. https://internationalsafetycenter.org/wp-content/uploads/2020/12/Moving_The_Sharps_Safety_In_Healthcare_Agenda_Forward_In_The_US.pdf	Position Statement	n/a	n/a	n/a	n/a	Recommends use of double gloving but states that surgeons may opt not to use this safety measure in specific situations.	IVB
62	Information Statement: Preventing the Transmission of Bloodborne Pathogens. American Academy of Orthopaedic Surgeons. Reviewed June 2012. Accessed February 27, 2024. https://www.aaos.org/about/bylaws-policies/statements--resolutions/information-statements/#:~:text=AAOS%20Information%20Statements%20are%20statements,and%20reach%20their%20own%20conclusions	Position Statement	n/a	n/a	n/a	n/a	Recommends the use of double gloving.	IVB
63	Tanner J, Parkinson H. Double gloving to reduce surgical cross-infection. *Cochrane Database Syst Rev.* 2009;3:CD003087. doi:10.1002/14651858.CD003087.pub2.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	There is no evidence that use of double gloves reduces SSIs but use of double gloves reduces perforations of the inner gloves and perforation indicator systems increase the detection of glove perforations.	IA

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64	Meakin LB, Gilman OP, Parsons KJ, Burton NJ, Langley-Hobbs SJ. Colored Indicator Undergloves Increase the Detection of Glove Perforations by Surgeons During Small Animal Orthopedic Surgery: A Randomized Controlled Trial. *Vet Surg.* 2016;45(6):709-714.	RCT	574 double pairs of gloves from 300 orthopedic procedures (n=2,296 gloves)	type of inner glove (standard or colored indicator)	inner indicator gloves	Glove perforation and glove perforation detection	Glove perforations were identified in 43% of procedures with a mean of 2.3 holes per procedure. When the outer glove was perforated the inner glove was intact 63% of the time. Perforated glove detection was improved in indicator gloves over standard gloves.	IB
65	Lee SY. What Role Does a Colored Under Glove Have in Detecting Glove Perforation in Foot and Ankle Procedures? *Clin Orthop Relat Res.* 2022;480(12):2327-2334.	RCT	Double gloves used in 476 foot and ankle procedures.	Use of a perforation indicator system	Use of two standard color surgical gloves	Glove perforation rates, factors associated with glove perforation, and perforation detection when indicator systems are used	Glove perforation rate was 19%, the inner glove was perforated in 4% of procedures. Use of a perforation indicator system increased the detection of glove perforations. Glove perforation rates increased as tourniquet time increased.	IA
66	Edlich R, Wind TC, Heather CL, Thacker JG. An Update on the Innovative Surgical Double-Glove Hole Puncture Indication Systems: Reliability and Performance. *JLT.* 2018;27(2-4):339-353.	Nonexperimental	Two different color perforation indicator systems and 5 types of surgical needles (total N not reported)	n/a	n/a	Glove perforations	Glove perforations were identified within 2 mines in both indicator systems for all types of needles.	IIIC
67	Sayin S, Yilmaz E, Baydur H. Rate of Glove Perforation in Open Abdominal Surgery and the Associated Risk Factors. *Surg Infect (Larchmt)* . 2019;20(4):286-291.	Nonexperimental	280 pairs of gloves from 70 consecutive open abdominal procedures	n/a	n/a	glove perforation rate	The glove perforation rate was 10.7% and occurred in 54.3% of procedures. Most (78%) of perforations was undetected. Procedural durations longer than 61 minutes increased the risk of perforation over 12 times.	IIIB
68	Global Guidelines for the Prevention of Surgical Site Infection. 2nd ed. WHO Press, World Health Organization; 2018.	Guideline	n/a	n/a	n/a	n/a	Makes recommendations on surgical hand asepsis, drapes, plastic incise drapes, wound protectors, surgical gloves, and laminar air flow.	IVA
69	Han CD, Kim J, Moon SH, Lee BH, Kwon HM, Park KK. A Randomized Prospective Study of Glove Perforation in Orthopaedic Surgery: Is a Thick Glove More Effective? *J Arthroplasty.* 2013;28(10):1878-1881.	Nonexperimental	1170 gloves taken from 70 total knee arthroplasties and 40 tactile sensitivity tests	n/a	n/a	Glove perforations and tactile sensitivity	Researchers found that thick outer latex gloves reduced tactile sensitivity but were not correlated with greater protection from perforation than conventional outer gloves. The surgeon was more likely to have perforation in the outer glove than any other scrubbed team member.	IIIA
70	Guideline for a safe environment of care. In: Guidelines for Perioperative Practice. Denver, CO: AORN Inc, 2024:165–196.	Guideline	n/a	n/a	n/a	n/a	Provides recommendations for working safely in the perioperative environment.	IVA
71	Guideline for sharps safety. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2024:893–914.	Guideline	n/a	n/a	n/a	n/a	Provides recommendations for sharps safety in the perioperative environment.	IVA

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72	Fraser JF, Young SW, Valentine KA, Probst NE, Spangehl MJ. The Gown-glove Interface Is a Source of Contamination: A Comparative Study. *Clin Orthop Relat Res* . 2015;473(7):2291-2297 .	Nonexperimental	5 gown types (some toga and some gown/hood combinations)	n/a	n/a	Ultraviolet powder contamination at the gown-glove interface as read by Likert scale from 0-4.	All 5 types of gowns had contamination at the gown-glove interface, one toga style surgical helmet system had more than other types. This interface site is an area of concern for contamination.	IIIB
73	Edlich RF, Wind TC, Hill LG, Thacker JG. Creating another barrier to the transmission of bloodborne operative infections with a new glove gauntlet. *J Long Term Eff Med Implants* . 2003;13(2):97-101.	Nonexperimental	Eight volunteers donned one of the three types of disposable surgical gowns then randomly donned either a narrow or normal sized glove gauntlet.	n/a	n/a	Force necessary to separate the glove gauntlet from the gown cuff.	Glove-gown interface is weakest part of the barrier protection and can be permeable to water. All the glove cuffs of all the gown types were permeable to water and could allow for exposure to potentially infectious materials. The narrow glove gauntlet increased the security of the cuff by almost 2 fold no matter which gown was worn.	IIIB
74	Wistrand C, Söderquist B, Falk-Brynhildsen K, Nilsson U. Exploring bacterial growth and recolonization after preoperative hand disinfection and surgery between operating room nurses and non-health care workers: a pilot study. *BMC infectious diseases.* 2018;18(1):466.	Quasi-experimental	25 participants	Bacterial cultures of glove-gown interface and 3 hand locations of 12 OR RNs	Bacterial cultures of glove-gown interface and 3 hand locations of 13 non-health care personnel	Bacterial growth and recolonization	OR RNs had significantly higher bacterial growth than non-health care personnel at two of three culture sites and OR RNs. Five of the 12 OR RNs had bacterial recolonization at the end of the glove cuff after use.	IIB
75	Byrd WA, Kavolus JJ, Penrose CT, Wellman SS. Donning Gloves Before Surgical Gown Eliminates Sleeve Contamination. *J Arthroplasty.* 2019;34(6):1184-1188.	Quasi-experimental	37 orthopedic surgeons and residents completed both the intervention and control groups (n= 74 gown and gloving events)	A single pair of sterile gloves donned first before the sterile gown	Open and closed assisted gloving techniques	Gown contamination (but not the knit cuff)	All methods where the gown was donned first resulted in some level of contamination. Conversely, the glove-first method of gown and glove donning did not result in contamination. Knit cuff contamination was excluded from all groups.	IIB
76	Sundet A, Nelms NJ, Michelson JD. Donning Gloves Before Surgical Gown Cross-contaminates the Assistant. *Arthroplast Today.* 2022;17:142-144. doi:10.1016/j.artd.2022.08.009.	Nonexperimental	40 surgical technologists and nurses	n/a	n/a	The gloves-first technique resulted in increased contamination of the surgical assistant's gloves (P ¼ .002). There was no difference in contamination of the surgical gown (P ¼.982).	Although the staff-assisted open-gloving technique may improve the sterility of the sur geon, it does so at the expense of the surgical assistant. Surgeons adopting this technique should	IIIA
77	Lakomkin N, Cruz AI,Jr, Fabricant PD, Georgiadis AG, Lawrence JTR. Glove Perforation in Orthopaedics: Probability of Tearing Gloves During High-Risk Events in Trauma Surgery. *J Orthop Trauma.* 2018;32(9):474-479.	Nonexperimental	4 investigators using 6 high-risk orthopedic maneuvers	n/a	n/a	Glove perforations	consider donning their own undergloves or having the assistant rescrub before any further contact with	IIIB

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78	Kim K, Zhu M, Munro JT, Young SW. Glove change to reduce the risk of surgical site infection or prosthetic joint infection in arthroplasty surgeries: a systematic review. *ANZ J Surg.* 2019;89(9):1009-1015.	Systematic Review	n/a	n/a	n/a	n/a	the sterile environment	IIB
79	Partecke LI, Goerdt AM, Langner I, et al. Incidence of microperforation for surgical gloves depends on duration of wear. *Infect Control Hosp Epidemiol.* 2009;30(5):409-414.	RCT	898 pairs of used surgical gloves	Use of surgical gloves	Compared against length of time until perforation, role of the team member with the perforation, and different hands and digits that became perforated	micro perforations	Gloves that were worn for 90 minutes or less had the least amount of perforations. Perforations increased with time worn. No difference was found in the rate of perforations for the role of the scrubbed person. Most perforations were on the left hand and mostly the left index finger. Recommends changing gloves after 90 minutes of surgery.	IA
80	Harnoß JC, Partecke LI, Heidecke CD, Hübner NO, Kramer A, Assadian O. Concentration of bacteria passing through puncture holes in surgical gloves. *Am J Infect Control.* 2010;38(2):154-158.	Quasi-experimental	128 outer gloves and 122 inner gloves from 20 septic laparotomies.	Intraoperative swab of the outer glove	Bacterial contamination from the inner glove	Bacterial contamination and glove perforations	The average perforation rate of the outer glove was 15%. 82% of perforations were unnoticed by the perioperative team. Most (86%) of perforations occurred in the non-dominant hand with the index finger being the most likely place of perforation at 36%. Bacterial contamination of the outer glove from the inner glove was 4.7%.	IIA
81	Hübner NO, Goerdt AM, Stanislawski N, et al. Bacterial migration through punctured surgical gloves under real surgical conditions. *BMC Infect Dis* . 2010;10:192.	Nonexperimental	194 gloves consisting of 98 outer and 96 inner gloves were collected from 20 consecutive elective and emergency laparotomy procedures	n/a	n/a	Bacterial contamination and glove perforations	During an average of 100 minutes of wear, the outer glove perforation rate was 10%. Most perforations occurred in the non-dominant hand with the index finger being the most likely area of perforation at 25%. Six of the procedures had bacterial contamination intraoperatively on the outer glove that was linked to bacterial contamination of the inner glove. For perforated gloves the calculated bacterial migration from inner to outer glove was 50%	IIIB
82	Kojima Y, Ohashi M. Unnoticed glove perforation during thoracoscopic and open thoracic surgery. *Ann Thorac Surg.* 2005;80(3):1078-1080.	Quasi-experimental	47 thoracic procedures including 24 horoscopic and 23 open procedures	Gloves used during the procedures by a single surgeon	23 unused sterile gloves	Rate of unnoticed glove perforations	The glove and procedure perforation rates were significantly lower in thorascopic procedures (25%) than open procedures (70%). There was no difference in perforation rate between gloves worn on any specific hand. When gloves were worn for more than 2 hours during thorascopic procedures there was a significantly higher perforation rate.	IIB

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83	de Oliveira AC, Gama CS. Evaluation of surgical glove integrity during surgery in a Brazilian teaching hospital. *Am J Infect Control.* 2014;42(10):1093-1096.	Nonexperimental	1090 gloves from 100 procedures including gastroenterology, cardiovascular, and pediatrics.	n/a	n/a	Glove perforations	Surgeries over 150 minutes were significantly associated with perforations. Double-gloving with a perforator indicator system is crucial.	IIIB
84	Biswas D, Bible JE, Whang PG, Simpson AK, Grauer JN. Sterility of C-arm fluoroscopy during spinal surgery. *Spine* (Phila Pa 1976). 2008;33(17):1913-1917. doi:10.1097/BRS.0b013e31817bb130 [IIB].	Quasi-experimental	25 spinal procedures with a regular size fluoroscopy machine performed by 2 spine surgeons.	25 c-arm machine drapes were swabbed in 5 locations after being used during a procedure.	25 c-arm drapes were cultured immediately after draping as a positive control group and the c-arm console was also swabbed as a negative control (n=25)	Bacterial contamination	100% of the intervention drapes used were contaminated. The upper portion of the c-arm drape is highly contaminated. The researchers concluded that the top of the c-arm drape should not be considered sterile.	IIB
85	Peters, Paul G. Laughlin, Richard T. Markert, Ronald J. Nelles, David B. Randall, Kyle L. Prayson,Michael J. Timing of C-arm drape contamination. *Surg Infect (Larchmt)* . 2012;13(2):110-113. doi:10.1089/sur.2011.054.	Nonexperimental	30 consecutive fracture fixation procedures using full size c-arm	n/a	n/a	Contamination of the c-arm cover, time to contamination, number of personnel and door openings.	In five cases the c-arm was not contaminated and in 5 cases the c-arm was contaminated from the start. The contamination rates were as follows 17% at draping, 50% at 20 min, 57% at 40 min, 80% at 80 minutes. The lateral movement of the c-arm was significantly positively correlated to time to contamination. The researchers suggest limiting contact with the c-arm	IIIB
86	Momenzadeh K, Williams C, Czerwonka N, Kwon JY, Nazarian A, Miller CP. Contamination of the Mini C-Arm During Foot and Ankle Surgery. *Foot Ankle Int.* 2021;42(8):994-1001. doi: 10.1177/10711007211001032.	Nonexperimental	50 foot and ankle procedures using a mini c-arm	n/a	n/a	Mini c-arm drape contamination	Most of the drapes (70%) had at least one area of contamination. Of the 8 locations sampled for contamination locations 1, 2, & 8 were the most likely to be contaminated. These areas correspond to locations where the surgeon touches the machine to manipulate it. Glove changes recommended.	IIIB
87	Gershkovich GE, Tiedeken NC, Hampton D, Budacki R, Samuel SPDE, Saing M. A Comparison of Three C-Arm Draping Techniques to Minimize Contamination of the Surgical Field. *J Orthop Trauma.* 2016;30(10):e351-e356. doi:10.1097/BOT.0000000000000619.	Nonexperimental	Three different c-arm draping methods were used in 5 simulations.	n/a	n/a	Drape contamination taken as an average in distance	The traditional three-quarter sheet draping method was contaminated at a level that was within the area of the sterile field when the c-arm was brought into a lateral position. Additionally, the traditional three quarter method of c-arm draping caused the "surgeon's" gown and gloves to be contaminated when the other two methods did not	IIIB

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88	Romano DM, Hautala GS, Abbenhaus EJ, et al. Comparison of 3 C-Arm Draping Techniques to Prevent Far Side Contamination. *J Orthop Trauma.* 2021;35(5):276-279.	Quasi-experimental	Draped c-arm moved into the sterile field 15 times.	Two interventions: 1) a commercially available 'close-fitting' c-arm drape (Medline) and 2) standard c-arm drape combined with a split drape stapled to the sterile field and around the C-arm	Standard C-arm Drape	Sterile field contamination on the side of the image intensifier in lateral position from fluorescent powder	The C-arm draping utilizing the split drape had the least sterile field contamination. Contamination of the drape on the side of the x-ray tube (ie, surgeon's side) was not tested a commercial drape was used on that side of the OR bed.	IIB
89	Singh VK, Hussain S, Javed S, Singh I, Mulla R, Kalairajah Y. Sterile surgical helmet system in elective total hip and knee arthroplasty. *J Orthop Surg (Hong Kong)* . 2011;19(2):234-237.	Quasi-experimental	40 elective total hip and knee arthroplasty procedures	20 procedures with laminar air flow	20 procedures without laminar air flow	Surgical helmet system contamination	The surgical helmet systems had an 80% contamination rate. Researchers recommend avoiding contact with the surgical helmet system during the procedure and changing gloves if contact is made.	IIC
90	Kearns KA, Witmer D, Makda J, Parvizi J, Jungkind D. Sterility of the personal protection system in total joint arthroplasty. *Clin Orthop Relat Res.* 2011;469(11):3065-3069. doi:10.1007/s11999-011-1883-1.	Nonexperimental	5 swabs of the surgical helmet systems worn during 61 primary total hip arthroplasty and 41 total knee arthroplasty procedures	n/a	n/a	Intraoperative contamination rates of surgical helmet systems	At the initial donning of the surgical helmet system the contamination rate was 22%. At the end of the procedure the average contamination rate was 47%. The researchers concluded that the surgical helmet system cannot be assumed to be sterile after it is removed from the initial packaging and that gloves should be changed after it is touched or adjusted during the procedure.	IIIC
91	Young S, Chisholm C, Zhu M. Intraoperative contamination and space suits: a potential mechanism. *Eur J Orthop Surg Traumatol.* 2014;24(3):409-413.	Nonexperimental	12 simulated procedures with 4 different sterile gown configurations	n/a	n/a	Presence of fluorescent powder	All surgical helmet system toga evaluations had migration of powder onto the flexor area of both arms, but most was found on the surgeon's right dominant hand in the flexor area. Only the standard gown group had no powder any areas of the gown. Recommended surgical helmet systems be used for PPE only and that drape tape should be used around the inner glove-gown interface area	IIIB
92	Bible JE, O'Neill KR, Crosby CG, Schoenecker JG, McGirt MJ, Devin CJ. Microscope Sterility during Spine Surgery. *Spine* (Phila Pa 1976). 2012;37(7). doi:10.1097/BRS.0b013e3182286129 [IIIB].	Nonexperimental	25 single surgeon spine procedures that used a microscope	n/a	25 microscope drapes were swabbed after application for negative controls and an undraped technician console was swabbed on each microscope as a positive control.	Bacterial contamination	96% of the used drapes were contaminated with rates between 12% to 44%. The areas of the used drapes with significant contamination included the shafts of the optic eye pieces on the main surgeon side, the forehead position on both the surgeon and assistant side, and the overhead portion of the drape.	IIIB

