

AORN Guideline for Medication Safety
Evidence Table

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
1	Billstein-Leber M, Carrillo CJ, Cassano AT, Moline K, Robertson JJ. ASHP guidelines on preventing medication errors in hospitals. <i>Am J Health Syst Pharm.</i> 2018;75(19):1493-1517.	Guideline	n/a	n/a	n/a	n/a	Guidelines for preventing hospital medication errors.	IVB
2	Statement on medication error rates. National Coordinating Council for Medication Error Reporting and Prevention: Recommendations/ Statements Web site. https://www.nccmerp.org/statement-medication-error-rates . Updated 2008. Accessed 4/20, 2022.	Position Statement	n/a	n/a	n/a	n/a	Position statement on preventing and reporting medication errors.	IVC
3	State operations manual appendix A. survey protocol, regulations and interpretive guidelines for hospitals. Rev. 200 ed. Centers for Medicare & Medicaid Services (CMS); 2020.	Regulatory	n/a	n/a	n/a	n/a	Regulations and explanatory content for hospitals caring for Medicare or Medicaid patients.	n/a
4	State operations manual appendix L. guidance for surveyors: Ambulatory surgical centers. Rev. 200 ed. Centers for Medicare & Medicaid Services (CMS); 2020.	Regulatory	n/a	n/a	n/a	n/a	Regulations and explanatory content for ambulatory surgery centers caring for Medicare or Medicaid patients.	n/a
5	Drug approvals and databases. https://www.fda.gov/drugs/development-approval-process-drugs/drug-approvals-and-databases . Updated 2021. Accessed 10/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	List of FDA Databases and resources for medication safety.	VA
6	Drug safety communications. https://www.fda.gov/drugs/drug-safety-and-availability/drug-safety-communications . Updated 2021. Accessed 10/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	FDA information about drugs safety communication.	VA
7	Drug alerts and statements. https://www.fda.gov/drugs/drug-safety-and-availability/drug-alerts-and-statements . Updated 2021. Accessed 10/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	Current drug alerts and statements from the FDA.	VA
8	Working to reduce medication errors. https://www.fda.gov/drugs/information-consumers-and-patients-drugs/working-reduce-medication-errors . Updated 2019. Accessed 10/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	FDA information on medication safety processes and oversight.	VA
9	Targeted medication safety best practices for hospitals. Institute for Safe Medication Practices (ISMP); 2022.	Position Statement	n/a	n/a	n/a	n/a	2022-2023 ISMP targeted practices for medication safety.	IVA
10	Recommendations for senior leadership to advance medication safety. https://www.nccmerp.org/recommendations-senior-leadership-advance-medication-safety . Updated 2020. Accessed 10/27, 2021.	Position Statement	n/a	n/a	n/a	n/a	NCCMERP leadership recommendations for improving medication safety.	IVC
11	Pharmaceutical compounding: Sterile preparations (797). In: USP compounding compendium. 2021st ed. Rockville, MD: U.S. Pharmacopeial Convention; 2021:38-79.	Guideline	n/a	n/a	n/a	n/a	Recommendations for precautions used when compounding medications.	IVB

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12	Fatal medication errors can result when drug entry fields populate after only a few letters. hazard #2: 2021 top 10 health technology hazards. https://www.ecri.org/components/HDJournal/Pages/Top_10_hazards_2021_No_2_drug_name_entry.aspx# . Published 1/28/2021. Updated 2021. Accessed 11/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	ECRI recommends that technology only populate medication names after 5 letters instead of three.	VB
13	The physician's role in medication reconciliation. American Medical Association (AMA); 2007Guidelines.	Consensus	n/a	n/a	n/a	n/a	AMA consensus report on patient medication reconciliation processes.	IVB
14	Institute of Medicine (US) Committee on Quality of Health Care in America. Preventing medication errors. Washington, DC: The National Academies Press; 2007:480. https://nap.nationalacademies.org/catalog/11623/preventing-medication-errors . 10.17226/11623.	Expert Opinion	n/a	n/a	n/a	n/a	National Academy of Medicine report on preventing medication errors.	VA
15	Institute of Medicine (US) Committee on Quality of Health Care in America. To err is human: Building a safer health system. Washington, DC: The National Academies Press; 2000:312. https://nap.nationalacademies.org/catalog/9728/to-err-is-human-building-a-safer-health-system . https://doi.org/10.17226/9728 .	Expert Opinion	n/a	n/a	n/a	n/a	National Academy of Medicine 2000 seminal report on errors and improving safety in health care systems.	VA
16	AORN position statement on criminalization of human errors in the perioperative setting. Denver, CO: Association of periOperative Registered Nurses (AORN); 2018Position Statements.	Position Statement	n/a	n/a	n/a	n/a	Position statement on criminalization of human errors in perioperative practice settings.	IVB
17	21 CFR 1308: Schedules of controlled substances. Government Publishing Office (GPO); 2021.	Regulatory	n/a	n/a	n/a	n/a	Federal regulations on schedules of controlled substances.	n/a
18	Johnstone EM, Burlingame BL, Conner R. Guideline for a Safe Environment of Care. Conner R, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for a safe perioperative environment of care.	IVA
19	Ogg MJ. Guideline for Care of the Patient Receiving Local-Only Anesthesia. Kyle E, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for care of perioperative patients receiving local-only anesthesia.	IVA
20	Wood A. Guideline for care of the patient receiving moderate Sedation/Analgesia. In: Kyle E, ed. Guidelines for perioperative practice. Denver, CO: AORN, Inc; 2021.	Guideline	n/a	n/a	n/a	n/a	Recommendations for care of perioperative patients receiving moderate sedation.	IVA
21	Wright R. Guideline for Minimally Invasive Surgery. Kyle E, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for minimally invasive surgery.	IVA
22	Jones E. Guideline for Prevention of Venous Thromboembolism. Kyle E, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for perioperative prevention of VTE.	IVA
23	Cierniak KH, Gaunt MJ, Grissinger M. Perioperative medication errors: Uncovering risk from behind the drapes. PENN PATIENT SAF ADVIS. 2018;15(4):22-38.	Expert Opinion	n/a	n/a	n/a	n/a	Contributing factors included communication, breakdowns, ordering issues, and improper handling.	VB

