

Evidence Table  
Guideline for Hand Hygiene  
September 1, 2016

REFERENCE #	CITATION	CONCLUSION(S)	CONSENSUS SCORE	EVIDENCE TYPE	POPULATION	INTERVENTIONS	COMPARISON	SAMPLE SIZE	OUTCOME MEASURE
1	Ellingson K, Haas JP, Aiello AE, et al. Strategies to prevent healthcare-associated infections through hand hygiene. <i>Infect Control Hosp Epidemiol.</i> 2014;35(8):937-960.	SHEA Compendium Guideline on hand hygiene.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
2	Tanner J, Dumville JC, Norman G, Fortnam M. Surgical hand antiseptics to reduce surgical site infection. <i>Cochrane Database Syst Rev.</i> 2016;1:CD004288.	No one surgical hand antiseptic was more effective than another for preventing SSI. Although the evidence was conflicting, some research indicates that alcohol-based antiseptics may be more effective for reducing bacterial counts on hands than aqueous-based solutions. The evidence is also unclear on how the number of bacteria correlates to the likelihood of a patient developing an SSI. Overall, the available evidence on surgical hand antiseptics is low quality.	IB	Systematic Review	n/a	n/a	n/a	10	SSI, hand bacterial counts
3	WHO Guidelines on Hand Hygiene in Health Care. Geneva, Switzerland: World Health Organization; 2009.	WHO guidelines for hand hygiene, including surgical hand scrubs.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
4	Boyce JM, Pittet D; Healthcare Infection Control Practices Advisory Committee. Society for Healthcare Epidemiology of America. Association for Professionals in Infection Control. Infectious Diseases Society of America. Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings: recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. <i>Infect Control Hosp Epidemiol.</i> 2002;23(12 Suppl):S3-S40.	CDC Guidelines for Hand Hygiene.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
5	Surgical Site Infection: Evidence Update June 2013 [Evidence Update 43]. Manchester, United Kingdom: National Institute for Health and Care Excellence; 2013.	NICE (UK) Guideline for surgical site infection prevention.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
6	Fagernes M, Lingaas E. Factors interfering with the microflora on hands: a regression analysis of samples from 465 healthcare workers. <i>J Adv Nurs.</i> 2011;67(2):297-307.	Fingernails longer than 2 mm were significantly associated with the prevalence of <i>Staphylococcus aureus</i> . There was no effect of nail polish status on the bacterial count for the whole hand. Using hand lotion within 5 minutes before sampling was significantly associated with the presence of <i>Staphylococcus aureus</i> . Wearing a wristwatch was significantly associated with a higher total bacteria count on hands than not wearing a watch. Wearing rings was associated with a higher total number of bacteria, and wearing one ring increased the rate of colonization with <i>Enterobacteriaceae</i> .	IIIB	Non-experimental	Norwegian	n/a	n/a	465 health care personnel	Hand cultures

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7	Rupp ME, Fitzgerald T, Puumala S, et al. Prospective, controlled, cross-over trial of alcohol-based hand gel in critical care units. <i>Infect Control Hosp Epidemiol.</i> 2008;29(1):8-15.	Fingernail length longer than 2 mm (0.08 inches) was significantly associated with a higher number of microorganisms compared with fingernail lengths shorter than 2 mm.	IIB	Quasi-experimental	USA, 2 medical-surgical intensive care units at a tertiary care teaching hospital	Alcohol-based hand rub introduced to unit	No alcohol-based hand rub in unit	174 personnel	Hand hygiene compliance, patient outcomes, microbial hand flora of health care personnel
8	Hautemaniere A, Cunat L, Diguio N, et al. Factors determining poor practice in alcoholic gel hand rub technique in hospital workers. <i>J Infect Public Health.</i> 2010;3(1):25-34.	Having long nails was associated with ineffective hand rub use by the evaluation criteria. However, the researchers did not describe the nail length that was used to classify nails as long in this study.	IIB	Quasi-experimental	France	Educational intervention (30-minute session to teach best practices for use of alcohol-based hand rub)	n/a	3,067 hospital personnel	Hand hygiene effectiveness (validated technique to observe rubbing time (limit 30 seconds), adherence to application protocol, and visual criteria [UV light])
9	AST Standards of Practice for Surgical Attire, Surgical Scrub, Hand Hygiene and Hand Washing. April 13, 2008. Association of Surgical Technologists. <a href="http://www.ast.org/uploadedFiles/Main_Site/Content/About_Us/Standard_Surgical_Attire_Surgical_Scrub.pdf">http://www.ast.org/uploadedFiles/Main_Site/Content/About_Us/Standard_Surgical_Attire_Surgical_Scrub.pdf</a> . Accessed June 27, 2016.	AST Standards for surgical scrubs and hand hygiene.	IVC	Guideline	n/a	n/a	n/a	n/a	n/a
10	Infection Prevention and Control Guidelines for Anesthesia Care. 2015. American Association of Nurse Anesthetists. <a href="http://www.aana.com/resources2/professionalpractice/Pages/Infection-Prevention-and-Control-Guidelines-for-Anesthesia-Care.aspx">http://www.aana.com/resources2/professionalpractice/Pages/Infection-Prevention-and-Control-Guidelines-for-Anesthesia-Care.aspx</a> . Accessed June 27, 2016.	AANA Infection control guide.	IVB	Consensus	n/a	n/a	n/a	n/a	n/a
11	Arrowsmith VA, Taylor R. Removal of nail polish and finger rings to prevent surgical infection. <i>Cochrane Database Syst Rev.</i> 2014;8:CD003325.	One small trial investigated the number of bacteria on the skin of personnel with and without nail polish and did not identify any clear differences between bacterial counts. No studies were found on the effect of perioperative personnel wearing rings. No studies were found to evaluate the effect on surgical wound infection. There is insufficient evidence to determine whether wearing nail polish effects the rate of surgical wound infection.	IC	Systematic Review	n/a	n/a	n/a	1	Surgical wound infection
12	Van Der Meer EWC, Boot CRL, Van Der Gulden JWJ, et al. Hands4U: The effects of a multifaceted implementation strategy on hand eczema prevalence in a healthcare setting. Results of a randomized controlled trial. <i>ContactDerm.</i> 2015;72(5):312-324.	Researchers found that 12 months after the baseline report, the intervention group was significantly more likely to report hand eczema, less hand washing, more frequent moisturizer use, and more use of cotton undergloves. Increased awareness of hand eczema symptoms may have led to the increased reporting of hand eczema in the intervention group.	IB	RCT	Netherlands	Educational intervention to prevent hand eczema	No education	1,649 hospital personnel	Self-reported hand eczema and preventive behavior

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13	Harnoss JC, Brune L, Ansorg J, Heidecke C-D, Assadian O, Kramer A. Practice of skin protection and skin care among German surgeons and influence on the efficacy of surgical hand disinfection and surgical glove perforation. BMC Infect Dis. 2014;14:315.	Survey: Sent to 16,000 German surgeons, 1,433 responses (response rate 11%). 50% reported skin irritation or discomfort, only 5% reported that they used skin care products. 10% refused to use skin care products because of concern that the product would reduce the antimicrobial efficacy of the surgical hand rub. Risk of participation bias.  Experimental crossover study: Intervention group had significantly higher skin moisture with no significant changes in surgical hand rub effectiveness or glove microperforations than the control group. Readers cautioned to assess the compatibility of skin care products with hand hygiene products during the product selection process.	IB	Survey and RCT	German surgeons	Using skin care products three times daily for 8 days (n = 13)	Did not use any skin care products (n = 13)	23	Effect of skin protection and skin care products on surgical hand antisepsis and glove microperforations after 3 hours of glove wear at rest.