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93	Hosseini P, Mundis GMJ, Eastlack R, et al. Do Longer Surgical Procedures Result in Greater Contamination of Surgeons' Hands? *Clin Orthop Relat Res.* 2016;474(7):1707-1713. doi:10.1007/s11999-016-4832-1	Nonexperimental	20 spinal procedures over 3 hours long completed by 3 different surgeons	n/a	n/a	colony forming units per milliliter (CFUs per ml)	Hand recolonization from bacteria may reoccur after 5 hours of surgery for scrubbed personnel. Researchers suggest rescrubbing before the 5th hour of the procedure.	IIIB
94	Rattanakanokchai S, Eamudomkarn N, Jampathong N, Luong-Thanh B, Kietpeerakool C. Changing gloves during cesarean section for prevention of postoperative infections: a systematic review and meta-analysis. *Sci rep.* 2021;11(1):4592.	Systematic Review w/ Meta-	n/a	n/a	n/a	n/a	Glove changes during cesarean sections may reduce the risk of SSIs. However, the timing of the glove changes remains inconclusive with after placental delivery preferred.	IA
95	Narice BF, Almeida JR, Farrell T, Madhuvrata P. Impact of changing gloves during cesarean section on postoperative infective complications: A systematic review and meta-analysis. *Acta Obstet Gynecol Scand* . 2021;100(9):1581-1594.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Changing gloves during caesarean section delivery procedures decreased SSIs but only after delivery of the placenta.	IB
96	Carter AH, Casper DS, Parvizi J, Austin MS. A prospective analysis of glove perforation in primary and revision total hip and total knee arthroplasty. *J Arthroplasty* . 2012;27(7):1271-1275.	Nonexperimental	3863 gloves from total joint arthroplasty procedures	n/a	n/a	Glove perforation rates	When both outer and inner gloves were perforated the inner glove perforation was only noticed 81% of the time. Meaning careful inspection is warranted when an outer glove perforation is noticed. Revision procedures had a significant number of perforations for the surgeon. Glove perforations were more likely during the critical potions of the case, such as from exposure to implantation in total joint arthroplasty procedures.	IIIB
97	Beldame J, Lagrave B, Lievain L, Lefebvre B, Frebourg N, Dujardin F. Surgical glove bacterial contamination and perforation during total hip arthroplasty implantation: When gloves should be changed. *Orthopaedics & Traumatology: Surgery & Research* . 2012;98(4):432-440.	Nonexperimental	28 cases with gloves collected from all scrubbed personnel	n/a	n/a	Glove perforation and contamination rates	Glove contamination was found in 53.6% of the procedures. Most of the contamination happened during the joint reduction part of the arthroplasty case. Only 3.5% of the gloves studied had perforations, most from the surgeon on their dominant hand. Perforations were significantly more likely to occur during the incision and implantation stages of the procedure. The perforations were not associated with increased risk of bacterial contamination	IIIB

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98	Mazurek MJ, Rysz M, Jaworowski J, et al. Contamination of the surgical field in head and neck oncologic surgery. *Head Neck.* 2014;36(10):1408-1412.	Nonexperimental	50 reconstructive head and neck resections. A total of 336 swabs were collected from the surgical field and the drapes within 10cm of exposed skin.	n/a	n/a	Bacterial Contamination	Of all the swabs 71% were contaminated and 45% of the contaminated swabs were contaminated with over 1 bacteria source. The researchers reported a larger number of contaminated samples occurring in the second hour. In 15 surgeries one or more swabs was negative after a contaminated sample had already been taken. There was no link between SSIs and surgical field contamination, but that contamination of surgical field increases with the duration of the procedure. Recommend decreasing contact with patient's skin and frequent glove changes.	IIIB
99	Schweitzer D, Klaber I, Fischman D, Wozniak A, Botello E, Amenábar PP. Surgical light handles: a source of contamination in the surgical field. *Acta Orthop Traumatol Turc.* 2015;49(4):421-425. doi:10.3944/AOTT.2015.14.0401	Nonexperimental	36 light handles from primary hip arthroplasty procedures	n/a	1 closed plate brought into the OR and back to the laboratory that was never opened and 1 control on the instrument table that was opened when the light handles were placed	Bacterial Contamination	Half of the light handles were contaminated the most frequently identified bacteria where staphylococcus epidermidis and staphylococcus aureus. Surgeons at the author's institution have stopped using light handles during hip arthroplasty procedures.	IIIB
100	Li X, Li M, Li J, et al. Glove perforation and contamination in fracture fixation surgeries. *Am J Infect Control.* 2017;45(4):458-460 [IIIC].	Nonexperimental	408 gloves from 28 procedures of open reduction and internal fixation were used.	n/a	n/a	Bacterial contamination and glove perforations	123 of the 408 gloves were contaminated but were not linked to a specific point in the surgery. Surgeon glove contamination and perforation rates were significantly higher than other scrubbed personnel. Gloves became perforated more frequently during work on the fracture and fixation with plates. The researchers concluded that gloves should be changed regularly to reduce contamination and perforations.	IIIC

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101	Kuroyanagi N, Nagao T, Sakuma H, et al. Risk of surgical glove perforation in oral and maxillofacial surgery. *Int J Oral Maxillofac Surg* . 2012;41(8):1014-1019.	Nonexperimental	1436 gloves from 150 oral and maxillofacial procedures.	n/a	n/a	intraprocedural glove perforation	The scrub person had the highest rate of glove perforations at 17.4% of the total perforation rate. The researchers stated this percentage to be a rate of 1 perforation per orthognathic cases. Less experienced scrub nurses (less than 4 years) were significantly more likely to have a perforation. Most perforations occurred on the non-dominant hand, first forefinger. The researchers concluded that double gloving offers a 95.2% protection rate in orthognathic surgery. The researchers also recommended glove changes during short intervals in cases prone to perforation. The time duration for glove changes was not stated and	IIIB
102	Hamel MS, Tuuli MG. Surgical Closing Protocol and Surgical Site Infection After Cesarean Delivery. *Obstet Gynecol* . 2022;139(5):745-747.	Expert Opinion	n/a	n/a	n/a	n/a	This is an editorial discussing clinical trials that demonstrate reduction of SSI after cesarean delivery.	VA
103	Schirmer A, Swan C, Hughes SJ, et al. Break Scrub to Take That Phone Call? *J Am Coll Surg.* 2018;226(6):1117-1121.	Nonexperimental	18 OR telephones receivers and gloves that held them with a towel were cultured. Fluorescent powder was placed on a surface to mimic a phone and help with a towel.	n/a	n/a	Bacterial contamination and the presence of fluorescent powder on gloves	Fluorescent powder was observed on gloves. CFUs were present on 17 of the phone samples with a median of 10 and a range from 1 to 35. 47% of the 17 gloves that used a towel to touch the phone had CFUs. Towels do not provide an effective barrier for a scrubbed person to hold a phone.	IIIB
104	Vijaysegaran P, Knibbs LD, Morawska L, Crawford RW. Surgical Space Suits Increase Particle and Microbiological Emission Rates in a Simulated Surgical Environment. *J Arthroplasty.* 2018;33(5):1524-1529.	Quasi-experimental	Five experiments in simulated surgical environment	Use of a SHS	Use of traditional surgical gown	Particle emission rates (PER) and microbiological emission rates (MER)	Four out of 5 experiments showed statistically significant increases in PER and MER rates. One experiment had inconsistent results but with trends to increased PER and MER rates.	IIB
105	Ling F, Halabi S, Jones C. Comparison of air exhausts for surgical body suits (space suits) and the potential for periprosthetic joint infection. *J Hosp Infect.* 2018;99(3):279-283.	Nonexperimental	4 Different Types of surgical helmet systems	n/a	n/a	Exhausted air patterns	All surgical helmet systems tested exhausted air into the OR. Depending on the device exhaust was seen in differing locations sometimes at or above the sterile field.	IIIB
106	Nakajima D, Tateiwa T, Masaoka T, Takahashi Y, Shishido T, Yamamoto K. Does modern space suit reduce intraoperative contamination in total joint replacement? An experimental study. *Eur J Orthop Surg Traumatol.* 2017;27(8):1139-1143.	Quasi-experimental	Three measurements in each of the three locations including inferior wrist, posterior to the feet, and near the chest.	Use of a surgical helmet system	Use of a surgical gown	Particle concentrations	Motion can increase particle counts at the chest level. Motion with use of SHSs created higher particle counts over use of traditional gowns at the chest level.	IIC

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107	Eggers JP, Krumme JW, Kotwal S. Iatrogenic Contamination With a Surgical Helmet System in Orthopedic Surgery. *Orthopedics.* 2021;44(6):e753-e756. doi:10.3928/01477447-20211001-16	Quasi-experimental	180 orthopedic procedures	60 procedures with SHSs, 60 procedures in SHSs when fan is not turned on until gowning complete. Zippered toga was used.	60 procedures completed in sterile gowns (ie, no SHS)	Contamination rates and bacteria types	There was contamination found in all groups with the highest levels in the SHS when face shield contamination was included. Use of SHS may increase contamination. However, use of SHS with delayed ventilation may decrease contamination. Surgeons wore masks during surgical hand antisepsis and removed it after the SHS was donned.	IIB
108	McGovern PD, Albrecht M, Muller SD, Reed MR, Khan SK. The influence of surgical hoods and togas on airborne particle concentration at the surgical site: an experimental study. *Journal of Orthopaedic Science.* 2013;18(6):1027-1030. doi:10.1007/s00776-013-0445-7	Quasi-experimental	Six trials of 3 configurations of gown and SHSs	Use of a SHS hood, use of a SHS toga	Use of a traditional gown (no SHS)	Particle concentrations	The gown had the highest level of particles, followed by the hood and toga. Use of a toga SHS provides a significant reduction in contaminated compared to a SHS hood and traditional gown (no SHS).	IIC
109	Shirley OC, Bayan A, Zhu M, Dalton JP, Wiles S, Young SW. Do surgical helmet systems affect intraoperative wound contamination? A randomised controlled trial. *Arch Orthop Trauma Surg* . 2017;137(11):1565-1569. doi:10.1007/s00402-017-2795-7	RCT	75 Total Knee Arthroplasty (TKA) Patients	SHS use without tape, SHS use with tape around the gown-glove interface	Traditional surgical gowns	Wound contamination	No difference in wound contamination rates was found between use of SHSs or traditional surgical gowns. The use of tape did not alter the wound contamination rate.	IB
110	Vermeiren A, Verheyden M, Verheyden F. Do Double-fan Surgical Helmet Systems Result in Less Gown-particle Contamination Than Single-fan Designs? *Clin Orthop.* 2020;478(6):1359-1365.	Quasi-experimental	Five 30-minute total knee arthroplasty simulations performed by two surgeons	Double fan SHS	Single fan SHS	Amount of ultraviolet powder on the flexor and extensor surfaces of the arms, axillary areas, and front and back of chest	All tests showed some contamination at the gown-glove interface but there was no difference in the powder contamination between single and double fan systems except in the axillary region where the single fan produced more contamination.	IIC
111	So E, Juels CA, Seidenstricker C, Walker R, Scott RT. Postoperative Infection Rates After Total Ankle Arthroplasty: A Comparison With and Without the Use of a Surgical Helmet System. *J Foot Ankle Surg* . 2022;61(4):802-806.	Nonexperimental	260 total ankle arthroplasty (TAA) patients	SHS	Traditional surgical gown	SSI and PJI rates	The use of SHSs does not influence PJI or SSI rates.	IIIB
112	Young SW, Zhu M, Shirley OC, Wu Q, Spangehl MJ. Do 'Surgical Helmet Systems' or 'Body Exhaust Suits' Affect Contamination and Deep Infection Rates in Arthroplasty? A Systematic Review. *J Arthroplasty.* 2016;31(1):225-233.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Body exhaust suits have shown more potential to reduce OR contamination than Surgical Helmet Systems, which have not been shown to reduce deep SSI rates during arthroplasty.	IIIB
113	Rahardja R, Morris AJ, Hooper GJ, Grae N, Frampton CM, Young SW. Surgical Helmet Systems Are Associated With a Lower Rate of Prosthetic Joint Infection After Total Knee Arthroplasty: Combined Results From the New Zealand Joint Registry and Surgical Site Infection Improvement Programme. *J Arthroplasty.* 2022;37(5):930-935.e1.	Nonexperimental	19,322 primary total knee arthroscopy procedures	n/a	n/a	Prosthetic joint infection (PJI) within 90 days and revision TKA for deep infection within 6 months.	97 patients had a PJI (0.50%) and 90 patients had a revision TKA (0.47%). Use of a SHS was associated with a lower PJI rate and revision TKA.	IIIC

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114	Nelson JP. Effectiveness, costs of clean rooms, helmet aspirators. *AORN J.* 1978 Mar;27(4):718-34. doi: 10.1016/s0001-2092(07)68537-8.	Literature Review	n/a	n/a	n/a	n/a	Clean rooms and helmet aspirator systems reduce the risk of SSIs.	VC
115	Hanselman AE, Montague MD, Murphy TR, Dietz MJ. Contamination Relative to the Activation Timing of Filtered-Exhaust Helmets. *J Arthroplasty.* 2016;31(4):776-780.	Nonexperimental	3 tests of airflow spray pattern from a surgical helmet fan and 8 trials of fan activation	n/a	n/a	Airflow spray pattern measured in distance from the surgical helmet system and ultraviolet particle contamination	Surgical helmet systems may contaminate the OR environment if turned on prior to the helmet and gown donning process being complete. The findings from this study do not explicitly state but do seem to support that surgical helmet systems turned on prior to surgical hand asepsis may potentially contaminate the hands and forearms.	IIIB
116	de Araujo Moriya GA, de Souza RQ, Gomes Pinto FM, Graziano KU. Periodic sterility assessment of materials stored for up to 6 months at continuous microbial contamination risk: Laboratory study. *Am J Infect Control.* 2012. doi:10.1016/j.ajic.2012.01.020	RCT	175 containers in four different sterile packaging styles	Contamination of the outer packaging of 150 of the packages	25 packs were opened after the sterilization process	Contamination of the sterile packages	None of the packages opened grew microbial contaminants, suggesting that event related sterility crucial for unopened packages that have not experienced a damaging event (eg, holes, strikethrough)	IB
117	Dalstrom DJ, Venkatarayappa I, Manternach AL, Palcic MS, Heyse BA, Prayson MJ. Time-dependent contamination of opened sterile operating-room trays. *Journal of Bone & Joint Surgery - American Volume* . 2008;90(5):1022-1025	RCT	Three groups of 15 instrument trays each exposed for 4 hours.	1 group of 15 trays that were opened and immediately covered with a sterile towel. The trays were left in a locked OR for 4 hours.	One group of 15 instrument trays uncovered with no traffic, another group of 15 instrument trays uncovered with light traffic.	Bacteria and fungal contamination	None of the covered trays were contaminated. Three uncovered instrument trays had immediate contamination and were eliminated from the results. Of the 27 remaining trays at 30 minutes 4% were contaminated and at one hour 15% were contaminated, at 2 hours 22% were contaminated, and at 4 hours 30% were contaminated. Contamination was progressive with time, traffic did not make a difference. Open instruments only when needed and cover when not in use.	IC
118	Menekse G, Kuscu F, Suntur BM, et al. Evaluation of the Time-dependent Contamination of Spinal Implants: Prospective Randomized Trial. *Spine.* 2015;40(16):1247-1251. doi:10.1097/BRS.0000000000000944.	Quasi-experimental	2 groups of spinal pedicle screws from implant instrument trays were used.	Group 2 had the implant tray opened and covered immediately with a towel (n=22).	Group 1 had the implant tray opened and left uncovered (n=20).	Screw Contamination	Neither group had contamination at moment 0 (at opening). At the 30 minute mark a significant difference in contamination began, with the uncovered groups being more contaminated. Contamination started later in the covered group and was significantly less than the uncovered group for the remaining duration of the study period (120 min). Contamination levels were not linked to a risk for postoperative SSIs.	IIA
119	Bible JE, O'Neill KR, Crosby CG, Schoenecker JG, McGirt MJ, Devin CJ. Implant contamination during spine surgery. *Spine Journal.* 2013;13(6):637-640. doi:10.1016/j.spinee.2012.11.053.	RCT	105 spinal implant procedures performed by one surgeon	54 procedures were randomized to the covered implant group	51 procedures were in the uncovered implant group	spinal implant contamination	Covered implants were significantly less contaminated than uncovered implants (2.0% versus 16.7%). The researchers recommended not opening implants until needed when possible, but need to balance that recommendation with the understanding delayed opening may lead to surgical treatment delays.	IB

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120	Edmiston CEJ, Sinski S, Seabrook GR, Simons D, Goheen MP. Airborne particulates in the OR environment. *AORN J.* 1999;69(6):1169-7, 1179 passim. doi:10.1016/s0001-2092(06)61884-x	Quasi-experimental	28 periods of sampling in 38 major vascular surgeries.	Textiles (scrubs, drapes, sterile pack material) made of wood pulp polyester	Textiles made of polypropylene fabric	Types of airborne particulates and bacteria	The study found that the particulates consisted mostly of wood pulp fibers from disposable gowns and drapes. Airborne bacterial identified several pathogenic organisms. The researcher suggested further study on the impact of airborne particulates and bacteria in the OR environment on SSIs.	IIB
121	Panahi P, Stroh M, Casper DS, Parvizi J, Austin MS. Operating room traffic is a major concern during total joint arthroplasty. *Clin Orthop Relat Res* . 2012;470(10):2690-2694.	Nonexperimental	80 primary total joint procedures and 36 revision total joint procedures	n/a	n/a	Door openings and causes of door openings, personnel category of those opening the door	Door opening averaged 60 in primary procedures and 135 in revision procedures and nurses and manufacturer's representative contributed to the majority of the door openings. Additionally 47% of door opening had no clear cause, leading researchers to question the necessity of opening the door. Since revision cases were significantly higher in traffic the researchers suggest strategies to reduce door opening such as storage of supplies and education of personnel. Researchers also suggested limiting supply opening to right before the supply is needed to limit the exposure of the supply to the increased traffic and potential	IIIB
122	Chosky SA, Modha D, Taylor GJS. Optimisation of ultra-clean air. The role of instrument preparation. *J Bone Joint Surg Br.* 1996;78-B(5):835-837. http://www.bjj.boneandjoint.org.uk/content/78-B/5/835.abstract	Nonexperimental	41 total joint replacements in varying laminar air flow ORs.	n/a	n/a	Bacterial contamination	Bacterial fallout was only present during instrument preparation and not during the operation. Setting up in laminar air flow environments and covering instruments after set up until the patient is transferred to the OR table reduced contamination levels by 28 fold. Excluding covering, the reduction in bacterial contamination was 24-fold for instrument preparation in a laminar air flow room instead of an instrument preparation room.	IIIB
123	Sadrizadeh S, Tammelin A, Ekolind P, Holmberg S. Influence of staff number and internal constellation on surgical site infection in an operating room. *Particuology.* 2014;13.	Nonexperimental	Studied 2 simulated OR configurations with equipment and 4 or 10 simulated personnel.	n/a	n/a	Active and passive bacteria-carrying particle dispersion discussed as CFU/m3	Heat discussed as rising thermals from the OR staff, lights and equipment over the OR table can impact airflow. The farther the particle source (i.e. personnel) is from the sterile field the less particles come in contact with it. Recommended limiting personnel in cases with high risk of SSI to no more than five to size people in the OR. This number was cited to limit bacteria to no higher than 10 cfu/m3, based on their results from OR staffing levels and PCR counts	IIIA