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24	Beyea SC, Hicks RW, Becker SC. Medication errors in the OR—A secondary analysis of medmarx. AORN Journal. 2003;77(1):122-134.	Nonexperimental	731 medication errors that occurred in the OR	n/a	n/a	Examined various characteristics of the event.	Most medication errors are related to administration and the RN is frequently involved in errors. Limited by errors reported to USP voluntary reporting databases.	IIIC
25	Keers RN, Williams SD, Cooke J, Ashcroft DM. Causes of medication administration errors in hospitals: A systematic review of quantitative and qualitative evidence. Drug Saf. 2013;36(11):1045-1067.	Systematic Review	n/a	n/a	n/a	n/a	Systematic review of studies on causes of medication administration errors categorized according to Reason's model of accident causation.	IIIC
26	ASHP guidelines: Minimum standard for pharmacies in hospitals. American Society of Health-System Pharmacy (ASHP) Guidelines.	Guideline	n/a	n/a	n/a	n/a	Hospital pharmacist minimum standard guidelines.	IVB
27	ASHP guidelines: Minimum standard for ambulatory care pharmacy practice. American Society of Health-System Pharmacy (ASHP) Guidelines.	Guideline	n/a	n/a	n/a	n/a	Ambulatory pharmacist minimum standard guidelines.	IVB
28	Haas, R. E., Beitz, E., Reed, A., Burtnett, H., Lowe, J., Crist, A. E., Jr, et al. (2017). No bacterial growth found in spiked intravenous fluids over an 8-hour period. American Journal of Infection Control, 45(4), 448-450.	Nonexperimental	80 IB bags of lactated ringers solution	n/a	n/a	Presence of bacteria	No bacterial growth was found in the solution 8 hours after spiking.	IIIB
29	Gaunt MJ. Medication errors: When pharmacy is closed. PENN PATIENT SAF ADVIS. 2012;9(1):11-17.	Expert Opinion	n/a	n/a	n/a	n/a	Recommends 24-hour pharmacy service or considering telepharmacy or remote pharmacist review of medication orders to prevent medication errors after hours.	VB
30	Bickham P, Golembiewski J, Meyer T, Murray CG, Wagner D. ASHP guidelines on perioperative pharmacy services. AM J HEALTH SYST PHARM AJHP. 2019;76(12):903-820.	Guideline	n/a	n/a	n/a	n/a	Recommendations for perioperative pharmacy practice.	IVB
31	ISMP Guidelines for Safe Medication Use in Perioperative and Procedural Settings. Institute for Safe Medication Practices (ISMP); 2022	Guideline	n/a	n/a	n/a	n/a	Recommendations for safe use of medications in the perioperative setting.	IVB
32	Berrios-Torres SI, Umscheid CA, Bratzler DW, et al. Centers for disease control and prevention guideline for the prevention of surgical site infection, 2017. JAMA Surg. 2017;152(8):784-791.	Guideline	n/a	n/a	n/a	n/a	CDC guideline for prevention of SSI.	IVA
33	Clinical practice guidelines for antimicrobial prophylaxis in surgery. ASHP Therapeutic Guidelines.	Guideline	n/a	n/a	n/a	n/a	ASHP guideline for antimicrobial prophylaxis in surgery.	IVB
34	Norman G, Atkinson RA, Smith TA, et al. Intracavity lavage and wound irrigation for prevention of surgical site infection. The Cochrane database of systematic reviews. 2017;10(10):CD012234-CD012234.	Systematic Review	n/a	n/a	n/a	n/a	Systematic review of RCTs on intracavity lavage and wound irrigation for prevention of SSIs.	IA

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35	Edmiston CE,Jr, Leaper D, Spencer M, et al. Considering a new domain for antimicrobial stewardship: Topical antibiotics in the open surgical wound. Am J Infect Control. 2017;45(11):1259-1266	Expert Opinion	n/a	n/a	n/a	n/a	Review of practices and suggestions to improve the judicious use of topical antibiotics in open surgical wounds.	VA
36	Surgical management of osteoarthritis of the knee. evidence-based clinical practice guideline. American Academy of Orthopaedic Surgeons (AAOS); 2015.	Guideline	n/a	n/a	n/a	n/a	Recommendations for surgical management of osteoarthritis of the knee including the use of bone cement with antibiotics.	IVB
37	Cahn J. Guideline for Autologous Tissue Management. Wood A, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for the perioperative management of autologous tissue.	IVA
38	Suzuki R, Imai T, Sakai T, Tanabe K, Ohtsu F. Medication errors in the operating room: An analysis of contributing factors and related drugs in case reports from a japanese medication error database. J Patient Saf. 2021.	Nonexperimental	541 reported medication errors in the OR	n/a	n/a	Factors associated with OR medication errors	Incorrect doses and incorrect drug use were factors that were significantly positively associated with medication errors. Improved environmental factors and quality monitoring were recommended.	IIIB
39	Rosenwasser R, Winterstein AG, Rosenberg AF, Rosenberg EI, Antonelli PJ. Perioperative medication errors in otolaryngology. Laryngoscope. 2010;120(6):1214-1219.	Nonexperimental	Perioperative medication errors (including preoperative, intraoperative, and postoperative) reported during 589 otolaryngology procedures	n/a	n/a	Number and type of perioperative medication errors.	Four intraoperative errors were reported. The researchers reported the types of errors but did not specify where the various types of errors occurred (ie, preoperative, intraoperatively, or postoperatively). Of the 20 identified errors in the study only two seem may have been related to intraoperative nursing practice, including the ordering of a drug that was not needed on a pre-printed order form, and a sample bottle of ofloxacin give to the family postoperatively with no prescription or instructions.	IIIB

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40	Ierano C, Thursky K, Peel T, Rajkhowa A, Marshall C, Ayton D. Influences on surgical antimicrobial prophylaxis decision making by surgical craft groups, anaesthetists, pharmacists and nurses in public and private hospitals. PLoS One. 2019;14(11):e0225011.	Qualitative	15 focus groups and one paired interview	n/a	n/a	Surgical antimicrobial prophylaxis (SAP) decision making	Six key themes were identified. Prescribing skills for SAP are a low priority, autonomy take precedence over guideline compliance, social impacts reinforce established practice, improved communication, documentation, and data collection are needed, and there is a lack of clarity for roles and accountability.	IIIB
41	Rizvi ZM, Palasanthiran P, Wu C, McMullan B, Mostaghim M. Adherence to surgical antibiotic prophylaxis guidelines in children: A cohort study. J Paediatr Child Health. 2020;56(1):34-40.	Nonexperimental	360 pediatric procedures	n/a	n/a	Non adherence to surgical antimicrobial prophylaxis guidelines and early SSIs	Overall noncompliance was associated with incorrect surgical wound classification.	IIIC
42	Core elements of hospital antibiotic stewardship programs. Atlanta, GA: Centers for Disease Control and Prevention (CDC); 2019.	Expert Opinion	n/a	n/a	n/a	n/a	CDC core elements of hospital antibiotic stewardship committees.	VA
43	Antibiotic stewardship statement for antibiotic guidelines: Recommendations of the healthcare infection control practices advisory committee . Healthcare Infection Control Practices Advisory Committee (HICPAC); 2017.	Guideline	n/a	n/a	n/a	n/a	HICPAC statement on antibiotic stewardship.	IVB
44	Borden S, Goose M, Robitaille M, Schroeder K. Cardiac arrhythmia from epinephrine overdose in epidural test dose. Saudi J Anaesth. 2019;13(3):249-252. http://www.saudija.org/ ; http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed20&NEWS=N&AN=628452364 . doi: http://dx.doi.org/10.4103/sja.SJA_218_19 .	Case Report	n/a	n/a	n/a	n/a	Medication error and patient harm associated with injection of the wrong dose of epinephrine because the kit used did not have the test dose due to a shortage.	VB
45	Neff MP. Propofol drug shortage associated with worse postoperative nausea and vomiting outcomes despite a mitigation strategy. AANA J. 2018;86(2):147-154.	Nonexperimental	2090 patients (662 preshortage, 728 shortage, 700 postshortage)	n/a	n/a	Postoperative Nausea and Vomiting risk factors, anesthetic management, and PONV outcomes	Patients during the shortage had higher incidence of PONV, greater need for rescue antiemetics, and longer duration of stay.	IIIB
46	Baumer AM, Clark AM, Witmer DR, Geize SB, Vermeulen LC, Deffenbaugh JH. National survey of the impact of drug shortages in acute care hospitals. Am J Health Syst Pharm. 2004;61(19):2015-2022.	Nonexperimental	370 usable responses from 1496 Pharmacy Director (24.7% Response Rate)	n/a	n/a	Costs, time, and impact of medication shortages	Medication shortages compromised patient care, and increased costs, and required a significant amount of time to manage.	IIIB
47	Fox ER, McLaughlin MM. ASHP guidelines on managing drug product shortages. Am J Health Syst Pharm. 2018;75(21):1742-1750.	Guideline	n/a	n/a	n/a	n/a	ASHP guideline on managing medication shortages	IVB