14	Facility Guidelines Institute, US Department of Health and Human Services, American Society for Healthcare Engineering. Guidelines for Design and Construction of Hospitals and Outpatient Facilities. Chicago, IL: American Society for Healthcare Engineering of the American Hospital Association; 2014.	FGI guidelines for design and construction of hospitals, including hand hygiene stations and surgical hand scrub facilities.	IVC	Guideline	n/a	n/a	n/a	n/a	n/a
15	Guideline for prevention of transmissible infections. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2016:471-506.	The activities of health care personnel with dermatitis, infections, exudative lesions, and nonintact skin should be restricted when these activities pose a risk of transmission of infection to patients and other health care providers.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
16	Bolyard EA, Tablan OC, Williams WW, Pearson ML, Shapiro CN, Deitchmann SD. Guideline for infection control in healthcare personnel, 1998. Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol. 1998;19(6):407-463.	State, federal, and professional guidelines and strategies should be followed to determine the need for work restrictions for health care personnel with bloodborne infections.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
17	Henderson DK, Dembry L, Fishman NO, et al. SHEA guideline for management of healthcare workers who are infected with hepatitis B virus, hepatitis C virus, and/or human immunodeficiency virus. Infect Control Hosp Epidemiol. 2010;31(3):203-232.	State, federal, and professional guidelines and strategies should be followed to determine the need for work restrictions for health care personnel with bloodborne infections.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
18	Guideline for surgical attire. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2016:95-118.	Jewelry that cannot be contained within the surgical attire not be worn in the semi-restricted or restricted areas.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
19	Loftus RW, Brown JR, Koff MD, et al. Multiple reservoirs contribute to intraoperative bacterial transmission. Anesth Analg. 2012;114(6):1236-1248.	The contaminated hands of anesthesia providers serve as a significant source of patient environmental and stopcock set contamination in the operating room. Intraoperative bacterial transmission to the IV stopcock set occurred in 11.5% (19/164) of cases, 47% (9/19) of which were of provider origin. Intraoperative bacterial transmission to the anesthesia environment occurred in 89% (146/164) of cases, 12% (17/146) of which were of provider. Origin.	IIIA	Non-experimental	USA, medical center	n/a	n/a	164 cases	Cultures of anesthesia provider hands, anesthesia environment, and IV tubing

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20	Mermel LA, Bert A, Chapin KC, LeBlanc L. Intraoperative stopcock and manifold colonization of newly inserted peripheral intravenous catheters. <i>Infect Control Hosp Epidemiol.</i> 2014;35(9):1187-1189.	38% of patients who had catheters inserted intraoperatively had contamination of at least 1 of the 3 stopcocks on their catheter manifold assembly, predominantly with heavy growth of skin flora. Although manifold lumen flush cultures revealed less growth, transient bacteremia from injection into colonized stopcocks may occur.	IIIB	Non-experimental	USA, hospital	n/a	n/a	24 patients	Cultures of stopcocks and manifold of newly inserted IV
21	Loftus RW, Brown JR, Koff MD, et al. Multiple reservoirs contribute to intraoperative bacterial transmission. <i>Anesth Analg.</i> 2012;114(6): 1236-1248.	Bacterial contamination of patients, provider hands, and the environment contributes to stopcock transmission events, but the surrounding patient environment is the most likely source. Stopcock contamination is associated with increased patient mortality (p = .014). Multimodal programs designed to target each of these reservoirs in parallel should be studied intensely as a comprehensive approach to reducing intraoperative bacterial transmission.	IIIA	Non-experimental	USA, 3 medical centers	n/a	n/a	548 cases	Cultures: provider hand, patient, environment, peripheral IV tubing 3-way stopcocks
22	Cosgrove MS. Infection control in the operating room. <i>Crit Care Nurs Clin North Am.</i> 2015;27(1):79-87.	Literature review on infection control practices in the OR, including hand hygiene.	VB	Literature Review	n/a	n/a	n/a	n/a	n/a
23	Munoz-Price LS, Birnbach DJ. Hand hygiene and anesthesiology. <i>Int Anesthesiol Clin.</i> 2013;51(1):79-92.	Expert opinion with references about performance of hand hygiene by anesthesia professionals. Current hand hygiene guidelines have not taken into account the rapid pace and task density associated with the administration of anesthesia in the perioperative setting. Supports the use of personal hand hygiene dispensers to increase access to hand hygiene products for anesthesia professionals.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a
24	Munoz-Price LS, Lubarsky DA, Arheart KL, et al. Interactions between anesthesiologists and the environment while providing anesthesia care in the operating room. <i>Am J Infect Control.</i> 2013;41(10):922-924.	There is a need for more specific hand hygiene guidelines tailored to anesthesia personnel providing care in the OR setting. Anesthesia providers touched 1,132 objects during 8 hours of observations and performed a total of only 13 hand disinfections.	VA	Organizational Experience	USA, teaching hospital	n/a	n/a	1,132	Contacts between anesthesiologist and the OR