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124	Andersson AE, Bergh I, Karlsson J, Eriksson BI, Nilsson K. Traffic flow in the operating room: An explorative and descriptive study on air quality during orthopedic trauma implant surgery. *AJIC* . 2012;40(8):750-755. doi:10.1016/j.ajic.2011.09.015.	Nonexperimental	91 samples	n/a	n/a	Bacterial contamination, traffic flow, and number of people in the OR	57% of the air samples collected in the displacement ventilated ORs were over the recommended level of CFUs. Traffic flow per operation was strongly positively correlated to increased CFUs. Increased numbers of people present also increased CFUs.	IIIB
125	Andersson AE, Petzold M, Bergh I, Karlsson J, Eriksson BI, Nilsson K. Comparison between mixed and laminar airflow systems in operating rooms and the influence of human factors: experiences from a Swedish orthopedic center. *Am J Infect Control* . 2014;42(6):665-669.	Nonexperimental	63 orthopedic implant procedures with 164 samples from laminar air flow ORs and 91 samples from direct ventilation rooms.	n/a	n/a	Colony forming unit results from the filters placed on the plates every 20 minutes. Mean number of people and door openings.	This study supported the use of laminar air flow over directional ventilation in surgery. Also concluded that environmental contamination of adjacent areas may play a factor in the OR and that OR personnel need to understand how ventilation systems work. Door opening rates and number of people also contribute significantly to air contamination. Every door opening increased the CFU by 3% and every person increased the CFUs by 13%.	IIIA
126	Memarzadeh F, Manning AP. Comparison of operating room ventilation systems in the protection of the surgical site. *ASHRAE Trans.* 2004;108(Pt 2):1–13.	Quasi-experimental	Airflow modeling and particle-tracking methods to compare the risk of contamination depositon in an OR surgical site and back table for different ventilation systems	Particles (skin squame/around 10mm) released in three locations in the room	comparison of different ventilation systems using a model. *"The ventilation system designsconsidered incorporated commonly used diffuser types, in particular, conventional, laminar, nonaspirating, and displacement diffuser types"*		The results show that ventilation systems that provide laminar flow conditions are the best choice, although some care needs too be taken in their design. A face velocity of around 30 to 35 fpm (0.15m/s to 0.18m/s) is sufficient from the laminar diffuser array, ***provided that the size of the diffuser array is appropriate.***	IIB
127	Sunagawa S, Koseki H, Noguchi C, et al. Airborne particle dispersion around the feet of surgical staff while walking in and out of a bio-clean operating theatre. *J Hosp Infect* . 2020;106(2):318-324.	Quasi-experimental	5 series of each movements	Walking as a group (4 people 2 physicians, 2 nurses)	Walking independently	Particle number and dispersion	When walking particles became airborne from the floor and feet of the personnel. Walking as a group significantly increases the number of particles and the likelihood that the particles would reach the level of the OR instrument table. Walking independently and slowly near sterile areas may help decrease particle dispersion.	IIB

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128	Sadrizadeh S, Pantelic J, Sherman M, Clark J, Abouali O. Airborne particle dispersion to an operating room environment during sliding and hinged door opening. *J Infect Public Health.* 2018;11(5):631-635.	Nonexperimental	computational fluid dynamic method review of door opening flows	n/a	n/a	Air velocity, temperature, pressure, and CFUs.	Positive pressure works when the door is closed. Both hinged and sliding doors have the same affect on the room pressure when opened. When a door is opened there is a jump in CFUs/m3 that takes 4 minutes to return to the relative baseline state. When a door is opened in rapid succession before the 4 minutes of recovery the level of CFS will respike to the high level associated with door openings and not return to baseline until 4 minutes without door openings has been achieved. When doors are opened every 2.5 minutes it leads to an overall elevation in the level of contamination by ~7 CFU/m3. The positive pressure gradient is temporarily reversed when the door is opened	IIIB
129	Birgand G, Azevedo C, Rukly S, et al. Motion-capture system to assess intraoperative staff movements and door openings: Impact on surrogates of the infectious risk in surgery. *Infection Control and Hospital Epidemiology* . 2019;40(5):566-573.	Nonexperimental	59 procedures (34 orthopedic, 25 cardiac)	n/a	n/a	Door openings, staff movements, particle and microbial air sampling, wound culture	The frequency of door openings was associated with increased particle and microbial air contamination but not wound contamination. The movements of the personnel were also associated with increased particle counts.	IIIB
130	Guideline for sterilization. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2024:997–1024.	Guideline	n/a	n/a	n/a	n/a	Perioperative recommendations for instrument sterilization.	IVA
131	Mittal A, Blackburn AZ, Katakam A, Bedair HS, Melnic CM. Dual Surgical Setup Associated with Reduced Infection Recurrence for Hip and Knee Arthroplasty After Two-Stage Exchange. *J Am Acad Orthop Surg* . 2024;32(2):68-74. doi:10.5435/JAAOS-D-23-00317.	Nonexperimental	A retrospective study was conducted between January 2000 and December 2021 to isolate patients who underwent TSE after total joint arthroplasty of the hip and knee.	n/a	n/a	Infection recurrence requiring surgical intervention. Demographic factors, preoperative comorbidities, operating surgeon, single versus dual setup, hospital setting, use of long-term antibiotics postoperatively after TSE, aspiration data, and infecting organism were compared between cohorts using multivariate regression analysis	Utilization of a dual surgical setup is a low-cost modifiable risk factor associated with a lower risk of recurrence of after TSE of the hip and knee for PJI	IIIA
132	21 CFR 878.4370: Surgical drape and drape accessories. 4–1–22 ed. U.S. Government Publishing Office; 2022.	Regulatory	n/a	n/a	n/a	n/a	Regulatory language on surgical drapes.	n/a

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133	O'Grady NP, Alexander M, Burns LA et al. Guidelines for the prevention of intravascular catheter-related infections, 2011. Updated October 2017. Accessed February 14, 2024. Centers for Disease Control and Prevention. https://www.cdc.gov/infectioncontrol/pdf/guidelines/bsi-guidelines-H.pdf	Guideline	n/a	n/a	n/a	n/a	CDC Guideline. States that maximal barrier protections are recommended for the placement of central venous catheters (CVCs), placement of peripherally inserted central catheters (PICCs), and guidewire exchanges.	IVA
134	Guideline for electrosurgical safety. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2024:143–164.	Guideline	n/a	n/a	n/a	n/a	Perioperative recommendations for the safe use of electrosurgical devices.	IVA
135	Taaffe KM, Allen RW, Fredendall LD, et al. Simulating the effects of operating room staff movement and door opening policies on microbial load. *Infect Control Hosp Epidemiol.* 2021;42(9):1071-1075.	Nonexperimental	4 orthopedic surgeries, 15 hours of footage	n/a	n/a	Door openings & movement	The researchers used the information in the videos to re-create surgical event flow and then compared the door openings and movements with microbial load. Movements and the width of door openings affect microbial load.	IIIB
136	Wong KY, Tan H, Nyakuma BB, et al. Effects of medical staff's turning movement on dispersion of airborne particles under large air supply diffuser during operative surgeries. *Environ Sci Pollut Res Int.* 2022;29(54):82492-82511.	Nonexperimental	computational fluid dynamic method turning movements of the scrub nurse from right to left was tested at over 3	n/a	n/a	Disruptions in airflow velocity and particle concentrations	Movements of the scrub nurse can interrupt airflow distribution and increase particle concentration in the area where the forearms are turning.	IIIB
137	Brohus H, Balling KD, Jeppesen D. Influence of movements on contaminant transport in an operating room. *Indoor Air* . 2006;16(5):356-372. doi:10.1111/j.1600-0668.2006.00454.x	Nonexperimental	Six computational fluid dynamic scenarios	n/a	n/a	Impact of movements on ventilation effectiveness (eg, velocity) and bacterial concentration	Movements significantly impact airflow, this includes the presence of staff and objects (eg, OR Lights), increased particle counts below the level of the sterile field, walking away, and returning to the sterile field.	IIIB
138	Calderwood MS, Anderson DJ, Bratzler DW, et al. Strategies to prevent surgical site infections in acute-care hospitals: 2022 Update. *Infection Control & Hospital Epidemiology* . 2023;44(5):695-720. doi:10.1017/ice.2023.67	Guideline	n/a	n/a	n/a	n/a	SHEA, IDSA, and APIC practice recommendation to prevent SSIs. Includes information on wound protectors and drapes.	IVA
139	Surgical site infections: prevention and treatment. National Institute for Health and Care Excellence (NICE); 2019	Guideline	n/a	n/a	n/a	n/a	Recommendations to prevent SSIs from the UK.	IVB
140	Webster J, Alghamdi A. Use of plastic adhesive drapes during surgery for preventing surgical site infection. *Cochrane Database of Systematic Reviews* 2015, Issue 4. Art. No.: CD006353. DOI: 10.1002/14651858.CD006353.pub4.	Systematic Review	n/a	n/a	n/a	n/a	There was no new evidence for this Cochrane systematic review update from the 2011 version. Plastic adhesive drapes are not shown to prevent SSIs and there is some evidence to suggest that they may cause SSIs. More randomized control trial research is needed for inclusion in future versions.	IA

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141	Nicholson O, Ho B, Chong C. Use of iodine-impregnated surgical drapes for prevention of surgical site infection: a systematic review and meta-analysis. *Wound Pract Res* . 2020;28(1):30-37.	Systematic Review w/ Meta-	n/a	n/a	n/a	n/a	Iodophor-impregnated adhesive incise drapes are beneficial in reducing SSIs in clean-contaminated procedures. Included cardiac, thoracic, and general procedures.	IIIB
142	Mundi R, Nucci N, Ekhtiari S, Wolfstadt J, Ravi B, Chaudhry H. Do Adhesive Drapes Have an Effect on Infection Rates in Orthopaedic Surgery? A Systematic Review and Meta-Analysis. *Clin Orthop* . 2022;480(3):551-559.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	They found a reduction in wound contamination with the use of adhesive drapes. Purposeful or inadvertent peeling of the drape at the wound edge may reduce drape effectiveness and increase the risk for wound contamination. Included iodophor-impregnated drapes and non-impregnated drapes.	IIA
143	Rezapoor M, Tan TL, Maltenfort MG, Parvizi J. Incise Draping Reduces the Rate of Contamination of the Surgical Site During Hip Surgery: A Prospective, Randomized Trial. *J Arthroplasty.* 2018;33(6):1891-1895.	RCT	Single center, single surgeon. 101 hip procedures, of which 85 were femoral acetabular osteoplasties and the remaining 16 were periacetabular ostomies	50 subjects in the iodine impregnated incise drape group	51 patients with no plastic adhesive drape used	Deep SSI within 6 months with organism identification and postoperative wound complications.	Patients in the iodine-impregnated plastic adhesive drape group had a 12% rate of positive bacterial cultures compared with a positive culture rate of 27.4% in the comparison group. There was also a non-significant increase in bacterial contamination when the iodine-impregnated drape was found to be separated from the skin. The study was stopped early due because of reductions in bacterial counts	IA
144	Bejko J, Tarzia V, Carrozzini M, et al. Comparison of Efficacy and Cost of Iodine Impregnated Drape vs. Standard Drape in Cardiac Surgery: Study in 5100 Patients. *J Cardiovasc Transl Res.* 2015;8(7):431-437.	Quasi-experimental	1616 cardiac surgery patients (808 in each group matched for risk factors)	Iodine impregnated plastic adhesive drape	Non-iodine impregnated plastic adhesive drape	SSI	Overall SSI rate and superficial SSI rate was significantly lower in iodine-impregnated plastic adhesive group.	IIA
145	Hesselvig AB, Arpi M, Madsen F, Bjarnsholt T, Odgaard A, ICON SG. Does an Antimicrobial Incision Drape Prevent Intraoperative Contamination? A Randomized Controlled Trial of 1187 Patients. *Clin Orthop* . 2020;478(5):1007-1015.	RCT	1187 primary knee arthroscopy patients	Use of an antimicrobial incision drape	No drape used	Microbial contamination	Use of iodophor-impregnated drapes reduced contamination. Not using the drape was associated with increased microbial contamination. Patients with more than 10 mm of drape separation from the skin had a higher risk of contamination.	IA
146	Hanada M, Hotta K, Furuhashi H, Matsuyama Y. Intraoperative bacterial contamination in total hip and knee arthroplasty is associated with operative duration and peeling of the iodine-containing drape from skin. *Eur j orthop surg traumatol.* 2020;30(5):917-921.	Quasi-experimental	244 patients having total hip arthroplasty or total knee arthroplasty	Iodophor-impregnated drape adhered to the skin at specimen collection	Iodophor-impregnated drape not adhered to the skin at specimen collection	Bacterial contamination of surgical site after implant placed	Drapes that remain adhered to the skin may reduce bacterial contamination of the wound.	IIA
147	Barker CS, Soro V, Dymock D, Fulford M, Sandy JR, Ireland AJ. Time-dependent recontamination rates of sterilised dental instruments. *Br Dent J* . 2011;211(8):E17. doi:10.1038/sj.bdj.2011.869	Quasi-experimental	25 used dental mirrors went through a washer-disinfector cycle, individual packaging, and sterilization	Removed 5 mirrors at 0 (immediately after sterilization), 31, 60, 90, and 124 days	n/a	Bacterial contamination	None of the mirrors has aerobic or anaerobic bacterial contamination at any point in the testing window (0-124 days).	IIB

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148	Webster J, Lloyd W, Ho P, Burridge C, George N. Rethinking sterilization practices: evidence for event-related outdating. *Infect Control Hosp Epidemiol* . 2003;24(8):622-624. doi:10.1086/502264	Quasi-experimental	131 sterilized packs containing 262 test items	Every 3 months several sterile test packs were retrieved, opened and tested	n/a	Bacterial contamination	All the items were found to be sterile during the two year test period. Researchers concluded that when items are correctly wrapped and sterilized they will remain sterile unless the wrapping is damaged.	IIB
149	ANSI/AAMI ST79:Comprehensive Guide to Steam Sterilization and Sterility Assurance in Health Care Facilities. Association for the Advancement of Medical Instrumentation (AAMI); 2017. Includes the 2020 Ammendments.	Guideline	n/a	n/a	n/a	n/a	Consensus recommendations on instrument sterilization.	IVC
150	21 CFR 801: Labeling. "GovInfo"/ GPO (U.S. Government Publishing Office); 2022	Regulatory	n/a	n/a	n/a	n/a	Code of Federal Regulations Labeling requirement section.	n/a
151	21 CFR 801.5: Medical devices; adequate directions for use. "GovInfo"/ GPO (U.S. Government Publishing Office); 2022	Regulatory	n/a	n/a	n/a	n/a	Code of Federal Regulations adequate instructions for use of medical devices section	n/a
152	Chang CY, Furlong LA. Microbial stowaways in topical antiseptic products. *N Engl J Med.* 2012;367(23):2170-2173	Expert Opinion	n/a	n/a	n/a	n/a	Update and guidance from the FDA regarding the situation of microbial contamination of skin antiseptic agents.	VB
153	Pharmaceutical Compounding: Sterile Preparations (797). U.S. Pharmacopeial Convention; 2023.	Regulatory	n/a	n/a	n/a	n/a	provides standards for preparing compounded sterile medications to ensure patient safety and quality. It is essential for pharmacies and healthcare facilities involved in sterile compounding.	n/a
154	Safety briefs: Confusion over sterility of povidone iodine solution. ISMP Medication Safety Alert! 2023;28(25):1. Accessed February 27, 2024. https://www.ismp.org/sites/default/files/newsletter-issues/20231214.pdf	Expert Opinion	n/a	n/a	n/a	n/a	A hospital reported that labeling on the overwrap of a povidone-iodine solution seems to indicate that the solution is sterile. However, while the foil package itself, inside the overwrap, is sterile, its contents are NOT. Placing a non sterile solution in a package labeled "sterile" will cause confusion among providers who may believe they are choosing a sterile solution when they are not	VA
155	Markel TA, Gormley T, Greeley D, Ostojic J, Wagner J. Wearing long sleeves while prepping a patient in the operating room decreases airborne contaminants. *Am J Infect Control* . 2018;46(4):369-374. doi:10.1016/j.ajic.2017.10.016	Quasi-experimental	hospitals, 3 OR's	Mock skin prep procedures performed with covered arms	Bare arms	Airborne contamination and microbes present	Presence of particulates and shedding was decreased when arms were covered.	IIB