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48	Kaakeh R, Sweet BV, Reilly C, et al. Impact of drug shortages on U.S. health systems. <i>Am J Health Syst Pharm</i> . 2011;68(19):1811-1819.	Nonexperimental	353 ASHP pharmacy directors (27% response rate) completed the survey	n/a	n/a	Affects of medication shortages and steps to manage the shortage	The labor costs to manage a shortage was estimated to be \$216 million annually. Hospitals that were larger and had more automated processes spent more time when a shortage occurred.	IIIB
49	Drug shortages: Concern #5: Top 10 patient safety concerns for 2021. https://www.ecri.org/components/HRC/Pages/2021Top10_5.aspx . Published 3/12/2021. Updated 2021. Accessed 11/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	Discusses problems resulting from medication shortages and recommended actions.	VB
50	Aron L, Study K, Gans R, Yaniv A. Reducing the waste of lidocaine produces significant cost savings: An ambulatory surgery center case study. <i>Insight</i> . 2019;44(2):9-10.	Organizational Experience	Not stated	n/a	n/a	n/a	Describes a process evaluating the use of ophthalmic lidocaine that was placed in pre-filled syringes in the facility to address a shortage issue.	VC
51	Drug shortages statistics. https://www.ashp.org/drug-shortages/shortage-resources/drug-shortages-statistics?loginreturnUrl=SSOCheckOnly . Accessed 11/9, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	ASHP and University of Utah joint statistics on medication shortages.	VB
52	Current drug shortages. https://www.ashp.org/drug-shortages/current-shortages?loginreturnUrl=SSOCheckOnly . Accessed 11/9, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	ASHP Website with current list of medication shortages	VA
53	FDA drug shortages. current and resolved drug shortages and discontinuations reported to FDA. . . https://www.accessdata.fda.gov/scripts/drugshortages/default.cfm .	Expert Opinion	n/a	n/a	n/a	n/a	FDA Drug shortages database	VA
54	Ogg MJ. Guideline for Sharps Safety. Wood A, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations to prevent sharps injuries in perioperative personnel.	IVA
55	Dabliz R, Levine S. Medication safety in neonates. <i>Am J Perinatology</i> . 2012;29(1):49-56.	Expert Opinion	n/a	n/a	n/a	n/a	Summarizes recommendations for contents of reference materials.	VC
56	Gao, T., & Gaunt, M. J. (2013). Breakdowns in the medication reconciliation process. <i>Pennsylvania Patient Safety Advisory</i> , 10(4), 125-136.	Nonexperimental	501 medication error reports	n/a	n/a	Errors involving medication reconciliation	Medication reconciliation process should be standardized. The roles and responsibilities of personnel involved in reconciliation should be clearly defined. A standardized medication reconciliation form with a scripted list of questions or prompts should be used.	IIIA

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57	Anderson MA, Kyle E. Guideline for Complementary Care. Kyle E, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Perioperative practice recommendations for complementary care.	IVA
58	Gallo, E., Pugi, A., Lucenteforte, E., Maggini, V., Gori, L., Mugelli, A., et al. (2014). Pharmacovigilance of herb-drug interactions among preoperative patients. <i>Alternative Therapies in Health & Medicine</i> , 20(2), 13-17.	Nonexperimental	478 patients	n/a	n/a	Patients taking herbal remedies	Almost 50% of patients (79.8%) were taking an herbal remedy.	IIIA
59	Lee, A., Varma, A., Boro, M., & Korman, N. (2014). Value of pharmacist medication interviews on optimizing the electronic medication reconciliation process. <i>Hospital Pharmacy</i> , 49(6), 530-538.	Quasi-experimental	513 Medical record only, 986 medical record plus interview.	Medical record review plus patient interview.	No interview	Medication discrepancies	More medication discrepancies were identified when the reconciliation process included a review of the medical record and a patient interview compared to reviewing only the medical record.	IIB
60	Meyer, C., Stern, M., Woolley, W., Jeanmonod, R., & Jeanmonod, D. (2012). How reliable are patient-completed medication reconciliation forms compared with pharmacy lists? <i>American Journal of Emergency Medicine</i> , 30(7), 1048-1054.	Nonexperimental	315 patients	n/a	n/a	Medication discrepancies	Patients did not supply an accurate medication history.	IIIB
61	de Lorenzo-Pinto A, Ortega-Navarro C, Ribed A, et al. Cancellations of elective surgical procedures due to inadequate management of chronic medications. <i>J Clin Pharm Ther.</i> 2019;44(4):561-564.	Nonexperimental	5415 surgical procedures	n/a	n/a	Rate of surgical cancellations due to inadequate management of chronic medications	The rate of cancellations due to incorrect management of medications was 2.4% (19). The cancellations were related to poor understanding of anesthesia provider recommendations (n=15) and no preanesthesia evaluation (n=4). Anticoagulants or antiplatelet medications made up the largest percentage of medication cancellations (89.5%).	IIIB
62	Abrahamowicz M, Hanley J, Kurteva S, et al. Effect of an electronic medication reconciliation intervention on adverse drug events: A cluster randomized trial. <i>JAMA Netw Open.</i> 2019.	RCT	3491 patients	RightRx reviewed community medications from the insurer and aligned with medications used in the facility	Standard care consisting medication reconciliation at admission and discharge by the pharmacy, nurse, or physician.	Adverse drug events within 30 days of discharge, medication discrepancies, ED visits, and hospital readmissions.	Electronic medication reconciliation reduced discrepancies but did not reduce adverse drug errors or other adverse outcomes.	IA
63	Mekonnen, A. B., McLachlan, A. J., & Brien, J. E. (2016). Effectiveness of pharmacist-led medication reconciliation programmes on clinical outcomes at hospital transitions: A systematic review and meta-analysis. <i>BMJ Open</i> , 6(2), e010003.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	Pharmacist medication reconciliation during hospital transitions decreases adverse drug related hospital revisits, all-cause readmissions and ED visits.	IIB