25	Munoz-Price LS, Riley B, Banks S, et al. Frequency of interactions and hand disinfections among anesthesiologists while providing anesthesia care in the operating room: induction versus maintenance. <i>Infect Control Hosp Epidemiol.</i> 2014;35(8):1056-1059.	There were a high number of contacts of anesthesiologists with the anesthesia work environment and patients' body surfaces during both the induction and maintenance of anesthesia. Contacts with surfaces occurred a mean of 154.8 and 60 times per hour during induction and maintenance, respectively (P < .0001). Hand hygiene events were 1.8 per hour during induction versus 1.19 during maintenance (P = .018). The lack of tailored hand hygiene guidelines during anesthesia care in the OR makes changing behavior among providers particularly challenging. Therefore, more clear and reasonable expectations are urgently needed.	IIIB	Non-experimental	USA, teaching hospital	n/a	n/a	30 anesthesia providers observed	Number of contacts with the environment, hand hygiene

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26	Rowlands J, Yeager MP, Beach M, Patel HM, Huysman BC, Loftus RW. Video observation to map hand contact and bacterial transmission in operating rooms. <i>Am J Infect Control.</i> 2014;42(7):698-701.	Used video observations of anesthesia professionals to evaluate hand hygiene compliance with WHO criteria. Three perioperative team members (ie, an anesthesiologist, an anesthesiology resident, and a perioperative RN) reviewed the videos independently. The researchers found that hand hygiene compliance in the anesthesia work area was low and that compliance with current hand hygiene guidelines was not feasible. A limitation of the study was that the perioperative team being observed was aware of the recording, which could have biased the observations by creating a Hawthorne effect.	IIIA	Non-experimental	USA	n/a	n/a	Average of 149 hand hygiene opportunities per hour of anesthesia time	Hand hygiene compliance
27	Allen G. Hand hygiene and the surgical team. <i>Perioper Nurs Clin.</i> 2010;5(4):411-418.	Review of hand hygiene in the perioperative setting. Describes perioperative challenges and hand hygiene moments for RN circulator, anesthesia professionals, surgeon and surgical assistants, and scrub persons.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a
28	Krediet AC, Kalkman CJ, Bonten MJ, Gigengack ACM, Barach P. Hand-hygiene practices in the operating theatre: an observational study. <i>Br J Anaesth.</i> 2011;107(4):553-558.	Frequent interactions between patient, staff, and environment were observed. Adherence to hand-hygiene guidelines by OT staff was extremely low.	IIIB	Non-experimental	Netherlands, academic hospital	n/a	n/a	28 operations observed	Hand hygiene compliance
29	Fernandez PG, Loftus RW, Dodds TM, et al. Hand hygiene knowledge and perceptions among anesthesia providers. <i>Anesth Analg.</i> 2015;120(4):837-843.	Anesthesia provider knowledge deficits around to hand hygiene guidelines occur frequently and are often due to failure to recognize opportunities for hand hygiene after prior contact with contaminated patient and environmental reservoirs. Intraoperative hand hygiene improvement programs should address these knowledge deficits.	IIIA	Non-experimental	USA, 3 major academic medical centers and national survey of ASA members	n/a	n/a	Multicenter response rate 55.8% (221/396) National response rate 18.2% (609/3346)	Anesthesia provider hand hygiene knowledge
30	Biddle C, Shah J. Quantification of anesthesia providers' hand hygiene in a busy metropolitan operating room: what would Semmelweis think? <i>Am J Infect Control.</i> 2012;40(8):756-759.	Hand hygiene opportunities averaged 34 to 41/hour and peaked several times at 54/hour. Aggregate failure rate was 82% with a range of 64% to 93% by provider group, and was very poor among anesthesia providers. The task density of anesthesia care may conspire with an intrinsic hand hygiene failure rate. Given the task density of anesthesia care, and the observed failure rates, novel approaches to HH should be investigated.	IIIB	Non-experimental	USA, academic medical center	n/a	n/a	7,976 hand hygiene opportunities	Hand hygiene compliance
31	O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. <i>Am J Infect Control.</i> 2011;39(4 Suppl 1):S1-S34.	Hand hygiene should be performed before inserting or accessing a vascular device.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
32	Sahni N, Biswal M, Gandhi K, Yaddanapudi S. Quantification of hand hygiene compliance in anesthesia providers at a tertiary care center in northern India. <i>Am J Infect Control.</i> 2015;43(10):1134-1136.	Hand hygiene compliance before performing invasive procedures at the facility was good, although the HH after procedures was low. Anesthesia professionals had poor compliance during placement of IV catheters and intubation. Resident physicians were less compliant than consultant physicians.	VB	Organizational Experience	India	n/a	n/a	308 observations	Hand hygiene compliance

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33	Bellaard-Smith ER, Gillespie EE. Implementing hand hygiene strategies in the operating suite. <i>Healthc Infect.</i> 2012;17(1):33-37.	Significant improvement in hand hygiene compliance after implementing multiple hand hygiene strategies in the operating suite, including education about the WHO five moments of hand hygiene specific to the perioperative setting, appropriate glove use, correct hand hygiene technique, and hand care.	VA	Organizational Experience	Australia	Education (WHO five moments of hand hygiene specific to the perioperative setting, appropriate glove use, correct hand hygiene technique, and hand care)	Compliance before intervention	n/a	Hand hygiene compliance
34	Megeus V, Nilsson K, Karlsson J, Eriksson BI, Andersson AE. Hand hygiene and aseptic techniques during routine anesthetic care—observations in the operating room. <i>Antimicrob Resist Infect Control.</i> 2015;4(1):5.	Overall hand hygiene adherence was 8.1%. Lowest adherence was observed during induction phase before an aseptic task (2.2%) and highest during full-length surgeries after body fluid exposure (15.9%). Hand hygiene improvement strategy should include education and practical training in terms of how to carry out hand hygiene and aseptic techniques and how to use gloves correctly. Moreover it appears to be essential to optimize the work processes in order to reduce the number of avoidable hand hygiene opportunities thereby enhancing the possibilities for adequate use of HH during anesthetic care.	IIIB	Non-experimental	Sweden, general hospital	n/a	n/a	2,393 hand hygiene opportunities	Hand hygiene compliance