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156	Waked WR, Simpson AK, Miller CP, Magit DP, Grauer JN. Sterilization Wrap Inspections Do Not Adequately Evaluate Instrument Sterility. *Clinical Orthopaedics and Related Research®* . 2007;462. https://journals.lww.com/clinorthop/Fulltext/2007/09000/Sterilization_Wrap_Inspections_Do_Not_Adequately.32.aspx	Nonexperimental	90 instrument wrappers with six defect sizes from 1.1 mm to 10.0 mm and no defects were inspected by 9 medical personnel (stage 1) and were tested for bacterial penetration after nail was put through (stage 2)	n/a	n/a	Detection of holes of various sizes in instrument wrappers and bacterial penetration of the wrappers	Holes of smaller sizes were harder to detect. Even the smallest holes transmitted bacterial contaminates. Recommend consideration of closed-tray designs for instrument sets (ie, pans not wrapped sets).	IIIB
157	Mobley KS, Jackson III JB. A prospective analysis of clinical detection of defective wrapping by operating room staff. *Am J Infect Control.* 2018;46(7):837-839.	Nonexperimental	912 instrument wrap identification of holes and tears by 48 staff on 20 instrument wrappers (one wrap subsequently found to have a tear that was not part of the study and was excluded)	n/a	n/a	Correct identification of a hole or tear in an instrument wrapper (Pass or Fail)	Trained OR personnel using standard processes for identification only correctly determined if an instrument wrapper was intact or had a hole or tear 56.1% of the time.	IIIB
158	Rashidifard CH, Mayassi HA, Bush CM, et al. Looking for Holes in Sterile Wrapping: How Accurate Are We? *Clin Orthop.* 2018;476(5):1076-1080.	Nonexperimental	Thirty participants (OR RNs=13, STs = 10, Orthopedic Surgery Residents =7) & 46 instrument wrappers (36 with holes of various sizes, 10 controls)	n/a	n/a	Detection of holes of various sizes in instrument wrappers	Holes ≤ 2 mm were not reliably detected even with differences in participant experience levels or lighting source used (to enable detection). There was no correlation between detection accuracy and inspection time. Use of ambient light versus use of an overhead surgical light did not affect detection rates.	IIIB
159	Kelly SR, Huish EG, Holmboe MC, Lara DL, Trzeciak MA, Cash R. Detection of Surgical Wrap Defects in the Operating Room Setting. *Orthopedics.* 2021:1-4.	Nonexperimental	40 sterilization wraps 10 in each group with holes 1.2 mm, 3.7 mm, and 6.8 mm and no defects evaluated by 20 OR personnel	n/a	n/a	Detection of holes of various sizes in instrument wrappers	The smaller the hole the more likely that the hole will be missed. Large holes were only detected correctly 80% of the time. The best detections rates among staff was 77.5%.	IIIC
160	Trier T, Bello N, Bush TR, Bix L. The role of packaging size on contamination rates during simulated presentation to a sterile field. *PLoS ONE* . 2014;9(7).	Nonexperimental	97 people for a total of 582 trials.	n/a	n/a	Contamination in the form of ultraviolet powder	Large peel pouches were significantly more contaminated than small peel pouches. Medium sized peel pouches were not as contaminated as large peel pouches but were more contaminated than small peel pouches but it was not a significant finding.	IIIB

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161	Vocelle AR, Trier T, Bix L, Bush TR. A method for quantifying key components of the opening process for opening pouch-style packages containing medical devices. *Appl Ergon.* 2019;76:97-104. doi:10.1016/j.apergo.2018.12.010	Nonexperimental	11 parameters for opening pouch-style packages tested with 9 health care professionals	n/a	n/a	Handling time, package manipulations, pulls, pull distance, times spent pulling	All nine people crossed above the sterile field when opening packages. Opening large packages result in more time spent over the sterile field.	IIIB
162	Lucas Anne D, Srinidhi N, Gordon Edward A, Hitchins Victoria M. Evaluating Device Design and Cleanability of Orthopedic Device Models Contaminated with a Clinically Relevant Bone Test Soil. *Biomedical Instrumentation & Technology* . 2015;49(5):354-362.	Quasi-experimental	Five models of fabricated aluminum cannulated orthopedic instruments of increasing complexity, each model was made 5 times.	Residual bone cement (soil) testing after 10 applications of cement and subsequent cleaning	Residual bone cement testing after 1 application of cement and subsequent cleaning	Amount and location of bone cement debris	More complex instrument designs had more bone cement debris. Devices retained significantly more bone cement after use and cleaning ten times than one time.	IIB
163	Tosh PK,a, Disbot MCCRN, Duffy JM, et al. Outbreak of Pseudomonas aeruginosa Surgical Site Infections after Arthroscopic Procedures: Texas, 2009. *Infection Control & Hospital Epidemiology* . 2011;32(12):1179-1186.	Case Report	n/a	n/a	n/a	n/a	7 cases of organ/deep space SSI were found at a hospital and linked to residual bioburden in arthroscopic instrument lumens.	VB
164	Parada SA, Grassbaugh JA, DeVine JG, Arrington ED. Instrumentation-Specific Infection After Anterior Cruciate Ligament Reconstruction. *Sports Health.* 2009;1(6):481-485.	Case Report	n/a	n/a	n/a	n/a	An outbreak of 5 SSIs in a fourteen week period was found to be related to bioburden inside a small cannula hex driver used during ACL reconstruction.	VB
165	Wellington IJ, Schneider TJ, Hawthorne BC, et al. Prevalence of bacterial burden on macroscopic contaminants of orthopaedic surgical instruments following sterilization. *J Hosp Infect* . 2022;130:52-55. doi:10.1016/j.jhin.2022.08.010	Nonexperimental	33 contaminants (ie, bone, cement, hair) collected from orthopedic instrument trays over a 6-month period	n/a	n/a	Bacterial contamination, most frequently contaminated instruments, and common types of contaminants	Most contaminants (97%) did not grown any microbial contamination. Only a single Kushner wire with adhered bone cement grew contamination. Researchers suggest that most things are likely to be sterile and will not pose an increased infection risk to patients. Cannulated and uncannulated drill bits are most frequently contaminated with debris. Identified contaminants included bone, cement, hair, metal, suture, blood, and water. A third of the contaminants were not identified	IIIB
166	Guideline for care and cleaning of surgical instruments. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2024:403–438.	Guideline	n/a	n/a	n/a	n/a	Recommendations for care and cleaning of surgical instruments in perioperative settings.	IVA

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
167	Rezzadeh K, Parikh H, Guanche I, et al. Clean or Dirty? A Systematic Review of Splash Basin Use and Its Infectious Potential in Orthopaedic Surgery. *Iowa Orthop J.* 2022;42(2):82-89	Systematic Review	n/a	n/a	n/a	n/a	Splash basins are highly contaminated. Some studies suggest abandoning the practice but the variability of cleaning instruments with sponges has not been studied. Contamination ranged from 2% to 74% with a mean of 23.9%. Use of diluted antiseptics added to splash basins was associated with 0% contamination in two studies. Although the positioning is in the sterile field they have a wide surface area that may contribute to airborne contamination. If instruments placed in the splash basin are reintroduced to the operative site it could cause cross contamination. Open as close to the time of use as possible. Placing splash basins in areas where passersby are not likely to cause contamination	IIIB
168	Napoli C, Marcotrigiano V, Montagna MT. Air sampling procedures to evaluate microbial contamination: a comparison between active and passive methods in operating theatres. *BMC Public Health.* 2012 Aug 2;12:594. doi: 10.1186/1471-2458-12-594. PMID: 22853006; PMCID: PMC3444341.	Nonexperimental	32 turbulent airflow OR's at one hospital in Italy	n/a	n/a	total viable count (TVC) using active and passive sampling methods	Both active and passive methods of air sampling can be used for routine surveillance of air contamination in OR's. ORs with turbulent air systems had increases in the TVC when occupied compared to when there was no personnel in the room.	IIIC
169	Perez P, Holloway J, Ehrenfeld L et al. Door openings in the operating room are associated with increased environmental contamination. *Am J Infect Control* . 2018;46(8):954–956.	Nonexperimental	48 orthopedic and general surgery procedures	n/a	n/a	Bacterial contamination compared to location, number of personnel, temperature, humidity, and active warming devices.	A positive correlation was found between increased door openings and increased levels of CFUs, but only for the subset of cultures done outside of the laminar air flow (not within the LAF). Within the LAF, only staff number was associated with increased levels of CFUs. There was an observational finding that the more people standing at the OR table the more likely that the instrument table would be outside of the LAF air curtain. Concluded that numbers of personnel should be reduced and LAF should be used	IIIB
170	Alsved M, Civilis A, Ekolind P, et al. Temperature-controlled airflow ventilation in operating rooms compared with laminar airflow and turbulent mixed airflow. *J Hosp Infect.* 2019;98(2):181-190.	Nonexperimental	15 measurements in three locations during orthopedic procedures (close to the wound, instrument table, and room periphery) in three different OR HVAC types (n=45)	Temperature-controlled airflow (TCAF) OR	Vertical laminar airflow (LAF) OR and a turbulent mixed airflow (TMA) OR	CFUs, energy consumption, comfort (noise, draught)	Both the LAF and the TCAF OR's resulted in less than 10 cfu/m3 in all measurement locations in the room during surgery. TCAF had the lowest concentrations of cfus in the room periphery. TCAF also used less power and less noise and draught.	IIIB

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171	Wanta, Brendan T. Glasgow, Amy E. Habermann, Elizabeth B. Kor, Daryl J. Cima, Robert R. Berbari, Elie F. Curry, Timothy B. Brown, Michael J. Hyder,Joseph A. Operating Room Traffic as a Modifiable Risk Factor for Surgical Site Infection. *Surg Infect (Larchmt)* . 2016;17(6):755-760. doi:10.1089/sur.2016.123.	Nonexperimental	474 SSI patients and 803 control subject	n/a	n/a	SSIs	This large, single-center, retrospective, case control study found that OR traffic was significantly correlated to SSI rates, in cases classified as clean. They did find that SSIs were significantly linked to a history of diabetes mellitus and operative duration, in cases classified as clean.	IIIB
172	Agodi, A. Auxilia, F. Barchitta, M. Cristina, M L. D'Alessandro, D. Mura, I. Nobile, M. Pasquarella,C.Italian Study Group of Hospital Hygiene. Operating theatre ventilation systems and microbial air contamination in total joint replacement surgery: results of the GISIO-ISChIA study. *J Hosp Infect.* 2015;90(3):213-219. doi:10.1016/j.jhin.2015.02.014	Nonexperimental	28 ORs at multiple sites in Northern Italy during 1228 elective orthopedic total hip and knee procedures	n/a	n/a	Bacterial contamination, number of personnel, and number of door openings	There is considerable variability of microbial air contamination between OR ventilation types and in some cases between similar forms of ventilation types, many of which do not meet the standard requirements based on type. Facilities cannot assume that the airflow is providing an environment of acceptable microbial contamination even when it is built, monitored for function, and working correctly. Personnel need to be aware of how ventilation systems work and factors that impact it. The number of personnel and door openings were also significantly	IIIB
173	Castella A, Charrier L, Di Legami V, et al. Surgical site infection surveillance: analysis of adherence to recommendations for routine infection control practices. *Infect Control Hosp Epidemiol* . 2006;27(8):835-840	Nonexperimental	856 patient observations from 49 hospitals in Italy	n/a	n/a	Data collected about surgical infection control practices	The data collected on a wide range of surgical infection prevention parameters indicates a wide variation in practice supporting the idea that standardization and increased compliance to certain infection control practices may reduce the risk of SSIs in patients. Also found average number of people in an OR was 6-7 but that this was sometimes higher in academic medical centers and in hospitals with complex cases.	IIIB
174	Cao G, StorÃ¥s MCA, Aganovic A, Stenstad L, SkogÃ¥s JG. Do surgeons and surgical facilities disturb the clean air distribution close to a surgical patient in an orthopedic operating room with laminar airflow? *Am J Infect Control.*	Nonexperimental	4 simulated supine patient cases	n/a	n/a	Air velocity distribution	The effectiveness of a laminar air flow system may be greatly impacted by rising thermals from surgical equipment and personnel. The position of the overhead surgical lights may also greatly influence the effectiveness of the LAF.	IIIB
175	Rezapoor M, Alvand A, Jacek E, Paziuk T, Maltenfort MG, Parvizi J. Operating Room Traffic Increases Aerosolized Particles and Compromises the Air Quality: A Simulated Study. *J Arthroplasty.* 2018;33(3):851-855. doi: 10.1016/j.arth.2017.10.012.	Nonexperimental	Two experiments of particle counting with door opening and numbers of personnel	n/a	n/a	Numbers of personnel, number of door openings, particle counts	The number of personnel and door openings are a major source of airborne particles.	IIIB

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176	Smith, Eric B. Raphael, Ibrahim J. Maltenfort, Mitchell G. Honsawek, Sittisak. Dolan, Kyle. Younkins,Elizabeth A. The effect of laminar air flow and door openings on operating room contamination. *J Arthroplasty.* 2013;28(9):1482-1485. doi:10.1016/j.arth.2013.06.012 [IIB].	Quasi-experimental	642 settle plates, 2 used during each of the 81 orthopedic procedures of varying types.	1 settle plate was placed in a sterile basin inside of the laminar air flow curtain for 30 min of exposure from incision to the completion of the procedure	1 settle plate was placed in a sterile basin outside of the laminar air flow curtain for 30 min of exposure from incision to the completion of the procedure	Bacterial contamination, surgical duration, door openings, number of people, and temperature and humidity	The contamination rate was almost always lower inside the LAF curtain than outside. The study showed that the LAF does keep contamination levels down for surgeries 90 minutes or less. When compared to door openings the LAF was shown to reduce CFUs due to increased door openings but it did not completely negate the effect. The longer the case, the more door openings were recorded. Interestingly the researchers found that any door opening at all increased the number of CFUs significantly - by 70%. Therefore, the first door opening was what was most associated with contamination risk. LAF decreased microbial contamination by 36.6%. Therefore, all parts of the sterile field should be	IIB
177	Taaffe K, Lee B, Ferrand Y, et al. The Influence of Traffic, Area Location, and Other Factors on Operating Room Microbial Load. *Infect Control Hosp Epidemiol.* 2018;39(4):391-397.	Nonexperimental	27 recorded procedures	n/a	n/a	Microbial load	Found that microbial loads are correlated to movement. Increased amounts of traffic in a location correlates greater microbial loads. However, number of people and door openings did not correlate to microbial load. Recommends minimizing traffic by sterile field.	IIIC
178	Weiser MC, Shemesh S, Chen DD, Bronson MJ, Moucha CS. The Effect of Door Opening on Positive Pressure and Airflow in Operating Rooms. *J Am Acad Orthop Surg* . 2018;26(5):e105-e113.	Nonexperimental	6 empty ORs with each test configuration performed three times.	n/a	n/a	Pressure readings, smoke study results	When two doors are opened simultaneously outside air entered the OR.	IIIB
179	Hansen D, Krabs C, Benner D, Brauksiepe A, Popp W. Laminar air flow provides high air quality in the operating field even during real operating conditions, but personal protection seems to be necessary in operations with tissue combustion. *Int J Hyg Environ Health.* 2005;208(6):455-460.	Nonexperimental	105 consecutive surgical procedures under laminar air flow in three ORs lasting an average of 75 minutes	n/a	n/a	Air particle and bacterial contamination at the surgical site and instrument table	Particle levels were significant during tissue coagulation at the surgical site. This finding is important because the authors also found that increased particle levels above 5µm was significantly linked to the number of bacteria. CFUs were also significantly higher prior to incision at the instrument table and surgical site. The researchers concluded that CFU elevation prior to the procedure start may be linked to increased activity prior to incision. Particle counts were not correlated to the amount of conversation.	IIIB

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180	Radcliff KE, Rasouli MR, Neusner AK,Christopher K., et al. Preoperative Delay of More Than 1 Hour Increases the Risk of Surgical Site Infection. *Spine.* 2013;38(15):1318-1323. doi:10.1097/BRS.0b013e31828f1f0b.	Nonexperimental	7991 spine cases at a single center	n/a	n/a	SSI rates against minutes between in room time and incision time	Of the 7991 cases, 276 had SSIs. Patients that had an average in room delay prior to incision of over an hour were significantly more likely to have an SSI. The authors also found a statistically significant correlation between month of surgery and preoperative delay although it was weak.	IIIB
181	Lynch RJ, Englesbe MJ, Sturm L, et al. Measurement of foot traffic in the operating room: implications for infection control. *Am J Med Qual.* 2009;24(1):45-52. doi:10.1177/1062860608326419	Nonexperimental	3071 door openings in 28 procedures	n/a	n/a	Door openings by service, parts of the procedure, reasons, number of people, and procedural duration	Surgical traffic as measured as door openings per hour was varied across surgical specialties. The preincision time frame included 30%-50% of all the door openings recorded. Most door openings occurred because of information requests. As the duration of the procedure increased so did the numbers of door openings.	IIIB
182	Joseph A, Khoshkenar A, Taaffe KM, et al. Minor flow disruptions, traffic-related factors and their effect on major flow disruptions in the operating room. *BMJ Qual Saf.* 2019;28(4):276-283.	Nonexperimental	28 videos from 3 different OR's	n/a	n/a	Major and Minor flow disruptions	Flow disruptions can include layout, environmental hazards, usability, interruptions, and equipment failure. The severity of the disruption determined if it was mayor or minor. Minor flow disruptions can increase the risk of major disruptions.	IIIB
183	Salvati EA, Robinson RP, Zeno SM, Koslin BL, Brause BD, Wilson PDJ. Infection rates after 3175 total hip and total knee replacements performed with and without a horizontal unidirectional filtered air-flow system. *Journal of Bone & Joint Surgery* - American Volume. 1982;64(4):525-535.	Nonexperimental	3175 primary total hip (N = 2289) and total knee arthroplasty (N = 886) patients	n/a	n/a	Infection Rates	Total hip arthroplasty procedure infection rates decreased when performed in an horizontal unidirectional air flow OR. However, total knee arthroplasty procedures increased when performed in a horizontal unidirectional airflow OR. The researchers found that the scrubbed personnel in the total knee arthroplasty procedures were occasionally positioned between the horizontal unidirectional air flow and the patient's surgical incision site. There was also a statistically significant correlation between the number of people in the OR and the infection rates.	IIIB
184	Sadrizadeh S, Holmberg S, Tammelin A. A numerical investigation of vertical and horizontal laminar airflow ventilation in an operating room. *Build Environ.* 2014;82:517-525. doi:10.1016/j.buildenv.2014.09.013	Nonexperimental	Two different configurations (ie, OR set up) in two different types of airflow (ie, horizontal, vertical)	n/a	n/a	Airflow disruptions	Interruptions in airflow distributions occur in both horizontal and vertical unidirectional ultraclean air delivery systems from people and objects (eg, OR Lights).	IIIB
185	Salimnia H, Meyer MP, Mitchell R, et al. A laboratory model demonstrating the protective effects of surgical masks, face shields, and a combination of both in a speaking simulation. *Am J Infect Control.* 2021;49(4):409-415.	Quasi-experimental	Three groups of (face covers) three experiments each (simulated talking) over two distances	Use of a surgical mask (one group), use of a surgical mask and face shield (second group)	No mask or face shield	Averaged bacterial counts in each group	Use of surgical masks by both the simulated speaker and listener produced the least bacteria.	IIB