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64	Renaudin A, Choukroun C, Richard H, et al. Impact of a preoperative pharmaceutical consultation in scheduled orthopedic surgery on admission: A prospective observational study. BMC Health Serv Res. 2020;20(1):747.	Nonexperimental	360 patients scheduled for orthopedic surgery	Pharmacist input a pre-anesthesia consult medication history and made recommendations for medication orders on admission	n/a	Unintended medication discrepancies and patient and anesthesiologist satisfaction	One unintended medication discrepancy occurred in 13% of patients. Of the 63 discrepancies detected, the most common types were omission (25.4%) and incorrect drug (23.8%). Two discrepancies were potentially life threatening.	IIIB
65	Gonzalez-Garcia L, Salmeron-Garcia A, Belda-Rustarazo S, Cabeza-Barrera J, Garcia-Lirola M, Moya-Roldan S. Medication reconciliation at admission to surgical departments. J Eval Clin Pract. 2016;22(1):20-25.	Nonexperimental	176 surgical patients	n/a	n/a	Prevalence of reconciliation errors on admission to surgical departments, clinical impact, and risk factors	Most patients has a reconciliation error with drug omission being the more frequent.	IIIB
66	Falconer EA, Harris DA, Singh A, et al. Pharmacy-led initiative for improving peri-operative medication reconciliation among bariatric surgical patients: What is the role? Surg Endosc. 2021.	Nonexperimental	353 bariatric patients	n/a	n/a	Medication changes, 30-postoperative outcomes	Inclusion of an inpatient pharmacist consultation facilitated more appropriate therapy for hypotension and increased use of non-narcotic patient medications after discharge.	IIIB
67	Lake N, Nawer H, Wagner D. Piloting medication histories in a pediatric postanesthesia care unit. J Perianesth Nurs. 2019;34(1):117-123.	Organizational Experience	75 pediatric surgical medication histories	n/a	n/a	Medication discrepancies	74 medication discrepancies were identified, omission was the most common.	VB
68	Shiu, J. R., Fradette, M., Padwal, R. S., Majumdar, S. R., Youngson, E., Bakal, J. A., et al. (2016). Medication discrepancies associated with a medication reconciliation program and clinical outcomes after hospital discharge. Pharmacotherapy: The Journal of Human Pharmacology & Drug Therapy, 36(4), 415-421.	Nonexperimental	433 patients	n/a	n/a	Medication discrepancies	Medication discrepancies continued to occur after medication reconciliation was performed but all were considered to have no effect on the patient.	IIIB
69	Lehnbom, E. C., Stewart, M. J., Manias, E., & Westbrook, J. I. (2014). Impact of medication reconciliation and review on clinical outcomes. Annals of Pharmacotherapy, 48(10), 1298-1312.	Systematic Review	n/a	n/a	n/a	n/a	Medication reconciliation has not demonstrated significant improvements in patient outcomes.	IIIB
70	Hellstrom, L. M., Hoglund, P., Bondesson, A., Petersson, G., & Eriksson, T. (2012). Clinical implementation of systematic medication reconciliation and review as part of the lund integrated medicines management model--impact on all-cause emergency department revisits. Journal of Clinical Pharmacy & Therapeutics, 37(6), 686-692.	Quasi-experimental	1216 patients in admission group, 2758 patients in control group.	Medication reconciliation and review.	No medication reconciliation and review.	Number of ED visits, mortality, or re-hospitalizations.	Performing medication reconciliation and medication review did not decrease the number of ED visits, mortality, or re-hospitalizations.	IIA

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71	Ebbens MM, Gombert-Handoko K, Wesselink EJ, van den Bemt, Patricia M.L.A. The effect of medication reconciliation via a patient portal on medication discrepancies: A randomized noninferiority study. <i>J Am Med Dir Assoc.</i> 2021.	RCT	499 perioperative patients	Use of a patient portal during the medication reconciliation	Standard medication reconciliation processes using a pharmacy technician screening	Medication discrepancies	There was no difference in medication discrepancies between use of the patient portal and the standard process. Use of the electronic medication reconciliation portal saved time.	IA
72	Arenas-Villafranca J, Moreno-Santamaria M, Lopez Gomez C, Munoz Gomez-Millan I, Alvaro Sanz E, Tortajada-Goitia B. An admission medication reconciliation programme carried out by pharmacists: Impact on surgeons' prescriptions. <i>Euro J Hosp Pharm Sci Pra.</i> 2018;25:E62-E65.	Nonexperimental	179 patients out of 1986 medication reconciliation reports	n/a	n/a	Surgeon degree of acceptance of information in medication reconciliation reports	The surgeons reconciled 98.9% of patient medication reconciliation reports in the OR, 85.8% were fully reconciled.	IIIB
73	Guisado-Gil A, Ramirez-Duque N, Baron-Franco B, Sanchez-Hidalgo M, De la Portilla F, Santos-Rubio M. Impact of a multidisciplinary medication reconciliation program on clinical outcomes: A pre-post intervention study in surgical patients. <i>Res Social Adm Pharm.</i> 2021;17(7):1306-1312.	Quasi-experimental	308 patients	Implementation of an interdisciplinary medication reconciliation program.	Pre-intervention group	The impact of a medication reconciliation program on mortality, preventable surgery cancellations, and risk factors for complications.	Vulnerable populations of patients over 75 years old and those with cardiovascular disease had a reduction in length of stay. The intervention group had a significant improvement in management of preoperative blood pressure in hypertensive patients and for insulin reconciliation in patients with diabetes.	IIB
74	Institute of Medicine (US) Committee on Quality of Health Care in America. Medications in single-dose vials: Implications of discarded drugs. Washington, DC: The National Academies Press; 2021:174. https://nap.nationalacademies.org/catalog/25911/medications-in-single-dose-vials-implications-of-discarded-drugs . 10.17226/25911.	Expert Opinion	n/a	n/a	n/a	n/a	National Academy of Medicine report on the implications of discarded drugs specific to single dose vials.	VA
75	Sentinel event alert 52: Preventing infection from the misuse of vials(2014). The Joint Commission (TJC). Retrieved from https://www.jointcommission.org/resources/patient-safety-topics/sentinel-event/sentinel-event-alert-newsletters/sentinel-event-alert-issue-52-preventing-infection-from-the-misuse-of-vials/#.YqeQlaHMI2w	Expert Opinion	n/a	n/a	n/a	n/a	Provides recommendations for use of single use vials.	VB
76	Tsai PB, Bergin MW. Unintentional infiltration of high dose epinephrine in an infant: A case report. <i>A A Pract.</i> 2020;14(6):e01179. https://journals.lww.com/aacr/pages/default.aspx ; http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emexa&NEWS=N&AN=631774024 . doi: http://dx.doi.org/10.1213/XAA.0000000000001179 .	Case Report	n/a	n/a	n/a	n/a	Patient received an excessive dose of epinephrine due to poor verbal orders, mismatch between stocked medications and preferences card information, compounding issues, and lack of labeling just before injection.	VB