35	Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA; Healthcare Infection Control Practices Advisory Committee. Guideline for prevention of catheter associated urinary tract infections 2009. <i>Infect Control Hosp Epidemiol.</i> 2010;31(4):319-326.	Hand hygiene should be performed before inserting a urinary catheter.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
36	Andersson AE, Bergh I, Karlsson J, Eriksson BI, Nilsson K. The application of evidence-based measures to reduce surgical site infections during orthopedic surgery—report of a single-center experience in Sweden. <i>Patient Saf Surg.</i> 2012;6(1):11.	Observed hand hygiene in orthopedic surgical procedures and found poor adherence to hand disinfection guidelines, including during aseptic insertion technique procedures.	IIIB	Non-experimental	Sweden, Orthopedic teaching hospital, Fracture procedures and total joint arthroplasty	n/a	n/a	254 opportunities for hand hygiene in 10 observation sessions	Adherence to hand disinfection guidelines
37	American Society of Anesthesiologists Task Force on Infectious Complications Associated with Neuraxial Techniques. Practice advisory for the prevention, diagnosis, and management of infectious complications associated with neuraxial techniques: a report by the American Society of Anesthesiologists Task Force on Infectious Complications Associated with Neuraxial Techniques. <i>Anesthesiology.</i> 2010;112(3):530-545.	ASA Report on infectious complications associated with neuraxial techniques.	IVB	Consensus	n/a	n/a	n/a	n/a	n/a
38	Jochum D, Iohom G, Bouaziz H. Asepsis in regional anesthesia. <i>Int Anesthesiol Clin.</i> 2010;48(4):35-44.	Hand hygiene should be done before administration of regional anesthesia.	VB	Expert Opinion	n/a	n/a	n/a	n/a	n/a
39	Guideline for environmental cleaning. In: <i>Guidelines for Perioperative Practice.</i> Denver, CO: AORN, Inc; 2016:7-28.	Floors in the perioperative setting should be considered contaminated at all times. Items that contact the floor for any amount of time should be considered contaminated.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a

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40	Birnbach DJ, Rosen LF, Fitzpatrick M, Carling P, Arheart KL, Munoz-Price LS. Double gloves: a randomized trial to evaluate a simple strategy to reduce contamination in the operating room. <i>Anesth Analg.</i> 2015;120(4):848-852.	Researchers found that the group wearing two pairs of gloves during intubation and removing the outer gloves immediately after intubation contaminated significantly fewer surfaces, as measured by fluorescent marking gel.	IB	RCT	USA, simulated laryngoscopy and intubation in OR	Wore two pairs of gloves and removed the outer pair of gloves after intubation (n = 11)	Wore a single pair of gloves (n = 11)	22 anesthesiology residents	Contamination of surfaces measured with fluorescent marking gel
41	Birnbach DJ, Rosen LF, Fitzpatrick M, Carling P, Arheart KL, Munoz-Price LS. A new approach to pathogen containment in the operating room: sheathing the laryngoscope after intubation. <i>Anesth Analg.</i> 2015;121(5):1209-1214.	Researchers found that both double-gloving techniques were associated with significantly less contamination than single gloving. Use of the outer pair as a sheath for the laryngoscope immediately after intubation was associated with the least contamination of the IV hub, patient, and intraoperative environment.	IB	RCT	USA, simulated laryngoscopy and intubation in OR	(1) Wore two pairs of gloves and removed the outer pair of gloves after intubation (n = 15)  (2) Wore two pairs of gloves, removed the outer pair of gloves after intubation, and used the outer gloves to cover the laryngoscope (n = 15)	Wore a single pair of gloves (n = 15)	45 anesthesiology residents	Contamination of surfaces measured with fluorescent marking gel
42	State Operations Manual Appendix A—Survey Protocol, Regulations and Interpretive Guidelines for Hospitals. Rev 151; 2015. Centers for Medicare & Medicaid Services. <a href="https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_a_hospitals.pdf">https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_a_hospitals.pdf</a> . Accessed June 27, 2016.	§482.41(c)(2) states that “facilities, supplies, and equipment must be maintained to ensure an acceptable level of safety and quality,” including storage in compliance with fire codes.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
43	Guideline for a safe environment of care, part 1. In: <i>Guidelines for Perioperative Practice.</i> Denver, CO: AORN, Inc; 2016:237-262.	Dispenser placement and storage of flammable alcohol-based hand hygiene products must be in compliance with local, state, and federal regulations.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
44	NFPA 101: Life Safety Code. Quincy, MA: National Fire Protection Association; 2015.	NFPA recommendations for storage of flammable solutions and placement of alcohol-based hand hygiene product dispensers.	IVC	Guideline	n/a	n/a	n/a	n/a	n/a
45	State Operations Manual Appendix L—Guidance for Surveyors: Ambulatory Surgical Centers. Rev 137; 2015. Centers for Medicare & Medicaid Services. <a href="https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_l_ambulatory.pdf">https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_l_ambulatory.pdf</a> . Accessed June 27, 2016.	§482.41(c)(2) states that “facilities, supplies, and equipment must be maintained to ensure an acceptable level of safety and quality,” including storage in compliance with fire codes.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