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186	Letts RM, Doermer E. Conversation in the operating theater as a cause of airborne bacterial contamination. *J Bone Joint Surg Am.* 1983;65(3):357-362.	Quasi-experimental	Passive (n= 11 positions) and active air sampling while the OR was in use. Used albumin on surgical masks to simulate particles and droplets over a water bath simulating a surgical wound to study conversation	Empty OR's, Spoke aloud during the 5, 10, 20, 30, 40, 50 and 60 minute time periods	Occupied OR's, Spoke two words every 30 seconds	Bacterial contamination	Statistically significantly higher levels of contamination were found when the OR's were occupied. Time and amount of speaking were found to significantly increase bacterial contamination. However, when the mask was worn under a hood there was a reduction in bacteria found. Researcher state that conversations should be limited. Researchers concluded that personnel a main source of bacterial contamination in the OR. In areas of the OR with reduced traffic there was less bacteria found. However, areas in the OR near a door or supplies also has higher levels of bacteria found.	IIB
187	Markel TA, Gormley T, Greeley D, Ostojic J, Wagner J. Covering the instrument table decreases bacterial bioburden: An evaluation of environmental quality indicators. *Am J Infect Control.*	Nonexperimental	Static Testing 9 tables total for each 4, 8, & 24 hour time frames. Dynamic Testing - 9 tests for 1 hour each	n/a	n/a	Bacterial contamination	Table covering decreases contamination at the 4 and 8 hour point but not at 24 hours. Covering at least portions of the sterile instrument table (eg implants) even during the procedure may reduce the risk of contamination.	IIIB
188	Wistrand C, Soderquist B, Sundqvist A. Time-dependent bacterial air contamination of sterile fields in a controlled operating room environment: an experimental intervention study. *J Hosp Infect.* 2021;110:97-102.	Quasi-experimental	1584 Blood agar plates	Covering used	No covering used	Bacterial contamination	The mean time to bacterial contamination was longer in the covered group and the covered group had significantly less contamination. Use of sterile covers to protect sterile fields for up to 24 hours is recommended.	IIA
189	Russell M, Orness M, Barton C, Conrad A, Bedard NA, Brown TS. Is There a Time-Dependent Contamination Risk to Open Surgical Trays During Total Hip and Knee Arthroplasty? *Iowa Orthop J.* 2022;42(2):107-111.	Nonexperimental	23 primary total joint arthroplasty procedures with 109 swab cultures	n/a	n/a	Bacterial contamination of an empty instrument tray opened during the procedure	57% of the procedures had at least one positive culture. 17% of the culture swabs collected were positive for bacterial growth. There was no associations with time, temperature, or humidity.	IIIB
190	Najafi F, Fernández-Rodríguez D, Parvizi J. Sterile Setup Table in the Operating Room Is Not So Sterile. *J Arthroplasty.* 2023;38(3):562-566.e3.	Nonexperimental	52 total joint arthroplasty patients (hips and knees)	n/a	n/a	Microbial contamination of the air and instrument table. Included colony-forming units (CFUs) and next-generation sequencing (NGS) analysis	12.5% instrument table and air swabs had positive cultures. Pathogens were identified in 11 of 104 swabs with NGS testing. Al swabs were collected at the end of the procedure before drapes were removed. The instrument table should not be considered sterile.	IIIB

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191	Uzun E, Misir A, Ozcamdalli M, Kizkapan EE, Cirakli A, Calgin MK. Time-dependent surgical instrument contamination begins earlier in the uncovered table than in the covered table. *Knee Surg Sports Traumatol Arthrosc.* 2020;28(6):1774-1779. doi:10.1007/s00167-019-05607-y.	Quasi-experimental	culturing of k-wires used in TKA for 40 patients.	covering sterile field	not covering sterile field	Bacterial growth	Risk of contamination increases with time. Risk may decrease if the surgical instruments are covered.	IIB
192	Van Wicklin SA. Are knowledge and attitudes of perioperative registered nurses associated with the practices of covering and monitoring sterile tables? *Perioperative Care and Operating Room Managemen* t. 2018;12:16-25. doi:10.1016/j.pcorm.2018.09.005	Nonexperimental	857 survey responses from 1613 AORN members surveyed	n/a	n/a	Attitudes, practices, and preferences of perioperative RNs on covering of sterile tables	Perioperative RNs who were knowledgeable about the rational and AORN recommendations on table covering were more likely to cover their tables. The practice of table covering was highly varied but the process was not considered burdensome. The physical attendance of an individual directly observing a covered sterile table is still prevalent but most perioperative RNs do not believe that another perioperative team member entering the room would contaminate the covered table or that people in the room providing observation would be continuously vigilant	IIIB
193	Campbell BA, Manos J, Stubbs TM, Flynt NC. Pre-preparation of the sterile instrument table for emergency cesarean section. *Surg Gynecol Obstet.* 1993;176(1):30-32	Nonexperimental	100 cultures involving 2 sterile instrument tables that were covered and tested each day for 4 days (part 1). 80 cultures involving 4 sterile instrument tables that were covered and then uncovered with a rolled technique after seven days (part 2)	n/a	n/a	Bacterial and fungal contamination	The tables that were covered and uncovered daily only had two positive cultures found on the third day but did not have positive cultures on subsequent days. The tables that were set up and covered for 7 days had two positive cultures on the initial culture prior to covering and the cultures taken after 7 days had three positive cultures from different sites than the initial positive cultures on the same tables. The authors concluded that setting up and covering tables for up to 24 hours presents minimal risk to the patient. This study used a rolled method to remove the table cover.	IIIC
194	Fischer S, Thieves M, Hirsch T, et al. Reduction of Airborne Bacterial Burden in the OR by Installation of Unidirectional Displacement Airflow (UDF) Systems. *Med Sci Monit.* 2015;21:2367-2374. doi:10.12659/MSM.894251.	Quasi-experimental	1286 procedures	Unidirectional displacement airflow	Turbulent mixing ventilation	Bacterial contamination	Unidirectional displacement airflow reduces airborne bacteria.	IIA
195	ANSI/ ASHRAE/ ASHE Standard 170-2021: Ventilation of Health Care Facilities. ANSI/ ASHRAE/ ASHE Standard 170-2021: Ventilation of Health Care Facilities. *American Society for Healthcare Engineering of the American Hospital Association;* 2021:50 [IVC].	Consensus	n/a	n/a	n/a	n/a	Standards for ventilation in health care facilities in the US.	IVB

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196	De Korne DF, Van Wijngaarden JDH, Van Rooij J, Wauben LSGL, Hiddema UF, Klazinga NS. Safety by design: effects of operating room floor marking on the position of surgical devices to promote clean air flow compliance and minimise infection risks. *BMJ Qual Saf.* 2012;21(9):746-752.	Mixed Method: Nonexperimental and Qualitative	An average of 206 observations were taken in 4 time frames (series)	n/a	n/a	Positioning of sterile field, equipment, and overhead lights in relation to the laminar flow air curtain	The instrument table and the mayo stand were increasingly positioned in the laminar air flow area, with more impact on the instrument table. Eye infections were decreased in the two years following the study. The visual floor marks provided the staff a fool-proof way of determining where the laminar air flow was. It became evident that corneal implants may be occasionally outside of the laminar flow area and that increased the staff's awareness of moving crucial items inside the air flow impact area. There needs to be a way to "mark" the area for the overhead surgical lights to move them out of the laminar flow impact area when not in use.	IIIB
197	Health Technical Memorandum 03-01: Specialised Ventilation for Healthcare Premises: Part A – Design and Validation. National Health Service (NHS); 2021.	Consensus	n/a	n/a	n/a	n/a	Technical report from the United Kingdom on ventilation of healthcare facilities. Includes a definition of ultraclean air and information on air ventilation systems in ORs.	IVB
198	Cao G, Nilssen AM, Cheng Z, Stenstad LI, Radtke A, Skogås JG. Laminar airflow and mixing ventilation: Which is better for operating room airflow distribution near an orthopedic surgical patient? *Am J Infect Control.* 2019;47(7):737-743.	Nonexperimental	4 simulated cases	n/a	n/a	Airflow disruptions	Airflow disruptions in the air curtain are caused by OR lamps and thermal plumes.	IIIB
199	Chow TT, Yang XY. Ventilation performance in the operating theatre against airborne infection: numerical study on an ultra-clean system. *J Hosp Infect.* 2005;59(2):138-147. doi:10.1016/j.jhin.2004.09.006	Nonexperimental	Data from 7 computation fluid dynamics simulations	n/a	n/a	Air contamination, velocity, and heat dissipation	OR light impact the velocity of air and can affect particle settlement.	IIIC
200	Chow TT, Lin Z, Bai W. The Integrated Effect of Medical Lamp Position and Diffuser Discharge Velocity on Ultra-clean Ventilation Performance in an Operating Theatre. *Indoor and Built Environment. 2* 006;15(4):315-331. doi:10.1177/1420326X06067802	Nonexperimental	4 OR light configurations tested in 8 cases	n/a	n/a	Airflow disruptions	Airflow disruptions occur when OR Lights are placed over the OR bed but velocity and particle dispersion are different based on the configuration of the lights. These differences change the movement of infectious particles in the same space.	IIIB
201	Aganovic A, Cao G, Stenstad L, Skogås JG. Impact of surgical lights on the velocity distribution and airborne contamination level in an operating room with laminar airflow system. *Build Environ.* 2017;126:42-53. doi:10.1016/j.buildenv.2017.09.024	Nonexperimental	4 simulated procedures with different types of surgical lights	n/a	n/a	Airflow distribution & air bacterial sampling from OR Lights	Airflow velocity was disrupted in scenarios where lights are present. 1 CFU/m3 was recording in 43% of procedures with lights in the airflow path and no bacteria were recorded when lights were not in the airflow path.	IIIB
202	Kai T, Ayagaki N, Setoguchi H. Influence of the Arrangement of Surgical Light Axes on the Air Environment in Operating Rooms. *J Healthc Eng.* 2019;2019:4861273. doi:10.1155/2019/4861273	Nonexperimental	2 OR's using vertical laminar flow with either single-axis or double-axis surgical lights	n/a	n/a	Air current and cleanliness	Uniform vertical laminar airflow was achieved and cleanliness was better in the OR with surgical lights on a double-axis.	IIIB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
203	Refaie R, Rushton P, McGovern P, et al. The effect of operating lights on laminar flow: an experimental study using neutrally buoyant helium bubbles. *Bone Joint J* . 2017;99-B(8):1061-1066. doi:10.1302/0301-620X.99B8.BJJ-2016-0581.R2	Nonexperimental	5 configurations of OR Lights	n/a	n/a	Movement of bubbles in the airflow	OR lights between the diffuser array and the OR bed prevented laminar airflow and occasionally the airflow would rise to the lights then circulated back to the sterile field. When no lights were placed between the diffuser array and the OR bed laminar airflow was present.	IIIB
204	Cutler HS, Romero JA, Minor D, Huo MH. Sources of contamination in the operating room: A fluorescent particle powder study. *Am J Infect Control.* 2020;48(8):948-950. doi:10.1016/j.ajic.2019.12.027	Nonexperimental	Two part investigation, part one involved activation of the forced-air warming blanket, part two involved OR light manipulation	n/a	n/a	Florescent particle accumulation	Researchers found that increased OR light movement was correlated with florescent particle accumulation. Recommended placing sterile handles on the lights when they are not over the sterile field and limiting movements.	IIIB
205	Stocks GW, O'Connor DP, Self SD, Marcek GA, Thompson BL. Directed Air Flow to Reduce Airborne Particulate and Bacterial Contamination in the Surgical Field During Total Hip Arthroplasty. *J Arthroplasty.* 2011;26(5):771-776.	RCT	36 total hip arthroplasty patients.	Directed airflow using a portable laminar air flow device and a directed airflow system that was in place but off	Used current practice with no device in place	Particulate and bacterial contamination	The directed air flow group had significantly less bacterial and particle counts.	IB
206	Darouiche RO, Green DM, Harrington MA, et al. Association of Airborne Microorganisms in the Operating Room With Implant Infections: A Randomized Controlled Trial. *Infect Control Hosp Epidemiol.* 2017;38(1):3-10.	RCT	294 total hip arthroplasty, vascular bypass graft, or spinal implantation procedures	148 had portable laminar air flow unit used	146 had no portable laminar air flow unit used	Bacterial contamination and SSI rates	Bacterial contamination at the surgical incision site was significantly lower when the portable laminar air flow unit was used. Additionally, the amount of airborne bacteria at the surgical incision side was also significantly related to the implant infection rates. Infections only occurred in the group with did not have a portable laminar airflow unit used.	IB
207	Lapid-Gortzak R, Traversari R, van der Linden JW, Lesnik Oberstein SY, Lapid O, Schlingemann RO. Mobile ultra-clean unidirectional airflow screen reduces air contamination in a simulated setting for intra-vitreal injection. *Int Ophthalmol* . 2017;37(1):131-137. doi:10.1007/s10792-016-0236-1.	Quasi-experimental	10 simulated intra-vitreal injections procedures in a treatment room without mechanical ventilation with 10 measurements each	Use of a portable unidirectional ultra clean air delivery system	No use of a unidirectional ultra clean air delivery system	particle counts	Mobile unidirectional ultraclean air flow unit significantly reduced the particle concentration over the surgical site and the instrument table.	IIB

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208	Nilsson K-, Lundholm R, Friberg S. Assessment of horizontal laminar air flow instrument table for additional ultraclean space during surgery. *J Hosp Infect.* ;76(3):243-246. http://dx.doi.org/10.1016/j.jhin.2010.05.016.	Quasi-experimental	2 total knee arthroplasty procedures	Use of a table mounted laminar air flow unit	Use a of second table during the same procedure that did not have a mobile laminar air flow unit	particle and bacterial counts	This study is severely limited by size. The first phase of the study showed that the use of a mobile laminar air flow unit mounted to an instrument table outside the main fixed ceiling mounted LAF unit did not affect the airflow of the fixed unit. The second phase of the study found decreased particle and bacteria counts on the instrument tables that used the portable laminar air flow unit.	IIC
209	Ferretti S, Pasquarella C, Fornia S, et al. Effect of mobile unidirectional air flow unit on microbial contamination of air in standard urologic procedures. *Surg Infect (Larchmt)* . 2009;10(6):511-516. doi:10.1089/sur.2008.104.	Quasi-experimental	45 major urologic procedures	Use of a mobile ultra clean air flow unit	No mobile ultra clean air flow unit was used	Bacterial contamination	When the mobile unidirectional ultra clean air unit was used the instrument table had a statistically significant decrease in bacteria. The use of the mobile unit also significantly decreased bacteria during nephrectomies but not during prostatectomies.	IIB
210	Sossai D, Dagnino G, Sanguineti F, Franchin F. Mobile laminar air flow screen for additional operating room ventilation: reduction of intraoperative bacterial contamination during total knee arthroplasty. *J Orthop Traumatol.* 2011;12(4):207-211.	Quasi-experimental	34 total knee arthroplasty cases. The mobile LAF unit was also used on the instrument table for 6 surgeries and then six surgeries without it.	17 procedures had a mobile laminar air flow unit used positioned between two surgeons pointing at the incision site.	17 procedures had no mobile LAF unit	Bacterial contamination and particle counts reported as particles/m3.	Without the mobile LAF the bacterial air count at the surgical wound was 23.5 CFU/m3, with the mobile LAF it was 3.5 CFU/m3, this correlated to a significant 85% reduction.	IIB
211	Thore M, Burman LG. Further bacteriological evaluation of the TOUL mobile system delivering ultra-clean air over surgical patients and instruments. *J Hosp Infect.* ;63(2):185-192. http://dx.doi.org/10.1016/j.jhin.2005.12.011.	Nonexperimental	3 different portable unidirectional ultraclean air delivery systems tested.	n/a	n/a	Bacterial deposition rates	Most units reduced the amount of contamination but in some cases it was dependent on the position and proximity to the target area.	IIIB
212	Osher RH, Figueiredo GB, Schneider JG, Kratholm J. Purifying air over the operating field with a new mobile laminar airflow device to reduce the possibility of airborne contamination. *J Cataract Refract Surg* . 2021;47(10):1327-1332.	Quasi-experimental	Stage 1 116 eye procedures involving phacoemulsification for particle counting, Stage 2 - 150 eye procedures (99 = device use, 50 = no device use) for lint fibers	Portable laminar airflow device use	No Portable laminar airflow device use	Airborne particulates and lint fibers	The portable laminar airflow device significantly reduced particles. Lint fibers seen in 16 .16% of the 99 procedures during which the lint was delivered to the sterile field by instrument, an intraocular lens injector or on the intraocular lens. Most lint fibers were white (12) and 4 were blue. No lint fibers were seen during use of the portable device compared to the control group where it was not used.	IIA