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77	FDA'S human drug compounding progress report. three years after enactment of the drug quality and security act. U.S. Food & Drug Administration (FDA); 2017.	Expert Opinion	n/a	n/a	n/a	n/a	FDA report on medication compounding in the US 3 years after the enactment of additional regulations.	VA
78	Registered outsourcing facilities. (2022). Retrieved 6/14, 2022, from https://www.fda.gov/drugs/human-drug-compounding/registered-outsourcing-facilities	Expert Opinion	n/a	n/a	n/a	n/a	List of FDA-registered outsourcing facilities.	VA
79	ASHP guidelines on outsourcing sterile compounding services. AM J HEALTH SYST PHARM AJHP. 2015;72(19):1664-1675.	Guideline	n/a	n/a	n/a	n/a	Recommendations for compounded sterile preparation outsourcing.	IVB
80	Compounding and the FDA: Questions and answers. (2018). Retrieved 6/14, 2022, from https://www.fda.gov/drugs/human-drug-compounding/compounding-and-fda-questions-and-answers	Expert Opinion	n/a	n/a	n/a	n/a	FDA information on compounding medications.	VA
81	Information for outsourcing facilities. (2022). Retrieved 6/14, 2022, from https://www.fda.gov/drugs/human-drug-compounding/information-outsourcing-facilities	Expert Opinion	n/a	n/a	n/a	n/a	Information on FDA-registered outsourcing facilities.	VA
82	Pedersen CA, Schneider PJ, Ganio MC, Scheckelhoff DJ. ASHP national survey of pharmacy practice in hospital settings: Dispensing and administration - 2020. Am J Health-Syst Pharm. 2021;78(12):1074-1093. https://academic.oup.com/ajhp/issue ; http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emexb&NEWS=N&AN=2013684247 . doi: http://dx.doi.org/10.1093/ajhp/zxab120 .	Nonexperimental	269 hospitals (response rate 18.7%)	n/a	n/a	Review of hospital pharmacy dispensing and administration practices	Compounded sterile preparations are mostly outsourced.	IIIB
83	Matousek P, Kominek P, Garcic A. Errors associated with the concentration of epinephrine in endonasal surgery. European Archives of Oto-Rhino-Laryngology. 2011;268(7):1009-1011. Accessed 20110531.	Case Report	n/a	n/a	n/a	n/a	Medication dilutions should be prepared outside the OR. Dilutions of the same medications prepared in the facility should have different colored labels.	VC
84	Dehmel C, Braune SA, Kreyman G, et al. Do centrally pre-prepared solutions achieve more reliable drug concentrations than solutions prepared on the ward?. Intensive Care Med. 2011;37(8):1311-1316. Accessed 20110715.	Nonexperimental	100 admixtures made in pharmacy and 100 admixtures made in nursing unit.	n/a	n/a	Medication concentration	Medication dilutions should be prepared outside the OR. Dilutions of the same medications prepared in the facility should have different colored labels.	IIIB
85	Anto, B., Barlow, D., Osborne, C. A., & Whittlesea, C. (2011). Incorrect drug selection at the point of dispensing: A study of potential predisposing factors. International Journal of Pharmacy Practice, 19(1), 51-60.	Nonexperimental	911 dispensing errors	n/a	n/a	Predisposing factors to medication errors.	Medication selection errors are related to confusion caused by look-alike/sound-alike medications.	IIIB

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86	Grissinger, M. (2011). Ambulatory surgery facilities: A comprehensive review of medication error reports in pennsylvania. Pennsylvania Patient Safety Advisory, 8(3), 85-93.	Nonexperimental	502 medication error reports	n/a	n/a	Types of medication errors.	Report for the state of Pennsylvania containing medication error statistics from ambulatory surgery centers and recommendations for interventions to take to reduce the number of errors.	IIIB
87	Drug scheduling. https://www.dea.gov/drug-information/drug-scheduling . Accessed 4/27, 2022.	Expert Opinion	n/a	n/a	n/a	n/a	DEA information about drug scheduling.	VA
88	Core infection prevention and control practices for safe healthcare delivery in all settings: Recommendations of the HICPAC (2017). Healthcare Infection Control Practices Advisory Committee (HICPAC); 2017.	Guideline	n/a	n/a	n/a	n/a	HICPAC Core infection prevention and control recommendations in health care settings.	IVA
89	Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care. 2.3rd ed. National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention (CDC); 2016	Guideline	n/a	n/a	n/a	n/a	CDC recommendations for safe injection practices in outpatient settings.	IVB
90	Dolan SA, Arias KM, Felizardo G, et al. APIC position paper: Safe injection, infusion, and medication vial practices in health care. Am J Infect Control. 2016;44(7):750-757.	Guideline	n/a	n/a	n/a	n/a	Guidelines for safe Injection ,infusion, and medication vial practices in health care.	IVB
91	Safe Injection Guidelines for Needle and Syringe Use. American Association of Nurse Anesthesiology (AANA); 2022. https://www.aana.com/docs/default-source/practice-aana-com-web-documents-(all)/professional-practice-manual/safe-injection-guidelines-for-needle-and-syringe-use.pdf	Guideline	n/a	n/a	n/a	n/a	Recommendation for safe injection practices for Nurse Anesthesiologists.	IVB
92	Anderson MA, Giarrizzo-Wilson S. Guideline for Patient Information Management. Kyle E, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for perioperative patient information management	IVA
93	ISMP's guidelines for standard order sets. Institute for Safe Medication Practices (ISMP); 2010Guidelines.	Guideline	n/a	n/a	n/a	n/a	Guideline recommendations for order sets.	IVC
94	List of error-prone abbreviations. Recommendations Web site. https://www.ismp.org/recommendations/error-prone-abbreviations-list . Updated 2021. Accessed 5/16, 2022.	Expert Opinion	n/a	n/a	n/a	n/a	ISMP list of error-prone abbreviations.	VA
95	Do not use list. Fact Sheets Web site. https://www.jointcommission.org/resources/news-and-multimedia/fact-sheets/facts-about-do-not-use-list/ . Accessed 5/16, 2022.	Expert Opinion	n/a	n/a	n/a	n/a	Joint Commission list of Do-Not-Use abbreviations.	VA
96	Recommendations to enhance accuracy of Prescription/Medication order writing. https://www.nccmerp.org/recommendations-enhance-accuracy-prescription-writing . Updated 2014. Accessed 10/27, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	NCCMERP list of abbreviations to avoid.	VA