46	Petty WC. Closing the hand hygiene gap in the postanesthesia care unit: a body-worn alcohol-based dispenser. <i>J Perianesth Nurs.</i> 2013;28(2):87-97.	Supports the use of personal hand hygiene dispensers to increase access to hand hygiene products for anesthesia professionals.	VB	Expert Opinion	n/a	n/a	n/a	n/a	n/a
47	Loftus RW, Koff MD, Birnbach DJ. The dynamics and implications of bacterial transmission events arising from the anesthesia work area. <i>Anesth Analg.</i> 2015;120(4):853-860.	Supports the use of personal hand hygiene dispensers to increase access to hand hygiene products for anesthesia professionals.	VA	Expert Opinion	n/a	n/a	n/a	n/a	n/a

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48	Koff MD, Loftus RW, Burchman CC, et al. Reduction in intraoperative bacterial contamination of peripheral intravenous tubing through the use of a novel device. <i>Anesthesiology</i> . 2009;110(5):978-985.	Use of the personal dispenser was associated with significantly more hourly hand decontamination events, less IV tubing contamination, and lower health care-associated infection rates. A limitation of this study was that a standardized system was not used for health care-associated infection surveillance.	IB	RCT	USA, tertiary care Level 1 trauma center	Personal dispenser with an audible alarm every 6 minutes if no product had been dispensed	Before intervention	111 anesthesia professionals	Hourly hand decontamination events, contamination of the anesthesia work area and IV tubing, and health care-associated infection rates
49	Gould DJ, Moralejo D, Drey N, Chudleigh JH. Interventions to improve hand hygiene compliance in patient care. <i>Cochrane Database Syst Rev</i> . 2010;9:CD005186.	Using multiple strategies for education and training, such as engaging personnel in planning and social marketing strategies, may be helpful for improving hand hygiene compliance. However, the quality of the evidence was insufficient to draw a firm conclusion, and further research is needed to evaluate the effectiveness of educational interventions in increasing hand hygiene compliance.	IIC	Systematic Review	n/a	n/a	n/a	4	Hand hygiene compliance
50	Santos LX, Souza Dias MB, Borrasca VL, et al. Improving hand hygiene adherence in an endoscopy unit. <i>Endoscopy</i> . 2013;45(6):421-425.	Significant improvement in hand hygiene rates in an endoscopy unit after a hand hygiene education intervention that included task-oriented training and live demonstrations.	VA	Organizational Experience	Brazil, endoscopy unit	Hand hygiene education (task oriented training, live demonstrations)	Compliance before intervention	448 hand hygiene opportunities	Hand hygiene compliance
51	Elkaradawy SA, Helaly GF, Abdel Wahab MM. Effect of an infection control educational programme on anaesthetists' attitude and anaesthetic field bacterial contamination. <i>Egypt J Anaesth</i> . 2012;28(2):149-156.	Researchers found a significant reduction in bacterial contamination of the anesthesia machine and the hands of personnel after the intervention.	IIA	Quasi-experimental	Egypt	Educational intervention (policy and quiz)	n/a	500 operations, 35 personnel	Bacterial contamination on the anesthesia machine and hands of health care personnel
52	Swenne CL, Alexandrén K. Surgical team members' compliance with and knowledge of basic hand hygiene guidelines and intraoperative hygiene. <i>J Infect Prev</i> . 2012;13(4):114-119.	Hand disinfection before and after direct patient contact was incomplete, team members used gloves in an incorrect way, and scrub nurses did not always change sterile gloves after intraoperative skin disinfection before handling sterile instruments. The quantity of hand rub used varied and the mechanical performance of skin disinfection varied. Knowledge of hand hygiene routines and intraoperative hygiene routines among surgical team members is incomplete and adherence needs to improve. Regular routine observations and continuous feedback to all staff may be necessary to improve compliance and avoid deterioration of practice.	IIIB	Non-experimental	Sweden, university hospital	n/a	n/a	10 cardio-thoracic procedures observed	Hand hygiene compliance
53	Pan S-C, Chen E, Tien K-L, et al. Assessing the thoroughness of hand hygiene: "Seeing is believing." <i>Am J Infect Control</i> . 2014;42(7):799-801.	Researchers found that the most missed areas of the hand were the nails. The researchers recommended using fluorescent products as part of a "seeing is believing" hand hygiene campaign to encourage active participation.	IIA	Quasi-experimental	Taiwan	Hand hygiene with soap and water to remove fluorescent substance	n/a	388 personnel	Removal of fluorescent substance from hands



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54	Jericho BG, Kalin AM, Schwartz DE. Improving hand hygiene compliance by incorporating it into the verification process in the operating room. <i>Internet J Anesthesiol.</i> 2013;32(3):2.	Investigated two interventions to improve hand hygiene compliance in the perioperative setting: use of educational posters and including hand hygiene in the time-out process. The researchers found that compliance with using an alcohol-based hand foam was significantly improved after educational posters were placed in strategic locations and hand hygiene was included in the time-out process.	VA	Organizational Experience	USA, tertiary care institution	Use of educational posters and including hand hygiene in the time-out process	Compliance before intervention	1,000 observations	Hand hygiene compliance
55	Adams AB. Surgical hand antisepsis: where we have been and where we are today. <i>Perioper Nurs Clin.</i> 2010;5(4):443-448.	Review of historical progression of surgical hand antisepsis protocols. Surgical hand antisepsis is the first line of defense, gloves are the second because they may have leaks.	VB	Expert Opinion	n/a	n/a	n/a	n/a	n/a
56	Guideline for sterile technique. In: <i>Guidelines for Perioperative Practice.</i> Denver, CO: AORN, Inc; 2016:65-94.	Surgical hand antisepsis should be performed before donning a surgical gown and gloves.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