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213	Reduce risk from water. Centers for Disease Control and Prevention. Reviewed September 11, 2019. Accessed February 27, 2024. https://www.cdc.gov/hai/prevent/environment/water.html	Expert Opinion	n/a	n/a	n/a	n/a	Provides information about water safety and opportunistic pathogens that can be found in plumbing, including specific mycobacterium species.	VA
214	Nagpal A, Wentink JE, Berbari EF, et al. A Cluster of Mycobacterium wolinskyi Surgical Site Infections at an Academic Medical Center. *Infect Control Hosp Epidemiol.* 2014;35(9):1169-1175	Nonexperimental	6 cardiothoracic surgery patients with SSI from M. wolinskyi.	n/a	n/a	SSI rates and microorganisms in two and a half years following the case control study.	Study that looked at an outbreak of M. wolinskyi at a single facility, identified the potential source as the perfusion heart-lung machine water supply or the cold-air blaster in one specific OR room. Concluded that alternate machines and processes should be reviewed. Once the cold air blaster was removed and the heart-lung machine water system was changed to a portable system that can be drained, disinfected, and refilled no further infections of M. wolinskyi were reported in the 2 and a half years following. Poor documentation was noted for sterile solution used on the field and for cleaning of the dampener of the cold-air	IIIB
215	Sommerstein R, Ruegg C, Kohler P, Bloemberg G, Kuster SP, Sax H. Transmission of Mycobacterium chimaera from heater-cooler units during cardiac surgery despite an ultraclean air ventilation system. *Emerg Infect Dis.* 2016;22(6):1008-1013 [IIIC].	Nonexperimental	One OR with two tests (smoke dispersal and particle counts).	n/a	n/a	Smoke dispersal, particle measurements, and agar plate contamination	It only took 23 seconds for smoke from the heater-cooler device to reach the ultraclean air in the surgical field. When off the heater-cooler device had an average particle count of 5.2 particles a minute. Whereas when the heater-cooler device was on and oriented toward the field it had an average of 139 particles/min and 14.8 particles/min when it was on but oriented away from the surgical field. Researchers concluded that airflow generating devices pointing towards the operative field were more likely to cause airflow into the surgical field than airflow generating devices that were turned off or away from the	IIIC
216	Schreiber PW, Kuster SP, Hasse B, et al. Reemergence of Mycobacterium chimaera in Heater-Cooler Units despite Intensified Cleaning and Disinfection Protocol. *Emerg Infect Dis.* 2016;22(10):1830-1833.	Nonexperimental	134 water samples and 91 air samples.	n/a	n/a	The presence of mycobacterium chimaera	Heater cooler units in cardiac operating room underwent an intensive water and air sampling protocol to determine contamination. An intensive cleaning protocol was unable to prevent contamination in the water samples, but the air samples showed limited contamination decreasing the likelihood of a risk for surgical site infections. One conclusion was that the manufacturer's recommendations for cleaning of the heater cooler units may not have been effective.	IIIC

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217	Recommendations for the use of water-based heater cooler devices. US Food and Drug Administration. June 14 , 2022. Accessed February 27, 2024. https://www.fda.gov/medical-devices/what-heater-cooler-device/recommendations-use-water-based-heater-cooler-devices	Expert Opinion	n/a	n/a	n/a	n/a	Guidance from the FDA to prevent infections related to heater-cooler device used in cardiac surgery.	VA
218	Kuehl R, Banderet F, Egli A, et al. Different Types of Heater-Cooler Units and Their Risk of Transmission of Mycobacterium chimaera During Open-Heart Surgery: Clues From Device Design. Infect Control Hosp Epidemiol. 2018;39(7):834-840.	Nonexperimental	3 heater-cooler units from two different manufacturers	n/a	n/a	Microbial surveillance	There were differences in the microbial results for water and air between the devices. All infected patients had procedures that use one specific device leading researchers to conclude that device design may play a role.	IIIB
219	Götting T, Klassen S, Jonas D, Benk Ch, Serr A, Wagner D, Ebner W. Heater-cooler units: contamination of crucial devices in cardiothoracic surgery. *J Hosp Infect.* 2016 Jul;93(3):223-8. doi: 10.1016/j.jhin.2016.02.006.	Nonexperimental	4 types of air sampling taken at different distances from the unit, 4 air sampling at locations at different locations compared to the unit, mycobacterium chimaera testing in the patient and cardioplegia circuits of 4 devices	n/a	n/a	Positive samples for nonfermentors or m. chimaera.	When the heater-cooler unit was outside the room, M. chimaera was detected in front of the device and on the OR bed when the device was switched on. Door remained ajar due to tubing. The tubing was then routed through separate channels to allow the device to be moved outside the room and the door to be shut. However, this required extensive calculations of water volume, flow, and maintenance of the desired temperature for the machine due to the tubing extensions required.	IIIB
220	Contaminated heater-cooler devices. Centers for Disease Control and Prevention. May 19 , 2019. Accessed February 27, 2024. https://www.cdc.gov/hai/outbreaks/heater-cooler.html	Expert Opinion	n/a	n/a	n/a	n/a	CDC guidance on heater-cooler devices.	VA
221	Garvey MI, Ashford R, Bradley CW, Bradley CR, Martin TA, Walker J, Jumaa P. Decontamination of heater-cooler units associated with contamination by atypical mycobacteria. *J Hosp Infect.* 2016 Jul;93(3):229-34. doi: 10.1016/j.jhin.2016.02.007.	Quasi-experimental	Water samples from 4 heater-cooler units	3 decontamination processes	Current decontamination process	Microbial contamination	Following a prescribed contamination process after replacement of internal tubing brought water quality microorganisms to an acceptable level.	IIB
222	Xu K, Finn LE, Geist RL, et al. Mycobacterium chimaera infections among cardiothoracic surgery patients associated with heater-cooler devices-Kansas and California, 2019. *Infect Control Hosp Epidemiol.* 2022;43(10):1333-1338.	Case Report	n/a	n/a	n/a	n/a	Report of 18 cases of M. chimaera infections from two states. Discussion of recommendations including placement outside laminar flow, manufacturer recommended upgrades, disinfection, filling and draining of devices outside the OR.	VB
223	Hasse B, Hannan MM, Keller PM et al. International Society of Cardiovascular Infectious Diseases Guidelines for the Diagnosis, Treatment and Prevention of Disseminated Mycobacterium chimaera Infection Following Cardiac Surgery with Cardiopulmonary Bypass. *J Hosp Infect.* 2020;104(2):214–235.	Guideline	n/a	n/a	n/a	n/a	Mostly covers identification and treatment of the disease but there are a few recommendations on device use in clinical practice.	IVB

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224	Updated information to reduce potential cardiac surgery infection risks associated with the LivaNova 3T Heater-Cooler Systems: FDA Safety Communication. US Food and Drug Administration. October 19 , 2018. Accessed February 27, 2024. https://wayback.archive-it.org/7993/20201222111855/https://www.fda.gov/medical-devices/safety-communications/updated-information-reduce-potential-cardiac-surgery-infection-risks-associated-livanova-3t-heater	Expert Opinion	n/a	n/a	n/a	n/a	FDA guidance on use of a specific heater-cooler device.	VA
225	Update: Availability of deep-cleaning service of certain Liva-Nova PLC (formerly Sorin Group Deutschland GmbH) Stöckert 3T heater-cooler systems in the U.S.: FDA Safety Communication. US Food and Drug Administration. June 12 , 2018. Accessed February 27, 2024. https://wayback.archive-it.org/7993/20201224110611/https://www.fda.gov/medical-devices/safety-communications/update-availability-deep-cleaning-service-certain-livanova-plc-formerly-sorin-group-deutschland-gmbh	Expert Opinion	n/a	n/a	n/a	n/a	FDA guidance on deep cleaning procedures of a heater-cooler device.	VA
226	Menekşe Ş, Tanrıverdi ES, Oğuş H, et al. Stenotrophomonas maltophilia outbreak with a commercial blood gas injector as the culprit and interventions for source and prevention: A possible passage between patient and ECMO water heater device. *Am J Infect Control.* 2023;51(5):533-538. doi:10.1016/j.ajic.2022.07.012Am.J.Infect.Control.	Case Report	113 patients in a year period	n/a	n/a	n/a	Patients were infected with Stenotrophomonas maltophilia. Of the 67 samples collected 86.6% were clonally related. Extracorporeal membrane oxygenation (ECMO) water heater devices should be disinfected, needless blood gas injectors, and ECMO water reservoirs should be considered for surveillance in routine clinical practice.	VB
227	FDA's ongoing evaluation and continued monitoring of reports of nontuberculous Mycobacteria infections associated with water-based heater-cooler devices. US Food and Drug Administration. June 14 , 2022. Accessed February 27, 2024. https://www.fda.gov/medical-devices/what-heater-cooler-device/fdas-ongoing-evaluation-and-continued-monitoring-reports-nontuberculous-mycobacteria-infections#	Expert Opinion	n/a	n/a	n/a	n/a	FDA discussion of evaluation and monitoring of infections associated with heater-cooler devices.	VA
228	Barker TA, Dandekar U, Fraser N, et al. Minimising the risk of Mycobacterium chimaera infection during cardiopulmonary bypass by the removal of heater-cooler units from the operating room. *Perfusion.* 2018;33(4):264-269. doi:10.1177/0267659117739103	Organizational Experience	One project at one facility	n/a	n/a	n/a	Discussion of a quality improvement process to allow use of a heater-cooler unit in a dirty utility room adjacent to an OR.	VC
229	Matte GS, Sandora TJ, Howe RJ, et al. A novel wall water system for cardiopulmonary bypass may reduce the risk of aerosolized infection. *J Thorac Cardiovasc Surg.* 2018;156(1):318-324.	Organizational Experience	Design of a wall water system for heater-cooler devices	n/a	n/a	n/a	Discussion of an organizational improvement project to build access to water for heater-cooler devices into a wall.	VC
230	Eto S, Yoshikawa K, Takehara Y, et al. Usefulness of a multidisciplinary surgical site infection team in colorectal surgery. *J Med Invest.* 2021;68(3):256-259.	Quasi-experimental	955 colorectal patients	Instrument changes and glove changes for the surgeon before closure, wound irrigation, and antibiotic suture use.	Standard practice	SSI rates	In this pre/post study SSIs were significantly reduced with use of the intervention.	IIB

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231	Falconer R, Ramsay G, Hudson J, Watson A, Highland Colorectal SG. Reducing surgical site infection rates in colorectal surgery - a quality improvement approach to implementing a comprehensive bundle. *Colorectal Dis.* 2021;23(11):2999-3007.	Quasi-experimental	1075 patients having elective colorectal procedures	SSI bundle elements	Standard practice	SSI rates	Implementation of the bundle was associated with a decrease in SSI rates of 16.4% to 5.1% over the years of the study.	IIB
232	Faragher I, Tham N, Hong M, Guy S, Yeung J. Implementation of an organ space infection prevention bundle reduces the rate of organ space infection after elective colorectal surgery. *BMJ open qua* l. 2021;10(2).	Organizational Experience	173 patients having elective colorectal surgery	SSI bundle elements	Standard practice	Organ space SSIs, bundle compliance, costs, and unintended consequences	There was a significant reduction in SSIs after bundle implementation. The bundle compliance was fairly high but only 63% of patients had all 12 measures implemented. The range of compliance for the remaining patients was 9 to 11 of the bundle components implemented.	VA
233	Gorgun E, Rencuzogullari A, Ozben V, et al. An Effective Bundled Approach Reduces Surgical Site Infections in a High-Outlier Colorectal Unit. *Dis Colon Rectum.* 2018;61(1):89-98.	Quasi-experimental	2250 patients having colorectal procedures	SSI bundle elements	Standard practice	SSI rates and bundle compliance	There was a significant reduction in SSIs and there was between 75% to 99% compliance in use of the bundle measures.	IIB
234	Harris J. Success of a Colorectal Surgical Site Infection Prevention Bundle in a Multihospital System. *AORN J.* 2018;107(5):592-600.	Organizational Experience	No sample size given the multidisciplinary protocol was implemented for all patients who met the criteria	n/a	n/a	n/a	There were reductions in readmission rates, length of stay and SSIs for affected patients. The bundle included use of a fascial closure kit.	VB
235	Martinez C, Omesiete P, Pandit V, et al. A Protocol-Driven Reduction in Surgical Site Infections After Colon Surgery. *J Surg Res.* 2020;246:100-105.	Quasi-experimental	328 patients who had colon surgery	SSI bundle elements	Standard practice	SSI rates	Patients who participated in the protocol had significantly reduced infection rates.	IIB
236	Pop-Vicas A, Abad C, Baubie K, Osman F, Heise C, Safdar N. Colorectal bundles for surgical site infection prevention: A systematic review and meta-analysis. *Infect Control Hosp Epidemiol* . 2020;41(7):805-812.	Systematic Review w/ Meta-	n/a	n/a	n/a	n/a	Use of SSI prevention bundles in colorectal procedures reduces rates of SSIs.	IIIA
237	Ruiz-Tovar J, Boermeester MA, Bordeianou L, et al. Delphi Consensus on Intraoperative Technical/Surgical Aspects to Prevent Surgical Site Infection after Colorectal Surgery. *J Am Coll Surg.* 2022;234(1):1-11.	Nonexperimental	3 Delphi rounds with 15 panelists	n/a	n/a	Consensus on elements	Consensus was achieved on 16 evidence-based statements including use of a closure tray and love changes.	IIIA
238	Tobias J, Padilla BE, Lee J, et al. Standardized perioperative care reduces colorectal surgical site infection in children: A Western Pediatric Surgery Research Consortium multicenter analysis. *J Pediatr Surg.* 2023;58(1):45-51.	Quasi-experimental	336 pediatric patients having colorectal procedures	High compliance cohort (5-8 elements) n=198	Low compliance cohort (1-4 elements) n=138	Superficial SSIs	With high compliance (70%) to bundle element completion (5 or more elements), the rate of superficial SSIs decreased.	IIA
239	Weiser MR, Gonen M, Usiak S, et al. Effectiveness of a multidisciplinary patient care bundle for reducing surgical-site infections. *Br J Surg* . 2018;105(12):1680-1687.	Organizational Experience	1828 colorectal patients	n/a	n/a	n/a	Implementation of the bundle significantly reduced SSIs.	VB

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240	Ortiz H, Armendariz P, Kreisler E et al. Influence of rescrubbing before laparotomy closure on abdominal wound infection after colorectal cancer surgery: results of a multicenter randomized clinical trial. *Arch Surg* [Archives of Surgery Full Text]. 2012;147(7):614–620.	RCT	9 site multicenter study of 969 laparotomy for colorectal cancer resection	N=453. Removal of all drapes, rescrubbing by team members with new drapes and instruments used in closure	N=516. Scrubbed team member glove changes, old drapes covered with new drapes and new instruments used in closure	SSIs - superficial and deep	There were 146 SSIs in the post operative period. 12.8% were from the control group and 17.7% were from the intervention group. Replacement of drapes and re-scrubbing of team members did not make a statistically significant difference in SSI rates. Both groups used new drapes on the surface and new instruments and new gloves.	IA
241	Hoang SC, Klipfel AA, Roth LA, Vrees M, Schechter S, Shah N. Colon and rectal surgery surgical site infection reduction bundle: To improve is to change. *Am J Surg.* 2019;217(1):40-45.	Quasi-experimental	1351 patients having colorectal procedures	SSI bundle elements	Standard practice	SSI rates	Bundle use reduced SSIs especially as compliance increased.	IIA
242	Mcgee MF, Kreutzer L, Quinn CM, et al. Leveraging a Comprehensive Program to Implement a Colorectal Surgical Site Infection Reduction Bundle in a Statewide Quality Improvement Collaborative. *Ann Surg* . 2019;270(4):701-711.	Quasi-experimental	5137 patients who had colorectal procedures	SSI bundle elements	Standard practice	SSI rates and bundle adherence	SSI were significantly reduced and bundle adherence was correlated with a significant reduction in SSI rates.	IIA
243	Schlick CJR, Huang R, Brajcich BC, et al. Unbundling Bundles: Evaluating the Association of Individual Colorectal Surgical Site Infection Reduction Bundle Elements on Infection Rates in a Statewide Collaborative. *Dis Colon Rectum* . 2022;65(8):1052-1061.	Nonexperimental	2722 patients who had colorectal procedures in participating Illinois hospitals	n/a	n/a	Effective SSI prevention bundle elements for colorectal procedures.	Individuals with higher rates of adherence were less likely to have SSIs. Of all bundle components related to isolation technique, wound protectors and glove and gown changes were found to be effective.	IIIB
244	Ban KA, Minei JP, Laronga C, et al. American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. *J Am Coll Surg* . 2017;224(1). https://journals.lww.com/journalacs/Fulltext/2017/01000/American_College_of_Surgeons_and_Surgical.8.aspx	Guideline	n/a	n/a	n/a	n/a	Recommendations to prevent SSIs from the ACS and SIS.	IVA
245	Kuwahara R, Uchino M, Ikeuchi H, et al. Effect of Changing Surgical Instruments Before Wound Closure to Prevent Wound Infection in Lower GI Surgery: A Randomized Controlled Trial. *Dis Colon Rectum* . 2022;65(1):100-107.	RCT	437 patients that had surgery on their lower gastrointestinal tract	Use of new instruments during wound closure	Standard practice	SSI rates	There was not a decrease in SSIs when instruments were changed.	IB
246	NIHR Global Research Health Unit on, Global Surgery. Routine sterile glove and instrument change at the time of abdominal wound closure to prevent surgical site infection (ChEETAh): a pragmatic, cluster-randomised trial in seven low-income and middle-income countries. *Lancet* (london, england). 2022;400(10365):1767.	RCT	13301 patients having abdominal surgery in seven low- or middle-income countries	Routine changes of instruments and gloves for the scrubbed team members before wound closure	Standard practice	SSI rates	SSI rates were significantly decreased in the intervention group. The researchers recommend the implementation of routine glove and instrument changes before wound closure for abdominal procedures world-wide.	IA
247	Bekar A, Kahveci R, Tolunay S, Kahraman A, Kuytu T. Metastatic gliosarcoma mass extension to a donor fascia lata graft harvest site by tumor cell contamination. *World Neurosurg* . 2010;73(6):719-721. doi:10.1016/j.wneu.2010.03.015.	Case Report	n/a	n/a	n/a	n/a	Case report of seeding from metastatic cancer case to a graft donor area. Researchers reported that surgical instruments helped the spread of metastatic tumor cells. Authors recommend removing the instrumentation used in resection before closure and irrigating the surgical site	VA