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97	Reducing medication errors associated with at-risk behaviors by healthcare professionals. https://www.nccmerp.org/reducing-medication-errors-associated-risk-behaviors-healthcare-professionals . Updated 2014. Accessed 10/27, 2021.	Position Statement	n/a	n/a	n/a	n/a	NCCMERP recommendations on preventing at-risk behaviors of health care personnel to reduce medication errors.	IVC
98	Samaranayake, N. R., Cheung, D. S. T., Lam, M. P. S., Cheung, T. T., Chui, W. C. M., Wong, I. C. K., et al. (2014). The effectiveness of a 'do not use' list and perceptions of healthcare professionals on error-prone abbreviations. <i>International Journal of Clinical Pharmacy</i> , 36(5), 1000-1006.	Organizational Experience	1,028 pre implementation. 1,134 Phase 1 post, 1,076 Phase 2 post.	Implementation of a "Do Not Use" abbreviation list	No "Do Not Use" list	Use of risky abbreviations	A "Do not use" abbreviation list is beneficial but continual education on abbreviations is warranted.	VB
99	Wright A, Feblowitz JC, Pang JE, Carpenter JD, Krall MA, Middleton B, Sittig DF. Use of order sets in inpatient computerized provider order entry systems: a comparative analysis of usage patterns at seven sites. <i>Int J Med Inform</i> . 2012 Nov;81(11):733-45.	Nonexperimental	1,914 order sets used 676,142 times	n/a	n/a	Order set utilization	Order sets related to admission, discharge, and transfer and perioperative services were the most used. Data analysis is needed to optimize development and implementation of order sets.	IIIB
100	Recommendations to reduce medication errors associated with verbal medication orders and prescriptions. https://www.nccmerp.org/recommendations-reduce-medication-errors-associated-verbal-medication-orders-and-prescriptions . Updated 2015. Accessed 10/27, 2021.	Position Statement	n/a	n/a	n/a	n/a	Recommendations for prevention of medication errors associated with prescriptions and verbal orders.	IVC
101	Goldspiel B, Hoffman JM, Griffith NL, et al. ASHP guidelines on preventing medication errors with chemotherapy and biotherapy. <i>AM J HEALTH SYST PHARM AJHP</i> . 2015;72(8):e6-e35.	Guideline	n/a	n/a	n/a	n/a	Recommendations to prevent antineoplastic and biotherapy errors.	IVB
102	Recommendations to enhance accuracy of dispensing medications. https://www.nccmerp.org/recommendations-enhance-accuracy-dispensing-medications . Updated 2015. Accessed 10/27, 2021.	Position Statement	n/a	n/a	n/a	n/a	NCCMERP recommendations on increasing accuracy in medication dispensing practices.	VB
103	Cohen MR, Smetzer JL. No unlabeled containers anywhere, ever! Where did this come from? <i>Hosp Pharm</i> . 2015;50(3):185-188. [VC]	Case Report	n/a	n/a	n/a	n/a	Label medications on the sterile field, use Tall man letters on labels, put medications on sterile field as close to time of use as possible, verify medication when delivering to sterile field, discard all unlabeled solutions on sterile field.	VC
104	Fearon MC, Spruce L, Conner R, Wood A. Guideline for Team Communication. Conner R, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for team communication in perioperative practice.	IVA
105	Cello R, Conley M, Cooley T, et al. ASHP guidelines on the safe use of automated dispensing cabinets. <i>Am J Health Syst Pharm</i> . 2022;79(1):e71-e82.	Guideline	n/a	n/a	n/a	n/a	ASHP guideline on use of ADCs.	IVB

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106	Hicks, R. W., Becker, S. C., Windle, P. E., & Krenzischek, D. A. (2007). Medication errors in the PACU. <i>Journal of PeriAnesthesia Nursing</i> , 22(6), 413-419.	Nonexperimental	3,023 medication error reports	n/a	n/a	Frequency of types of medication errors.	Report describing the frequency of various types of medication errors.	IIIC
107	Tsang DK, Dansby M, Deng J, et al. A collaborative initiative for reducing operating room waste of unused refrigerated medication. <i>J Pharm Pract.</i> 2020;33(6):827-831.	Organizational Experience	Not Reported	n/a	n/a	n/a	Project to decrease refrigerated medication waste and costs succeeded when small medication refrigerators were placed in each CVOR.	VB
108	Siegel JD, Rhinehart E, Jackson M, Chiarello L. Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. <i>Healthcare Infection Control Practices Advisory Committee (HICPAC); 2007</i>	Guideline	n/a	n/a	n/a	n/a	Guidance for preventing transmission of infectious agents to patients and healthcare workers in the United States.	IVA
109	Coyle, J. R., Goerge, E., Kacynski, K., Rodgers, R., Raines, P., Vail, L. S., et al. (2016). Hepatitis C virus infections associated with unsafe injection practices at a pain management clinic, michigan, 2014-2015. <i>Pain Medicine</i> ,	Case Report	n/a	n/a	n/a	n/a	Medication vials should be entered with a new needle attached to a new syringe each time entered.	VC
110	Fabbri, G., Panico, M., Dallolio, L., Suzzi, R., Ciccia, M., Sandri, F., et al. (2013). Outbreak of ampicillin/piperacillin-resistant klebsiella pneumoniae in a neonatal intensive care unit (NICU): Investigation and control measures. <i>International Journal of Environmental Research & Public Health [Electronic Resource]</i> , 10(3), 808-815.	Case Report	n/a	n/a	n/a	n/a	Failure to follow various infection control practices resulted in infections in multiple patients. Practices not followed include single dose medication administered to multiple patients.	VC
111	Branch-Elliman, W., Weiss, D., Balter, S., Bornschlegel, K., & Phillips, M. (2013). Hepatitis C transmission due to contamination of multidose medication vials: Summary of an outbreak and a call to action. <i>American Journal of Infection Control</i> , 41(1), 92-94.	Case Report	n/a	n/a	n/a	n/a	HCV was spread through re-use of needles and use of a single-patient use vial on multiple patients.	VC
112	De Smet, B., Veng, C., Kruij, L., Kham, C., van Griensven, J., Peeters, C., et al. (2013). Outbreak of burkholderia cepacia bloodstream infections traced to the use of ringer lactate solution as multiple-dose vial for catheter flushing, phnom penh, cambodia. <i>Clinical Microbiology & Infection</i> , 19(9), 832-837.	Case Report	n/a	n/a	n/a	n/a	The use of multiple dose vials should be avoided.	VC
113	Baniasadi, S., Dorudinia, A., Mobarhan, M., Karimi Gamishan, M., & Fahimi, F. (2013). Microbial contamination of single- and multiple-dose vials after opening in a pulmonary teaching hospital. <i>Brazilian Journal of Infectious Diseases</i> , 17(1), 69-73.	Nonexperimental	205 vials	n/a	n/a	Medication contamination	Single and multidose vials that were opened, partially used, and were within the use date were contaminated.	IIIB
114	Ersoz, G., Uguz, M., Aslan, G., Horasan, E. S., & Kaya, A. (2014). Outbreak of meningitis due to serratia marcescens after spinal anaesthesia. <i>Journal of Hospital Infection</i> , 87(2), 122-125.	Case Report	n/a	n/a	n/a	n/a	Reuse of syringes and needles when withdrawing medications from a multiple-dose vial caused an outbreak of meningitis.	VC