57	Abdelatiff DA, El-Haiyk KS, Ghobashi NH, El-Qudaa RF, El-Sabouni RS. Comparing of using sterile brush during surgical scrubbing versus brushless for surgical team in operating room. <i>Life Sci J.</i> 2014;11(1):387-393.	Brushes for surgical hand scrubs are not necessary. Findings not statistically significant, but did show an increase in <i>Staphylococcus</i> one hour after scrub and glove removal in the group that used the brush. However, this study did not describe what antiseptic products were used.	IC	RCT	n/a	Brushless hand scrub	Hand scrub with brush	50	Bacterial cultures of hands
58	da Cunha ER, Matos FGOA, da Silva AM, de Araújo EAC, Ferreira KASL, Graziano KU. The efficacy of three hand asepsis techniques using chlorhexidine gluconate (CHG 2%). <i>Rev Esc Enferm USP.</i> 2011;45(6):1440-1445.	Statistical analyses showed there were no significant differences regarding the number of colony-forming units when comparing hand rubbing, hand scrubbing with sponge, and hand scrubbing with brush techniques ( $p=0.148$ ), which theoretically disregards the need to continue using brushes or sponges for hand asepsis.	IIB	Quasi-experimental	Brazil, health care workers	CHG 2% application methods: (1) Hand scrubbing with brush (2) Hand scrubbing with sponge (3) Hand rubbing with antiseptic agent only	n/a	32 health care workers	Hand cultures using glove juice method
59	Okgün Alcan A, Demir Korkmaz F. Comparison of the efficiency of nail pick and brush used for nail cleaning during surgical scrub on reducing bacterial counts. <i>Am J Infect Control.</i> 2012;40(9):826-829.	Using nail picks and brushes during the surgical scrub does not provide additional hand decontamination.	IB	RCT	Turkey, university hospital	(1) Use nail pick during surgical scrub (n = 20)  (2) Use brush during surgical scrub (n = 20)	Use surgical scrub alone (n = 20)	60 circulating nurses	Hand bacterial counts
60	Haessler S, Connelly NR, Kanter G, et al. A surgical site infection cluster: the process and outcome of an investigation—the impact of an alcohol-based surgical antisepsis product and human behavior. <i>Anesth Analg.</i> 2010;110(4):1044-1048.	Investigation of an SSI cluster. Direct observations of surgical hand antisepsis, including scrub and alcohol rub products, were performed. Observers noted inadequate pre-washing when required (eg, for soiled hands), lack of use of a nail pick, and incorrect application of the alcohol surgical hand rub product. Interviews revealed that the surgeons lacked understanding about correct alcohol rub product usage. After the product being misused was removed and the surgeons received education on proper surgical hand antisepsis technique, the SSI rate returned to a level at or below the medical center's historical rates.	VB	Organizational Experience	USA, academic, Level 1 trauma, tertiary care medical center	Misused product removed, surgical hand antisepsis education	n/a	n/a	SSI rates

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61	Fichtner A, Haupt E, Karwath T, Wullenk K, Pöhlmann C, Jatzwauk L. A single standardized practical training for surgical scrubbing according to EN1500: effect quantification, value of the standardized method and comparison with clinical reference groups. <i>GMS Z Med Ausbild.</i> 2013;30(2):Doc24.	In this pilot study, the researchers found that the intervention group had significantly better hand coverage than the control group, which received training after the test.	IC	RCT	Germany, skills lab	45-minute standardized peer training session on surgical hand scrubbing according to the European standard EN1500 (n = 80)	Received training after testing for hand coverage (n = 81)	161 Fourth year medical students	Hand coverage with a fluorescent surgical hand scrub antiseptic
62	Guideline for product selection. In: <i>Guidelines for Perioperative Practice.</i> Denver, CO: AORN, Inc; 2016:177-184.	The multidisciplinary team should develop a mechanism for product evaluation and selection of hand hygiene products.	IVB	Guideline	n/a	n/a	n/a	n/a	n/a
63	Barbadoro P, Martini E, Savini S, et al. In vivo comparative efficacy of three surgical hand preparation agents in reducing bacterial count. <i>J Hosp Infect.</i> 2014;86(1):64-67.	The alcohol-based solution was most effective and sustained for 3 hrs. Some volunteers experienced "skin peeling" (small sticky agglomerates, presumed to be formed by the reaction between flaking skin cells and the glycerol in the alcohol-based hand rub). The subjects with "skin peeling" had significantly less sustained reduction in bacteria than subjects without skin peeling, when compared to initial bactericidal effect.	IIC	Quasi-experimental	Laboratory, healthy volunteers	ABHR (40% isopropyl, 25% n-propyl, 1.74% glycerin, <1% triethanolamine salt of carbomer)	Chlorhexidine 4%  Povidone-iodine 7.5%	20	<i>in vivo</i> bactericidal product efficacy
64	Shen N-J, Pan S-C, Sheng W-H, et al. Comparative antimicrobial efficacy of alcohol-based hand rub and conventional surgical scrub in a medical center. <i>J Microbiol Immunol Infect.</i> 2015;48(3):322-328.	The alcohol-based hand rub was more efficacious for surgical antiseptics and had sustained efficacy, compared to conventional surgical scrub.	IIIB	Non-experimental	Taiwan, academic medical center	Ethyl alcohol (61%) with 1% CHG	Povidone-iodine 7.5%	128 health care workers	Hand cultures by plating swabs
65	Lai KW, Foo TL, Low W, Naidu G. Surgical hand antiseptics—a pilot study comparing povidone iodine hand scrub and alcohol-based chlorhexidine gluconate hand rub. <i>Ann Acad Med Singapore.</i> 2012;41(1):12-16.	Results suggest that the Avagard was more efficacious than aqueous povidone-iodine scrub at reducing baseline colony counts and sustaining this antiseptics.	IIC	Quasi-experimental	Singapore, volunteers at a suture practice workshop	Avagard hand rub followed by 1 hour of suture practice	Traditional povidone-iodine scrub followed by 1 hour of suture practice	10 volunteers	Hand cultures