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248	Zemmoura I, Ben Ismail M, Travers N, Jan M, Francois P. Maxillary surgical seeding of a clival chordoma. *Br J Neurosurg.* 2012;26(1):102-103. doi:10.3109/02688697.2011.595844.	Case Report	n/a	n/a	n/a	n/a	Case report of suspected surgical instrument seeding from clival chordoma.	VB
249	McLemore MS, Bruner JM, Curry JL, Prieto VG, Torres-Cabala CA. Anaplastic oligodendroglioma involving the subcutaneous tissue of the scalp: report of an exceptional case and review of the literature. *Am J Dermatopathol.* 2012;34(2):214-219. doi:10.1097/DAD.0b013e318230655c.	Case Report	n/a	n/a	n/a	n/a	Case report of surgical seeding of the scalp from anaplastic oligodendroglioma.	VA
250	Chang H, Ding Y, Wang P, Wang Q, Lin Y, Li B. Cutaneous Metastases of the Glioma. *J Craniofac Surg* . 2018;29(1):e94-e96.	Case Report	n/a	n/a	n/a	n/a	Cutaneous seeding of cranial based astrocytoma possibly from surgical instruments.	VB
251	Vogin G, Calugaru V, Bolle S, et al. Investigation of ectopic recurrent skull base and cervical chordomas: The Institut Curie's proton therapy center experience. *Head Neck.* 2016;38(Supplement 1):E1238-E1246.	Nonexperimental	371 patients reviewed for relapse. 5 were identified with seeding along the surgical pathway	n/a	n/a	Relapse of cancer	Five of the 13 identified relapse patients had seeding along the biopsy or surgical pathway.	IIIC
252	Iloreta AMC, Nyquist GG, Friedel M, Farrell C, Rosen MR, Evans JJ. Surgical Pathway Seeding of Clivo-Cervical Chordomas. *Journal of Neurological Surgery Reports.* 2014;75(2):e246-e250.	Case Report	n/a	n/a	n/a	n/a	Case report of clivo-cervical chordoma seeding after initial open surgery at the skin.	VB
253	Kang SI, Oh H, Kim MH, et al. Systematic review and meta-analysis of randomized controlled trials of the clinical effectiveness of impervious plastic wound protectors in reducing surgical site infections in patients undergoing abdominal surgery. *Surgery.* 2018;164(5):939-945.	Systematic Review w/ Meta Analysis	n/a	n/a	n/a	n/a	Wound protectors may reduce rates of SSIs in patients having abdominal surgery. Dual wound protectors may more likely to reduce SSI risk over single wound protectors.	IA
254	Zhang L, Elsolh B, Patel SV. Wound protectors in reducing surgical site infections in lower gastrointestinal surgery: an updated meta-analysis. *Surg Endosc.* 2018;32(3):1111-1122. doi:10.1007/s00464-017-6012-0	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	There was a significant decrease in infections in the wound protector group versus use of no wound protector and wound protectors with 2 rings (dual ring) were associated with a significantly lower rates of infections compared with wound protectors that only use one ring.	IA
255	Mao L, Zhou S, Liao J, Zhou X, Wang J. Effect of wound protectors in reducing the incidence of surgical site wound infection in lower gastrointestinal surgery: A meta-analysis. *INT WOUND J* . 2023;20(3):813-821.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Wound protectors that use one or two rings are more protective against infection that no wound protector use.	IIIA
256	Li X, Lin H, Zhu L, et al. The clinical effectiveness of wound edge protectors in reducing surgical site infection after abdominal surgery: meta-analysis. *BJS open* . 2022;6(3).	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	SSIs were decreased with use of a wound protector in abdominal surgery. Included studies were mostly procedures with wound classes of II or greater. Dual and single devices reduced SSIs compared to no device use.	IA

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257	Hassan K, Baloch S, Tan EJZ, et al. The effect of intraoperative wound protector use on the risk of surgical site infections in patients undergoing pancreatoduodenectomy: a systematic review and meta-analysis. *Langenbecks Arch Surg* . 2022;407(2):459-468.	Systematic Review w/ Meta-	n/a	n/a	n/a	n/a	Wound protector use was associated with a lower risk of superficial or deep SSI.	IIIA
258	Chomsky-Higgins K, Kahn JG. Interventions and Innovation to Prevent Surgical Site Infection in Colorectal Surgery: A Cost-Effectiveness Analysis. *J Surg Res* . 2019;235:373-382.	Nonexperimental	Decision-analytic model was used. Costs based on 2017 data and a clinical scenario including a 50 year old patient undergoing colorectal surgery	n/a	n/a	Costs, quality-adjusted life years	Device use was found to be superior to no intervention and dual ring devices were reported to have reductions in SSI risk leading to substantial cost savings despite elevated device cost.	IIIC
259	Lauricella S, Caricato M, Masciana G, Ciccozzi M, Angeletti S, Capolupo GT. Cost-effectiveness analysis of O-Ring wound retractor in elective laparoscopic colorectal surgery. *Ann Ital Chir.* 2021;92:460-464.	Nonexperimental	258 patient who had elective laparoscopic colorectal surgery	n/a	n/a	Cost difference between use of a wound protector device and no device use	No cost difference was found.	IIIB
260	Waring GJ, Shawer S, Hinshaw K. The use of O-ring retractors at Caesarean section : A systematic review and meta analysis. *Eur J Obstet Gynecol Reprod Biol.* 2018;228:209-214. doi: 10.1016/j.ejogrb.2018.06.037.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Use of wound protectors in cesarean section delivery procedures may reduce the rate of SSIs in patients with a BMI less than 35, decrease the need for uterus exteriorization (ie, bringing it partially outside the body), and can increase visualization in the operative field. However, routine use of wound protectors was not found to reduce the risk of SSIs, operative time, blood loss, the need for a blood transfusion, or additional postoperative analgesia	IA
261	Zuelzer DA, Allen J, Hsu JR, Matuszewski PE. The Far Side Opposite the Surgeon is Most Prone to Contamination From the C-Arm. *J Orthop Trauma.* 2019;33(12):e471-e474.	Nonexperimental	Draped c-arm device coated with fluorescent powder was moved from anterior/posterior position to lateral position 15 times with UV images captured at the 5th,10th, and 15th movement. This trial was performed 5 times.	n/a	n/a	Quantity and location of fluorescent powder contamination	Sterile field contamination occurred in all trials after 15 c-arm position changes. The area adjacent to the image intensifier (receiver) was the most contaminated.	IIIB

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262	Magee LC, Piazza B, Harwood K, Lawrence JT. C-arm contamination of the surgical field: Can contamination be reduced with an intervening drape? *Injury* . 2022;53(6):1994-1998.	Quasi-experimental	Draped c-arm device coated with fluorescent powder was moved from anterior/posterior position to lateral position 15 times with UV images captured at the 5th,10th, and 15th movement. This trial was performed 5 times for each group	Split drape used	Standard c-arm draping with 3/4 sheet and allis clamps	Contamination of the sterile field	The standard draping process resulted in significant sterile field contamination after 5 c-arm position changes. Use of the split drape method resulted in significantly less sterile field contamination when compared with the standard method.	IIB
263	Baird RA, Nickel FR, Thrupp LD, Rucker S, Hawkins B. Splash basin contamination in orthopaedic surgery. *Clin Orthop Relat Res.* 1984;(187)(187):129-133	Nonexperimental	78 orthopedic procedures	n/a	n/a	Bacterial contamination of the splash basin	74% of splash basins tested (with either saline or sterile water) had contamination but the colony counts were low (47% of positive cultures grew less than 10 colonies per 100ml specimen).Clean, clean-contaminated, and infected procedures and elective and emergent procedures had similar levels of contamination. The types of contamination identified were clinically relevant. Instruments placed in the splash basin should not be returned to the operative wound. Splash basin have a large surface area for exposure and may also be contaminated from instruments or gloves. Do not use the water in splash basins to cool instruments exposed to IUSS and do not return instruments that have been placed in splash basins to the surgical wound.	IIIB
264	Glait SA, Schwarzkopf R, Gould S, Bosco J, Slover J. Is repetitive intraoperative splash basin use a source of bacterial contamination in total joint replacement? *Orthopedics.* 2011 Sep 9;34(9):e546-9. doi: 10.3928/01477447-20110714-06. PMID: 21902155.	Nonexperimental	46 randomly chosen clean primary arthroplasty procedures (2 swabs each = 92 cultures)	n/a	n/a	Microbial contamination when the basin was opened compared to swabs of the basin taken at wound closure	One control (swab taken at basin opening) was positive (2.17%)and 1 of the samples taken at closure was positive (2.17%). The procedure with the infected sample at the end was significantly longer than the other procedures. This study used swabs and previous studies used aliquots so sampling methods may affect detection of contamination. There was a long time between the opening of the sterile basin and the start of the operation.	IIIC
265	Jonsson EÖ, Johannesdottir H, Robertsson O, Mogensen B. Bacterial contamination of the wound during primary total hip and knee replacement. Median 13 years of follow-up of 90 replacements. *Acta Orthop.* 2014;85(2):159-164. doi:10.3109/17453674.2014.899848	Nonexperimental	4 culture swabs collected during each of 49 primary hip arthroplasty procedures and 41 primary total knee arthroplasty procedures. Data collected in 1990 & 1991 and followed	n/a	n/a	Bacterial contamination of the wound and splash basin.	Splash basins were used to store instruments in sterile water when they were not in use. Contamination of splash basins was 19.6% and 29.3% (mean = 24.1%). Samples gathered before 130 minutes of surgery were contaminated than those collected after 130 minutes. Contamination was common but infections were rare. Longer procedure duration was correlated with higher rates of contamination.	IIIB

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266	Lindgren KE, Pelt CE, Anderson MB, Peters CL, Spivak ES, Gililland JM. A Chlorhexidine Solution Reduces Aerobic Organism Growth in Operative Splash Basins in a Randomized Controlled Trial. *J Arthroplasty.* 2018;33(1):211-215. doi:10.1016/j.arth.2017.08.017	RCT	111 splash basins	experimental solution that included 25 ml of 4% CHG added to 2 L of sterile water	Sterile Water	Bacterial contamination from aliquots	Splash basins continue to be used despite the potential for contamination. Use of the experimental solution (25 ml of 4% CHG added to 2 L sterile water) significantly reduced contamination compared to the sterile water group. Basins with sterile water had 9% contamination and basins with the experimental mixture had 0%. Recommended consideration of the inclusion of antiseptic mixtures in irrigation solution if use of sterile water in basins continues. Balance between reducing contamination in sterile water basins and the ability to remove gross soil during the procedure.	IA
267	Nazal MR, Galloway JL, Dhaliwal KK, Nishiyama SK, Shields JS. Dilute Povidone-Iodine Solution Prevents Intraoperative Contamination of Sterile Water Basins During Total Joint Arthroplasty. *J Arthroplasty* . 2020;35(1):241-246. doi:10.1016/j.arth.2019.08.016	RCT	100 total joint arthroplasty patients	Dilute betadine added to sterile water. Concentration: 2 L of sterile water with 4oz of 10% povidone-iodine solution added (dilution 1:500 or 0.02% betadine solution) (n=48)	Sterile water in splash basin (n=52)	Microbial contamination taken by aliquot	The betadine group had no contamination and the sterile water group had 47.9% contamination. Positive cultures were associated with procedures that had longer durations. Concentration: 2 L of sterile water with 4oz of 10% povidone-iodine solution added (dilution 1:500 or 0.02% betadine solution). Limitations of this research sampling methodology used (ie, swab versus aliquot and aliquot sample size), environment, duration.	IA
268	Hopper WR, Moss R. Common breaks in sterile technique: clinical perspectives and perioperative implications. *AORN J.* 2010;91(3):350-7. doi:10.1016/j.aorn.2009.09.027	Expert Opinion	n/a	n/a	n/a	n/a	There are different levels of breaks in sterile technique.	VB
269	Smith K, Araoye I, Gilbert S et al. Is retained bone debris in cannulated orthopedic instruments sterile after autoclaving? *Am J Infect Control.* 2018;46(9):1009–1013.	Quasi-experimental	15 inoculated 5 by 8 mm long cylindrical bone plugs in a cannulated drill bit	3 cannulated drill bits with bone plugs from drilling were inoculated with a mixture of different bacteria and then sterilized at 60, 120, and 180 minutes.	3 negative controls (only were exposed to sterile water), 3 positive controls (were not sterilized)	Bacterial contamination from the drill bit after sterilization with the inoculated bone in place.	Sterilization processes may not be effective in eradication of bacteria when bone debris is found in a cannulated instrument that when organic debris is found. The instrument should be considered contaminated and removed from the sterile field.	IIB
270	Rutala WA, Gergen MF, Weber DJ. Does blood on "dirty" instruments interfere with the effectiveness of sterilization technologies? *Infect Control Hosp Epidemiol* . 2022;43(9):1262-1264. doi:10.1017/ice.2021.202	Quasi-experimental	Uncleaned instruments (ie, 'dirty') were contaminated with test organisms and sterilized with steam, hydrogen peroxide gas plasma or ETO.	With blood	Without blood	Microbial Culture Results	Steam sterilization inactivated the bacteria when the instrument was dirty and in the presence of blood. ETO and hydrogen peroxide gas plasma are less reliable when the instruments are dirty or in the presences of blood.	IIB

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271	Resendiz M, Horseman TS, Hover AJ, Bradley DF, Lustik MB, West GF. Assessment of surgical instrument bioburden after steam sterilization: A pilot study. *Am J Infect Control.* 2020;48(2):219-221. doi:10.1016/j.ajic.2019.08.018	Quasi-experimental	54 instruments sets of 4 instruments each	27 wrapped instrument sets with 4 instruments and one randomly selected to be inoculated then steam sterilized	27 unwrapped instrument sets with 4 instruments and one randomly selected to be inoculated then steam sterilized	Microbial contamination	Instrument contamination was identified in 8% of unwrapped instrument sets and 15% of wrapped instruments sets. Wrapped instrument sets were more likely to be contaminated. Clean instruments in the trays (ie, noninnoculated instruments) were contaminated between 7% to 19% of the time. Contaminated instruments in an instrument tray pose a risk of contamination to other instruments in the tray.	IIB
272	Bronzatti JAG, de Souza RQ, Niero CV, et al. Evaluation of cleaning and sterilization of liposuction cannulas after intentional contamination with human fat, Mycobacterium abscessus subspecies bolletii, and Geobacillusstearothermophilus. *J Hosp Infect.* 2023;136:8-13. doi:10.1016/j.jhin.2023.03.021	Quasi-experimental	Phased study including various sizes of fat in 48 liposuction cannulas	Liposuction cannulas contaminated with fat and not cleaned, Groups of liposuction cannulas contaminated with fat and then cleaned, various cleaning practices	Brand new liposuction cannulas	Microbial contamination in the presence of fat	The presence of fat can inhibit sterilization and lead to microbial contamination.	IIA
273	Abdelaziz H, Zahar A, Lausmann C, et al. High bacterial contamination rate of electrocautery tips during total hip and knee arthroplasty. *Int Orthop.* 2018;42(4):755-760. doi:10.1007/s00264-018-3822-1	Quasi-experimental	150 electrosurgery cautery tips (ie, Bovie Tips)	50 tips from septic revisions of total joint replacement (TJR) procedures	50 tips from primary and 50 tips from aseptic TJR procedures.	Bacterial contamination	Overall contamination rate was 14.7% with the septic group rate at 30%. Recommend changing tips after debridement of infected tissue.	IIB
274	Guideline for manual chemical high-level disinfection. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2024:315–338.	Guideline	n/a	n/a	n/a	n/a	Recommendations for high-level disinfection (HLD) in perioperative practice.	IVA
275	Rutala WA, Weber DJ; Healthcare Infection Control Practices Advisory Committee, (HICPAC). Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008 (Update May 2019). Centers for Disease Control and Prevention. Accessed February 27, 2024. https://www.cdc.gov/infectioncontrol/pdf/guidelines/disinfection-guidelines-H.pdf	Guideline	n/a	n/a	n/a	n/a	Recommendations on high-level disinfection and Sterilization.	IVC
276	Butler MW, Zarosinski S, Rockstroh D. Improvement of surgical wound classification following a targeted training program at a children's hospital. *J Pediatr Surg.* 2018;53(12):2378-2382.	Organizational Experience	400 procedures for alignment with NSQIP criteria	n/a	n/a	Inaccurate surgical wound class assignment before and after a training program	Education and visual aids helped reduce the rate of misclassification of surgical wounds.	VB
277	Singh S, Podila S, Pyon G, Blewett J, Jefferson J, McKee R. An analysis of 3,954 cases to determine surgical wound classification accuracy: Does your institution need a monday morning quarterback? *Am J Surg.* 421;220(4):1115-1118.	Nonexperimental	Review of 3954 electronic medical records of patients over the age of 18 who had surgery at the facility.	n/a	n/a	Misclassification of the surgical wound classification based on information in the postoperative note.	Overall misclassification was 22%. Misclassification is common in specific procedures, service lines, and in specific time frames when the procedure is performed (ie, weekend).	IIIB
278	Levy SM, Lally KP, Blakely ML, et al. Surgical Wound Misclassification: A Multicenter Evaluation. *J Am Coll Surg.* 2015;220(3). https://journals.lww.com/journalacs/fulltext/2015/03000/surgical_wound_misclassification__a_multicenter.8.aspx	Nonexperimental	2034 procedures from 11 organizations	n/a	n/a	Concordance and misclassification of surgical wounds	The average concordance of surgical wound classification was 56% with a range of 47% to 66%. Appendectomy procedures had the lowest concordance 12% and inguinal hernia repairs had the highest at 92%.	IIIB