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115	Drezner, K., Antwi, M., Del Rosso, P., Dorsinville, M., Kellner, P., & Ackelsberg, J. (2014). A cluster of methicillin-susceptible staphylococcus aureus infections at a rheumatology practice, new york city, 2011. <i>Infection Control & Hospital Epidemiology</i> , 35(2), 187-189.	Case Report	n/a	n/a	n/a	n/a	A series of infections were related to the contamination of a multidose vial.	VC
116	Kundra, S., Singh, R. M., Grewal, A., Gupta, V., & Chaudhary, A. K. (2013). Necrotizing fasciitis after spinal anesthesia. <i>Acta Anaesthesiologica Scandinavica</i> , 57(2), 257-261.	Case Report	n/a	n/a	n/a	n/a	Report of a case of streptococcal necrotizing fasciitis resulting from a contaminated multidose vial.	VB
117	Moore, Z. S., Schaefer, M. K., Hoffmann, K. K., Thompson, S. C., Xia, G., Lin, Y., et al. (2011). Transmission of hepatitis C virus during myocardial perfusion imaging in an outpatient clinic. <i>American Journal of Cardiology</i> , 108(1), 126-132.	Case Report	n/a	n/a	n/a	n/a	HCV was transmitted between patients by the use of multidose vials and the use of shared needles between multiple patients.	VA
118	Antimicrobial Effectiveness Testing (51). 2021st ed. U.S. Pharmacopeial Convention; 2021:181-183	Guideline	n/a	n/a	n/a	n/a	Information about antimicrobial effectiveness of preservatives in medications.	IVC
119	Bjornstad M, Kosinski T, Burlage R. Evaluation of the efficacy and superiority of different vial rubber closure disinfection techniques. <i>Int J Pharm Compd</i> . 2020;24(5):434-438.	Nonexperimental	130 vials of sterile water for injection	90 vials (30 each) in 1 of 3 groups performing different methods of alcohol swab disinfection of the vial septum.	30 vials in the negative and 10 vials in the positive control group	Contamination of the vial septum	Disinfection of the vial by swabbing three times in one direction with different surfaces of the alcohol pad or in a back and forth motion three times over the septum with the same side of the alcohol pad was superior to no disinfection or disinfection using the same surface of the pad for three swipes in one direction.	IIIB
120	Hilliard, J. G., Cambronne, E. D., Kirsch, J. R., & Aziz, M. F. (2013). Barrier protection capacity of flip-top pharmaceutical vials. <i>Journal of Clinical Anesthesia</i> , 25(3), 177-180.	Nonexperimental	15 vials	n/a	n/a	Vial rubber septum contamination	The rubber septum requires decontamination prior to insertion of needle.	IIIB
121	Laha, B., & Hazra, A. (2015). Medication error report: Intrathecal administration of labetalol during obstetric anesthesia. <i>Indian Journal of Pharmacology</i> , 47(4), 456-458.	Case Report	n/a	n/a	n/a	n/a	Case report of a label not being read closely, keeping multiple injections together.	VC
122	Patel, S., & Loveridge, R. (2015). Obstetric neuraxial drug administration errors: A quantitative and qualitative analytical review. <i>Anesthesia & Analgesia</i> , 121(6), 1570-1577.	Systematic Review	n/a	n/a	n/a	n/a	Labels must be carefully read, all syringes must be labeled, labels should be double checked with another individual or a machine and only non-Leur lock connections should be used on spinal-epidural devices.	IIIB

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123	Yadav, G., Gupta, S. K., Bharti, A. K., Khuba, S., Jain, G., & Singh, D. K. (2013). Syringe swap and similar looking drug containers: A matter of serious concern. <i>Anaesthesia, Pain and Intensive Care</i> , 17(2), 205-207.	Case Report	n/a	n/a	n/a	n/a	Look-alike medications should be stored in separate locations, double check medications before administration, medications syringes should be labeled and label should be read carefully.	VC
124	Title 21: Food and drugs. chapter 9: Federal food, drug, and cosmetic act. subchapter V: Drugs and devices. part A: Drugs and devices. sec. 353a: Pharmacy compounding. 353a-1: Enhanced communication. 353b: Outsourcing facilities(2020). (2018 Edition, Supplement 2 ed.) Government Publishing Office (GPO).	Regulatory	n/a	n/a	n/a	n/a	Federal regulations on use of compounding facilities.	n/a
125	ASHP guidelines on compounding sterile preparations. American Society of Health-System Pharmacy (ASHP)Guidelines.	Guideline	n/a	n/a	n/a	n/a	Recommendations on compounding sterile preparations.	IVB
126	Elliott M, Liu Y. The nine rights of medication administration: An overview. <i>Br J Nurs</i> . 2010;19(5):300-305.	Expert Opinion	n/a	n/a	n/a	n/a	Details nine rights of medication safety.	VC
127	Zhou, L., Dhopeswarkar, N., Blumenthal, K. G., Goss, F., Topaz, M., Slight, S. P., et al. (2016). Drug allergies documented in electronic health records of a large healthcare system. <i>Allergy</i> ,	Nonexperimental	1,766,328 patients	n/a	n/a	Presence of medication allergies	Allergies are present in many patients and there is an increase in allergies to ACE inhibitors.	IIIB
128	Echeta, G., Moffett, B. S., Checchia, P., Benton, M. K., Klouda, L., Rodriguez, F. H. 3., et al. (2014). Prescribing errors in adult congenital heart disease patients admitted to a pediatric cardiovascular intensive care unit. <i>Congenital Heart Disease</i> , 9(2), 126-130.	Nonexperimental	85 adults, 33 pediatric patients	n/a	n/a	Medication errors	Medication dosage should be calculated based on the weight and not the age of the patient because some people are large pediatric patients or small adult patients.	IIIB
129	Cohen, M. R., & Smetzer, J. L. (2011). ISMP medication error report analysis. <i>Hospital Pharmacy</i> , 46(2), 82-86.	Case Report	n/a	n/a	n/a	n/a	A case report of a patient receiving a medication IV that was intended to be given as a wound irritant.	VC
130	Simmons, D., Phillips, M. S., Grissinger, M., Becker, S. C., & USP Safe Medication Use Expert Committee. (2008). Error-avoidance recommendations for tubing misconnections when using luer-tip connectors: A statement by the USP safe medication use expert committee. <i>Joint Commission Journal on Quality and Patient Safety / Joint Commission Resources</i> , 34(5), 293-6, 245.	Expert Opinion	n/a	n/a	n/a	n/a	Personnel should be educated about types of tubing, making correct connections. Only syringes intended for IV use should be used for IV injections. Policy and procedures should include the need to trace lines.	VB
131	Kanji, S., Lam, J., Goddard, R. D., Johanson, C., Singh, A., Petrin, L., et al. (2013). Inappropriate medication administration practices in canadian adult ICUs: A multicenter, cross-sectional observational study. <i>Annals of Pharmacotherapy</i> , 47(5), 637-643.	Nonexperimental	434 ICU patients	n/a	n/a	Simultaneous administration of two incompatible medications.	Two incompatible medications were observed to be given via the same IV line.	IIIA