66	Chen S-H, Chou C-Y, Huang J-C, Tang Y-F, Kuo Y-R, Chien L-Y. Antibacterial effects on dry-fast and traditional water-based surgical scrubbing methods: a two-time points experimental study. <i>Nurs Health Sci.</i> 2014;16(2):179-185.	Use of dry-fast antiseptics has a better persistent effect (P = 0.001), more nurses chose dry-fast antiseptics than surgeons (P = 0.012), and the post-operation number of colonies for nurses was significantly higher than that for surgeons (P = 0.003). Operating room nurses are long-term and frequent users of antibacterial agents, and their requirement of skin protection is higher. The dry-fast technique has the advantage of being less irritating to the skin and less time consuming; therefore, brush-free and dry-fast antiseptics is recommended.	IIIB	Quasi-experimental	Taiwan, medical center OR staff	Ethyl alcohol (61%) with 1% CHG	Povidone-iodine 7.5%	156 OR staff	Hand cultures using immersion in broth, cognitive scale for surgical technique concepts
67	Hamed Mahmoud M, Morad Asaad A, Ansar Qureshi M. Hand rubbing and scrubbing in relation to microbial count among surgical team members in a Saudi hospital. <i>Life Sci J.</i> 2013;10(3):198-205.	Surgical hand rub using avagard was significantly more effective in reducing skin colony counts compared to ethyl alcohol 70% and povidone iodine 7.5%.	IIIB	Quasi-experimental	Saudi, 300-bed general hospital	(A) Traditional povidone-iodine scrub (B) Ethyl alcohol 70% rub (C) Avagard	n/a	72 volunteer surgical team members	Hand cultures on agar plates

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68	Ghorbani A, Shahrokhi A, Soltani Z, Molapour A, Shafikhani M. Comparison of surgical hand scrub and alcohol surgical hand rub on reducing hand microbial burden. <i>J Perioper Pract.</i> 2012;22(2):67-70.	Both methods were effective in reducing microbial burden on the hands.	IC	RCT	Iran, 4 teaching hospitals	Wash hands with non-antibacterial soap and water for 30 seconds, then rub with 70% ethanol for 3 minutes or until dry (n = 18)	Wash hands with counted brush stroke method for 6 minutes with povidone-iodine (n = 15)	33 surgeons and nurses	Hand bacterial counts
69	Howard JD, Jowett C, Faoagali J, McKenzie B. New method for assessing hand disinfection shows that preoperative alcohol/chlorhexidine rub is as effective as a traditional surgical scrub. <i>J Hosp Infect.</i> 2014;88(2):78-83.	An alcohol/chlorhexidine hand rub was found to be as efficacious as a traditional scrub after 30 minutes.	IIB	Quasi-experimental	Australia, anaesthetists	Isopropyl alcohol (70%) with 0.5% CHG	4% CHG scrub	20 anaesthetists	Hand cultures by glove juice method
70	Chen C-F, Han C-L, Kan C-P, Chen S-G, Hung PW. Effect of surgical site infections with waterless and traditional hand scrubbing protocols on bacterial growth. <i>Am J Infect Control.</i> 2012;40(4):e15-e17.	Waterless hand scrub is as effective as traditional hand scrub in cleansing the hands of microorganisms and more efficient in terms of scrub time.	IIC	Quasi-experimental	Taiwan, OR staff from medical centers	Ethyl alcohol (61%) with 1% CHG	Traditional scrub: 4% CHG in 70% isopropyl alcohol and 10% povidone-iodine	100 OR staff members	Hand cultures, scrub time
71	Weight CJ, Lee MC, Palmer JS. Avagard hand antisepsis vs. traditional scrub in 3600 pediatric urologic procedures. <i>Urology.</i> 2010;76(1):15-17.	The incidence of wound infection was 2/1800 (0.11%) in the Avagard group and 3/1800 (0.17%) in the hand-scrub group (P .99 Fisher's exact test). No side effects for the patients or surgeon were noted, including skin irritations or allergic reactions in either group.	IIC	Quasi-experimental	USA, pediatric hospital, urology	Avagard surgical hand rub	Traditional antiseptic-impregnated hand brush scrubbing	3600 pediatric urologic procedures	Wound infections
72	Jarral OA, McCormack DJ, Ibrahim S, Shipolini AR. Should surgeons scrub with chlorhexidine or iodine prior to surgery? <i>Interact Cardiovasc Thorac Surg.</i> 2011;12(6):1017-1021.	CHG scrubs may reduce bacterial counts on hands more effectively than aqueous povidone-iodine.	IIIB	Systematic Review	n/a	n/a	n/a	8	Hand bacterial counts
73	Olson LKM, Morse DJ, Duley C, Savell BK. Prospective, randomized in vivo comparison of a dual-active waterless antiseptic versus two alcohol-only waterless antiseptics for surgical hand antisepsis. <i>Am J Infect Control.</i> 2012;40(2):155-159.	The alcohol plus CHG product showed noninferiority to the alcohol-only products at all sampling points and, based on significantly lower bacterial regrowth (p=.026), superior persistence to the alcohol-only products after 6 hours of glove wear.	IIA	Quasi-experimental	USA, healthy volunteers	(1) Ethyl alcohol (80%) (2) Ethyl alcohol (70%)	Alcohol (ethyl 61%) plus CHG (1%)	129 volunteers	Bacterial cultures (log counts), safety evaluation
74	Macinga DR, Edmonds SL, Campbell E, McCormack RR. Comparative efficacy of alcohol-based surgical scrubs: the importance of formulation. <i>AORN J.</i> 2014;100(6):641-650.	Alcohol-based antiseptics were equally or more effective than the alcohol and CHG combination surgical hand antiseptics. The most important criteria for choosing a surgical scrub are a demonstrated ability to meet efficacy criteria established by the FDA, skin tolerability, and end-user acceptance.	IB	RCT	USA, healthy volunteers	(1) Alcohol rub A (70% ethanol gel) (2) Alcohol rub B (90% ethanol liquid) (3) Alcohol (61% ethanol gel) with 1% CHG	Alcohol control (leave on liquid) 4% CHG (rinse off liquid)	Phase 1: 56 Phase 2: 75	FDA performance requirements in the 1994 TFM, for 5 days
75	Cargill DI, Roche ED, Van Der Kar CA, et al. Development of a health care personnel handwash with 6-hour persistence. <i>Am J Infect Control.</i> 2011;39(3):226-234.	Viacydin-Containing Alcohol Sanitizer (VCAS) was superior to or at parity with on-market products, exhibited substantial residual effects and persistence up to 6 hours, and was safe and well tolerated.	IIA	Quasi-experimental	USA, healthy volunteers	(A) Ethyl alcohol 62% surgical scrub (B) Ethyl alcohol 61% and 1% CHG (C) Ethyl alcohol 61% (D) Ethyl alcohol 62% personal handwash (E) Ethyl alcohol 62% foam	Viacydin-Containing Alcohol Sanitizer (VCAS)	n/a (Multiple studies, both in vitro and in vivo)	In vitro: Minimum inhibitory concentration (MIC), time kill, resistance development  In vivo: skin tolerance, efficacy testing