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279	Putnam LR, Levy SM, Holzmann-Pazgal G, Lally KP, Kao LS, Tsao K. Surgical wound classification for pediatric appendicitis remains poorly documented despite targeted interventions. *J Pediatr Surg.* 2015;50(6):915-918. doi:10.1016/j.jpedsurg.2015.03.008	Organizational Experience	995 children having appendectomies for acute appendicitis at a single institution over a 2 year period	Modification of the debriefing checklist to include SWC discussion at the end of the procedure and education-based workshop for all personnel providing direct patient care in the OR (ie, RNs, MDs	n/a	n/a	Pre/post intervention data collection showed that misclassification of surgical appendectomy procedures improved after the interventions were completed.	VB
280	Snyder RA, Johnson L, Tice J, et al. Wound Classification in Pediatric General Surgery: Significant Variation Exists among Providers. *J Am Coll Surg.* 2013;217(5). https://journals.lww.com/journalacs/fulltext/2013/11000/wound_classification_in_pediatric_general_surgery_.7.aspx	Nonexperimental	374 general surgery procedures	n/a	n/a	SWC variation	Disagreement between providers for SWC was 48% with significant variation found between providers. The highest levels of disagreement was found in fundoplication, appendectomy, and cholecystectomy procedures.	IIIB
281	Turrentine FE, Giballa SB, Shah PM, Jones DR, Hedrick TL, Friel CM. Solutions to intraoperative wound classification miscoding in a subset of American College of Surgeons National Surgical Quality Improvement Program patients. *Am Surg.* 2015;81(2):193-197	Organizational Experience	288 colorectal procedures	Pre/post quality improvement project that included education, informational posters, and postoperative debriefings.	n/a	n/a	Misclassification of SWC significantly decreased after the interventions.	VB
282	Wyrick DL, Smith SD, Dassinger MS. Implementation of the World Health Organization checklist and debriefing improves accuracy of surgical wound class documentation. *The American Journal of Surgery.* 2015;210(6):1051-1055. doi:10.1016/j.amjsurg.2015.08.010	Organizational Experience	390 combined appendectomy, inguinal hernia repair, fundoplication, gastrostomy tube placement, pyloromyotomy, incision and drainage of abscess, cholecystectomy, and stoma takedown procedures	Education sessions for nurses and surgeons, including use of sign out portion of the WHO checklist, checkpoint for surgeon debriefing to address SWC.	n/a	n/a	There was a statistically significant increase in SWC concordance after implementation of the interventions. Cholecystectomy procedures were the least accurate pre and post intervention.	VB
283	Zens TJ, Rusy DA, Gosain A. Pediatric surgeon–directed wound classification improves accuracy. *J Surg Res.* 2016;201(2):432-439. doi:10.1016/j.jss.2015.11.051	Organizational Experience	325 pediatric general surgery procedures - inguinal hernia repair, gastrostomy and Nissen fundoplication, appendectomy without perforation, and	Pre/post intervention included a structured debriefing process with surgeon-directed SWC.	n/a	n/a	There was a statistically significant increase in the accuracy of the documented SWC.	VB

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284	Surgical Site Infection (SSI) Event. Chapter 9. Surgical Site Infection (SSI) Event. Chapter 9. National Healthcare Safety Network, Centers for Disease Control and Prevention; 2023:41	Expert Opinion	n/a	n/a	n/a	n/a	CDC NHSN information on surgical wound classification.	VA
285	Berard F, Gandon J. Postoperative wound infections: the influence of ultraviolet irradiation of the operating room and of various other factors. *Ann Surg.* 1964;160(Suppl 2):1–192.	Quasi-experimental	14,854 patients from 5 institutions	Use of ultraviolet light	No ultraviolet light use	Surgical site infections (and SWC)	Seminal study that included the first definition of SWC.	IIB
286	Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. The Hospital Infection Control Practices, Advisory Committee. *Infect Control Hosp Epidemiol.* 1999;20(4):250–278.	Guideline	n/a	n/a	n/a	n/a	Historic CDC guideline that included definitions of surgical wound classification and described some catastrophic events that may be considered a break in sterile technique.	IVB
287	Cruse P. Wound infection surveillance. *Rev Infect Dis.* 1981;3(4):734–737.	Organizational Experienc	62,939 surgical wounds	n/a	n/a	n/a	Seminal article using and describing surgical wound classification. Glove perforations did not affect infection rates.	VB
288	Stefanou A, Worden A, Kandagatla P, Reickert C, Rubinfeld I. Surgical Wound Misclassification to Clean From Clean-Contaminated in Common Abdominal Operations. *J Surg Res.* 2020;246:131-138.	Nonexperimental	National Surgical Quality Improvement Program (NSQIP) procedural data on surgical wound classification of 1,208,544 colectomy, cholecystectomy, hysterectomy, and appendectomy.	n/a	n/a	Misclassification of the surgical wound classification	The overall misclassification rate was 1.90%. Hysterectomy was the most commonly misclassified procedure (3%) and colectomy is the least most commonly misclassified (0.82%). Misclassification was more common in laparoscopic procedures.	IIIB
289	Chupp RE, Edhayan E. An effort to improve the accuracy of documented surgical wound classifications. *Am J Surg.* 1202;215(3):515-517.	Organizational Experience	783 procedures including colectomies, appendectomies, and cholecystectomies	Pre/post intervention including placement of a reference algorithm in each OR and staff education.	n/a	n/a	Misclassification of SWC decreased significantly in colectomy and appendectomy procedures but not significantly in cholecystectomy procedures.	VB
290	Gorvetzian JW, Epler KE, Schrader S, et al. Operating room staff and surgeon documentation curriculum improves wound classification accuracy. *Heliyon.* 2018;4(8). doi:10.1016/j.heliyon.2018.e00728	Organizational Experience	747 patient charts reviewed retrospectively	pre/post intervention that included education, algorithm cards provided to staff and hund in the ORs, and change in electronic documentation requiring personnel to manually enter the SWC	n/a	n/a	The SWC agreement was significantly improved after the intervention.	VB

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291	Teter J, Guajardo I, AlRammah T, Rosson G, Perl TM, Manahan M. Assessment of operating room airflow using air particle counts and direct observation of door openings. *Am J Infect Control.* 2017;45(5):477-482.	Nonexperimental	1 OR with 7 plastic surgery cases over 5 days, 660 air measurements were taken	n/a	n/a	Air particle counts compared against door openings and numbers of personnel	Door openings were significantly positively correlated to increased particles greater than 0.5µ in size. The increase in particles was not associated with a particular door that was opened (eg outer corridor door versus sterile core door). The study found that one or more doors were open during almost half of all measurements taken. Particle counts did not correlate to the number of people in the OR. A third of all door openings was from circulating nurses.	IIIA
292	DiBartola AC, Patel PG, Scharschmidt TJ, et al. Operating room team member role affects room traffic in orthopaedic surgery: a prospective observational study. *Curr Orthop Pract* . 2017;28(3):281-286.	Nonexperimental	46 orthopedic cases with an implant	n/a	n/a	Door openings per minute	The overall rate of door openings per case was around 127 with a margin of 47 + or -. Procedures had an average time of 226 minutes and ranged from 90-521 minutes. This means that during each minute of the procedure the rate of door openings was between 0.2193 to 1.014. Nursing and surgical technologist traffic was the most significant group associated with door openings.	IIIA
293	DiBartola AC, Barron C, Smith S, et al. Decreasing Room Traffic in Orthopedic Surgery: A Quality Improvement Initiative. *Am J Med Qual.* 2019;34(6):561-568.	Organizational Experience	77 orthopedic procedures (35 pre, 42 post)	n/a	n/a	n/a	Door opening decreased significantly, and all groups but anesthesia had reductions in traffic. I*nterventions focused on education, awareness, and efficiency strategies including decreasing frequency of breaks, rules for door openings, door signs, door counters for awareness, proactive anticipation of supplies, briefings by surgeons, additional time outs prior to opening case cart supplies, and creating lists of anticipated supplies on the white board.*	VB
294	Parent M. OR Traffic and Surgical Site Infections: A Quality Improvement Project. *AORN J* . 2021;113(4):379-388.	Organizational Experience	Observations in primary total arthroplasty hip and knee procedures.	n/a	n/a	n/a	Traffic was reduced by 46.9% and door openings reduced from 1.96 per minute to 1.04 per minute.	VB
295	Young RS, O'Regan DJ. Cardiac surgical theatre traffic: time for traffic calming measures? *Interact Cardiovasc Thorac Surg.* 2010;10(4):526-529.	Nonexperimental	46 cardiac surgery patients in 2 OR's	n/a	n/a	Door opening rate and rate by minute and hour, frequency, and time door remains open	Total rate of door opening was 4273 for 46 cases. The average number of door openings per procedure 92.9. When the procedure duration was adjusted for the average rate of door opening per minute was 0.32 and per hours was 19.2. The doors took an average of 20 seconds to close. This meant that the door was open for an average of 31 minutes per procedure which totaled 10.7% of each hour. The researchers concluded that the rates of door openings was high and that it was unnecessary and would benefit from practice interventions to reduce these numbers. The researchers recommended education, training, auditing.	IIIC

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296	Sturm L, Sturm LK, Jackson J, Murphy S, Chenoweth C. Measurement and analysis of foot traffic in a university hospital operating room. *Am J Infect Control* . 2012;40(5):e124-e125.	Nonexperimental	28 procedures from cardiac, orthopedic (spine and joint), plastics, general, and neurosurgery	n/a	n/a	Door opening rates, role and number of personnel, and reason for door opening	Door openings range per case was 13-316. Cardiac surgery had the most openings and general surgery had the least. The preincision time had the highest rate of door openings. Most door opening (27-54%) were attributed to information requests and checking on the case or paperwork, which could be replaced with other types of communication. Personnel break openings were attributed to 20-26% of door openings and supply traffic was 11-22%. The perioperative nurse and the core staff generated 37-51% of the door openings. May contribute to contamination in the room.	IIIB
297	Pulido RW, Kester BS, Ran. Effects of intervention and team culture on operating room traffic. *Qual Manag Health Care.* 2017;26(2):103-107.	Nonexperimental	207 cases 50 were total hip and knee arthroplasties and 157 cases were orthopedic but non-arthroplasty	n/a	n/a	Door opening rates	Simple verbal commands by surgeons are shown to have a statistically significant reduction of OR door openings.	IIIB
298	Parikh SN, Grice SS, Schnell BM, Salisbury SR. Operating room traffic: is there any role of monitoring it? *J Pediatr Orthop.* 2010;30(6):617-623.	Quasi-experimental	2 phase study including 4350 minutes of surgical time	Observing OR traffic with the knowledge of the personnel (N = 1908 minutes)	Observing OR traffic without the knowledge of the personnel (N = 2442 minutes)	Door opening rates and number of people	Known surveillance of traffic in the OR did not change behavior. Monitoring is important but other interventions may be needed to decrease door openings.	IIC
299	Eskildsen SM, Moskal PT, Laux J, Del Gaizo DJ. The effect of a door alarm on operating room traffic during total joint arthroplasty. *Orthopedics.* 2017;40(6):e1081-e1085.	Nonexperimental	100 door openings during primary hip and knee cases by a single surgeon	n/a	n/a	Door opening rates and how long the door was open	The first 50 cases only counted door openings and time the door was ajar. In the next 50 cases an alarm was placed on the door to indicate when it was open. The alarm decreased door openings significantly but the result did decrease over time, presumably as the staff got used to the alarm. The amount of time the door was left open also was significantly decreased with the application of the alarm.	IIIA
300	Barbara D. Looking forward—infection prevention in 2017. *AORN J.* 2016;104(6):531-535.	Literature Review	n/a	n/a	n/a	n/a	Measurers to decrease door openings in the OR include use of intercom systems, real-time video monitoring systems, glass windows, mobile phones, storage of frequently used supplies inside the room, pass-through windows, door signs, and automatic door counters.	VB
301	Hamilton WG, Balkam CB, Purcell RL, Parks NL, Holdsworth JE. Operating room traffic in total joint arthroplasty: identifying patterns and training the team to keep the door shut. *Am J Infect Control.* 2018;46(6):633-636.	Nonexperimental	264 hip and knee total arthroplasty procedures	n/a	n/a	Door opening rates	Found that installing door opening counters was not enough to decrease door openings. Found reduction in door openings after education was provided.	IIIB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
302	Gormley T, Markel TA, Jones,Howard W., I.,II, et al. Methodology for analyzing environmental quality indicators in a dynamic operating room environment. *Am J Infect Control.* 2017;45(4):354-359. doi:10.1016/j.ajic.2016.11.001	Nonexperimental	3 different OR's om 3 different hospitals in 2 states	n/a	n/a	Rate of environmental quality indicators (EQIs) during dynamic testing in an OR (air velocity; temperature, humidity, and pressurization; and microbial data.	The EQI testing protocol was measurable and repeatable and can be used to evaluate air quality in the OR to guide facility personnel. The microbial data showed that the testes ORs corresponded to an ISO class 8. Achieving near-zero contaminants in an OR may not be practical or necessary.	IIIA
303	Pasquarella C, Balocco C, Colucci ME, et al. The Influence of Surgical Staff Behavior on Air Quality in a Conventionally Ventilated Operating Theatre during a Simulated Arthroplasty: A Case Study at the University Hospital of Parma. *Int J Environ Res Public Health.* 2020;17(2).	Quasi-experimental	2 simulated hip arthroplasty procedures	Personnel behaving incorrectly including 25 door openings, presence of additional personnel, unnecessary personnel movement and talking.	Personnel behaving correctly including three door openings, reduction of personnel movement, talking only about the procedure. At rest measurements were also taken as control data.	Rates of microbes, particulates, and climate including temperature, humidity, CO2, and air velocity	Correct behavior reduced microbial air rates. Personnel behavior had a strong influence on indoor air quality and ventilation efficacy. Contains some information to consider when determining potential benchmarks for air quality.	IIC
304	Wagner JA, Greeley DG, Gormley TC, Markel TA. Comparison of operating room air distribution systems using the environmental quality indicator method of dynamic simulated surgical procedures. *Am J Infect Control.* 2019;47(1):e1-e6.	Nonexperimental	Compared single large diffuser, multidiffuser array, and a 4-way throw diffuser for air during dynamic simulated surgical procedures	n/a	n/a	Colony forming units (CFUs), particulates, air velocity, CO2, and temperature	Cleaner air is delivered when the air delivery system eliminates blockages such as booms and access panels between the array and the sterile area. Researchers conclude that expansion of the air delivery system to areas outside the sterile field may further reduce contamination in critical zones.	IIIA
305	*ISO 14644-1:2015: Cleanrooms and Associated Controlled Environments. Part 1: Classification of Air Cleanliness by Particle Concentration.* 2nd ed. International Organization for Standardization (ISO); 2015.	Guideline	n/a	n/a	n/a	n/a	Recommendations for cleanrooms and controlled environments, such as those in a pharmacy hood.	IVB
306	*ANSI/ASHRAE Standard 52.2-2017: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.* American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE); 2017 [IVB].	Consensus	n/a	n/a	n/a	n/a	Standards for testing air ventilation including in health care facilities in the US. Provides information on airflow and air optimally moving from clean to dirty.	IVB
307	Hoffman PN, Williams J, Stacey A, et al. Microbiological commissioning and monitoring of operating theatre suites. *J Hosp Infect.* 2002;52(1):1-28. doi:10.1053/jhin.2002.1237	Consensus	n/a	n/a	n/a	n/a	Consensus report from the United Kingdom Hospital Infection Society detailing microbial monitoring in ORs.	IVB
308	Schuster LM, Chinn RYW, Arduino MJ et al. Guidelines for Environmental Infection Control in Health-Care Facilities: Recommendations of the CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Chicago IL: American Society for Healthcare Engineering/American Hospital Association; 2004.	Guideline	n/a	n/a	n/a	n/a	CDC recommendation on environmental infection control in healthcare organizations.	IVB

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309	Thomas AM, Simmons MJ. The effectiveness of ultra-clean air operating theatres in the prevention of deep infection in joint arthroplasty surgery. *The Bone & Joint Journal.* 2019;100-B(10):1264-1269.	Expert Opinion	n/a	n/a	n/a	n/a	Literature review and expert opinion article on ultraclean air in the OR. Discusses limitations of observational evidence, the logarithmic relationship between OR air quality and infection rates, and behavioral changes to increase the efficiency of ultraclean air ventilation systems.	VB
310	*P100 Facilities Standards for the Public Buildings Service with 2022 Addendum.* U.S. General Services Administration (GSA); 2021	Regulatory	n/a	n/a	n/a	n/a	Regulatory requirements and information on standards for governmental facilities including ventilation standards.	n/a
311	ASHRAE 241-2023: Control of Infectious Aerosols. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE); 2023.	Consensus	n/a	n/a	n/a	n/a	Developed during COVID-19 pandemic response to establish minimum requirements for control of infectious aerosols to reduce risk of disease transmission in the occupiable space in new buildings, existing buildings, and major renovations to existing buildings, including requirements for both outdoor air system and air cleaning system design, installation, commissioning, operation, and maintenance.	IVB
312	Mora M, Mahnert A, Koskinen K, et al. Microorganisms in Confined Habitats: Microbial Monitoring and Control of Intensive Care Units, Operating Rooms, Cleanrooms and the International Space Station. *Front Microbiol.* 2016;7:1573. doi:10.3389/fmicb.2016.01573	Literature Review	n/a	n/a	n/a	n/a	Discussion of 4 zones of cleanliness and bacterial burden. Questioning if particle count correlates to bacterial count. Recommends monitoring for air quality.	VB
313	Pasquarella CIM, Auxilia F, Barchitta M, et al. Air microbial sampling in operating theatres by active and passive methods: equation correlation from the GISIO-ISChIA study results and comparison with the EU GGMP recommendation, towards the definition of threshold values. *Acta Biomed.* 2023;94(1):e2023017.	Nonexperimental	335 elective prothesis procedures	n/a	n/a	Microbial air contamination values between passive and active sampling methods	Correlation between sampling methods was established. Both passive and active sampling methods can be used but passive methods may be considered more relevant during activity and can be used for routine microbial monitoring.	IIIC
314	Lidwell OM, Lowbury EJ, Whyte W, Blowers R, Stanley SJ, Lowe D. Effect of ultraclean air in operating rooms on deep sepsis in the joint after total hip or knee replacement: a randomised study. *Br Med J (Clin Res Ed)* . 1982;285(6334):10-14. doi:10.1136/bmj.285.6334.10	RCT	8055 hip and knee replacements (Hip n=6781, knee n=1274)	Use of ultraclean air delivery and body-exhaust suits	Use of conventional HVAC with routine surgical attire including sterile gowns	Bacteria in the air and surgical wound, the incidence of deep joint sepsis, and prophylactic antibiotic use	Use of ultraclean air delivery in the OR and whole body exhaust suits was correlated with significant reductions in bacteria and infections. Seminal study.	IA
315	*Health Technical Memorandum 03-01: Specialised Ventilation for Healthcare Premises. Part B: Management, Maintenance and Routine Testing of Existing Healthcare Ventilation Systems.* National Health Service (NHS); 2021.	Consensus	n/a	n/a	n/a	n/a	Technical report from the United Kingdom on ventilation of healthcare facilities. Includes recommendations on verifying the effectiveness of the air ventilation system in ORs which is considered a critical area.	IVB

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316	*ISO 14644-17: Cleanrooms and associated controlled environments. Part 17: Particle deposition rate applications.* International Organization for Standardization (ISO); 2021	Guideline	n/a	n/a	n/a	n/a	Recommendations and information on particle deposition rates in cleanrooms and controlled environments, such as those in a pharmacy hood.	IVB