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76	Kampf G, Reichel M, Hollingsworth A, Bashir M. Efficacy of surgical hand scrub products based on chlorhexidine is largely overestimated without neutralizing agents in the sampling fluid. <i>Am J Infect Control.</i> 2013;41(1):e1-e5.	Lack of neutralizing agents in the sampling fluid resulted in overestimation of efficacy by a factor of between 0.3 and 1.1 log <sub>10</sub> . Studies assessing the efficacy of CHG without using neutralizing agents in the culture sampling fluid may be flawed by overestimating efficacy.	IIB	Quasi-experimental	Germany, healthy volunteers	(1) Adding neutralizing agents to sampling and dilution fluid  (2) Neutralizing agents added to the dilution fluid	(3) Neutralizing agents were added to the dilution fluid only, and Cetaphil cream was applied after the final scrub on days 1 to 4	36 (18 in Avagard group, 18 in hibiclenz group)	Efficacy of Avagard and Hibiclenz
77	US Food and Drug Administration. Tentative final monograph for healthcare antiseptic drug products proposed rule. <i>Fed Regist.</i> 1994;59(116):31402-31452.	Current FDA requirements for health care hand wash or rub and surgical hand antiseptic products.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
78	21 CFR Part 310. Safety and effectiveness of health care antiseptics; topical antimicrobial drug products for over-the-counter human use; proposed amendment of the tentative final monograph; reopening of administrative record; proposed rule. <i>Fed Regist.</i> 2015;80(84):25166-25205.	Proposed rule to finalize the FDA TFM, requested additional scientific evidence from manufacturers to evaluate whether the ingredients in certain antiseptic products are safe and effective.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
79	Q&A for consumers: health care antiseptics. US Food and Drug Administration. <a href="http://www.fda.gov/Drugs/DrugSafety/InformationbyDrugClass/ucm445063.htm">http://www.fda.gov/Drugs/DrugSafety/InformationbyDrugClass/ucm445063.htm</a> . Accessed June 27, 2016.	While the FDA gathers scientific evidence from the manufacturers, they recommend that health care personnel continue to use health care antiseptics to maintain a standard of care to prevent patient infection.	n/a	Regulatory	n/a	n/a	n/a	n/a	n/a
80	Girard R, Carre E, Mermet V, et al. Factors influencing field testing of alcohol-based hand rubs. <i>Infect Control Hosp Epidemiol.</i> 2015;36(3):302-310.	Investigated factors that influenced the testing of alcohol-based hand rubs and found that test periods during colder seasons were significantly associated with skin reactions.	IIIB	Non-experimental	European field study	n/a	n/a	n/a	Factors influencing testing of hand rubs
81	Eiref SD, Leitman IM, Riley W. Hand sanitizer dispensers and associated hospital-acquired infections: friend or fomite? <i>Surg Infect.</i> 2012;13(3):137-140.	All hand sanitizer dispensers cultured one or more bacterial species. Contamination was greatest on the lever.	IIIB	Non-experimental	USA, urban teaching hospital	n/a	n/a	17 hand sanitizer dispensers	Bacterial cultures of the dispenser lever, rear underside, and area around dispensing nozzle
82	Assadian O, Kramer A, Christiansen B, et al. Recommendations and requirements for soap and hand rub dispensers in healthcare facilities. <i>GMS Krankenhhyg interdiszip.</i> 2012;7(1):Doc03.	German and Austrian Society for Hospital Hygiene Recommendations for hand hygiene product dispensers.	IVC	Position Statement	n/a	n/a	n/a	n/a	n/a
83	Anderson DJ, Podgorny K, Berrios-Torres SI, et al. Strategies to prevent surgical site infections in acute care hospitals: 2014 update. <i>Infect Control Hosp Epidemiol.</i> 2014;35(6):605-627.	SHEA Compendium Guideline on surgical site infection prevention.	IVA	Guideline	n/a	n/a	n/a	n/a	n/a
84	Homa K, Kirkland KB. Determining next steps in a hand hygiene improvement initiative by examining variation in hand hygiene compliance rates. <i>Qual Manage Health Care.</i> 2011;20(2):116-121.	Hospital-wide hand hygiene initiative (including perioperative area) improved overall hand hygiene compliance. Initiative included: support from organizational leaders, measurement and feedback of compliance and infection incidence, availability and improved accessibility to products, standardized approach to education, and increased awareness through marketing efforts within the organization. Used analysis of means technique to stratify hand hygiene compliance by hospital area and type of health care worker.	VB	Organizational Experience	USA, rural teaching hospital	Multiple interventions as part of hospital quality initiative	Compliance before intervention	n/a	Hand hygiene compliance

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85	Ottum A, Sethi AK, Jacobs EA, Zerbel S, Gaines ME, Safdar N. Do patients feel comfortable asking healthcare workers to wash their hands? Infect Control Hosp Epidemiol. 2012;33(12):1283-1284.	Surveyed 200 patient respondents (response rate 94.78%) about their comfort in reminding health care personnel to perform hand hygiene. 99.5% of patients surveyed believed that personnel were supposed to wash their hands before and after care.90.5% believed in reminding health care personnel to wash their hands only if they forgot. 14% of patients reported having asked personnel to wash their hands, with 64% comfortable reminding nurses and 54% comfortable reminding physicians. Patients who had worked in health care were significantly more likely to be comfortable asking personnel to wash their hands than patients who had not worked in health care.	IIIB	Non-experimental	USA, patient survey	n/a	n/a	200 patients	n/a
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