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132	Thomas L, Donohue-Porter P, Stein Fishbein J. Impact of interruptions, distractions, and cognitive load on procedure failures and medication administration errors. J Nurs Care Qual. 2017;32(4):309-317.	Nonexperimental	857 Observed medication administration episodes	n/a	n/a	Distractions, Interruptions, cognitive load during medication administration processes and numbers of procedural failures	Distractions and interruptions were common. Distractions included issues with other patients, fatigue, hunger, and noise level. Procedural failures varied between facilities with a range of 36.5% to 97.7%	IIIB
133	Bravo K, Cochran G, Barrett R. Nursing strategies to increase medication safety in inpatient settings. J Nurs Care Qual. 2016. Accessed 20160305.	Nonexperimental	1374 patients	n/a	n/a	Interruptions during medication administration.	Interruptions occur frequently during the process of medication administration.	IIIB
134	McLeod M, Barber N, Franklin BD. Facilitators and barriers to safe medication administration to hospital inpatients: A mixed methods study of nurses' medication administration processes and systems (the MAPS study). PLoS ONE [Electronic Resource]. 2015;10(6):e0128958. Accessed 20150623.	Nonexperimental	56 drug rounds	n/a	n/a	Interruptions	Interruptions during medication administration should be limited.	IIIB
135	Raban MZ, Westbrook JI. Are interventions to reduce interruptions and errors during medication administration effective?: A systematic review. BMJ Quality and Safety. 2014;23(5):414-421.	Systematic Review	n/a	n/a	n/a	n/a	Evidence supporting medication errors being decreased by decreasing interruptions is weak but it is present. Processes to reduce the number of interruptions should be instituted in addition to more research being completed.	IIA
136	Verweij L, Smeulers M, Maaskant JM, Vermeulen H. Quiet please! drug round tabards: Are they effective and accepted? A mixed method study. Journal of Nursing Scholarship. 2014;46(5):340-348. Accessed 20140828.	Nonexperimental	105 medication administrations pre intervention, 104 post intervention period 1, 104 post intervention period 2.	Wearing tabards	No tabards	Interruptions and medication errors.	The use of drug round tabards decreased the number of interruptions and simultaneously the number of medication errors.	IIIB
137	Pape TM. The effect of a five-part intervention to decrease omitted medications. Nurs Forum. 2013;48(3):211-222. Accessed 20130729.	Organizational Experience	LPNs and RNs on a single medical-surgical unit. 63 control/57 intervention group.	Implementation of Med Safe Protocol	No protocol	Distractions and interruptions.	A medication safety zone should be established. Nurses in zone should not be interrupted. Nurses should wear visible attire during medication administration. A medication safety checklist should be used. A coined reply for should be created for nurses to use when interrupted. Personnel should be educated regarding actions to take to decrease interruptions.	VB

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138	Cahn J, Wood A. Guideline for Sterile Technique. Wood A, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for preventing contamination to the sterile field.	IVA
139	Akbari H, Ghahremani-Chabok A, Mousavi SA. Inadvertent subcutaneous injection of atracurium during circumcision operation. Journal of Pediatrics Review. 2020;8(1):53-58.	Case Report	n/a	n/a	n/a	n/a	Poor placement of a look alike ampule and not reviewing the label before administration led to injection of the wrong medication.	VC
140	Chung J, Jeong M. Oxygen embolism caused by accidental subcutaneous injection of hydrogen peroxide during orthopedic surgery. Medicine. 2017;96(43):e8342.	Case Report	n/a	n/a	n/a	n/a	Hydrogen peroxide was placed on the sterile field with out verbal verification and the scrub person believing it to be local anesthetic agent but did not confirm that assumption leading to erroneous injection.	VC
141	Ohki T, Kichikawa K, Yokoi H, et al. Long-term results of the japanese multicenter viabahn trial of heparin bonded endovascular stent grafts for long and complex lesions in the superficial femoral artery. J Vasc Surg. 2021;74(6):1958-1967.e2.	Nonexperimental	103 patients treated with 194 heparin-bonded stent grafts used for treatment of superficial femoral artery lesions	n/a	n/a	Outcomes at 5 years	Long term use of the stent graft for complex superficial femoral artery lesions is safe and effective. Freedom from target lesion revascularization as 79.1% and there was no leg amputation, ischemia, or stent fractures.	IIIB
142	Varenhorst C, Lindholm M, Sarno G, et al. Stent thrombosis rates the first year and beyond with new- and old-generation drug-eluting stents compared to bare metal stents. Clin Res Cardiol. 2018;107(9):816-823.	Quasi-experimental	207,291 drug-eluting stents implanted	New generation stents	Old generation stents, bare metal stents	Late stent thrombosis rates	Newer generation stents were associated with lower rates of late stent thrombosis compared to bare metal stents during the first year post stenting. After a year the new generation and bare metal stents has similar rates of late stent thrombosis.	IIB
143	Cohen, M. R., & Smetzer, J. L. (2013). ISMP medication error report analysis - important change with heparin labels; benadryl dispensed instead of vitamins for home parenteral nutrition; potassium and sodium acetate injection mix-ups; don't truncate, stem, or shorten drug names. Hospital Pharmacy, 48(4), 267-269.	Case Report	n/a	n/a	n/a	n/a	Medication names should not be abbreviated, truncated, stemmed or shortened on medication labels.	VC
144	Trudeau M, Green E, Cosby R, et al. Key components of intravenous chemotherapy labeling: A systematic review and practice guideline. J ONCOL PHARM PRACT. 2011;17(4):409-424.	Guideline	n/a	n/a	n/a	n/a	Evidence based guideline for contents of medication labels.	IVB

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
145	DeHenau C, Becker MW, Bello NM, Liu S, Bix L. Tallman lettering as a strategy for differentiation in look-alike, sound-alike drug names: The role of familiarity in differentiating drug doppelgangers. <i>Appl Ergon</i> . 2016;52:77-84. Accessed 20150912.	Nonexperimental	16 nurses, 24 other health care providers, 40 lay people.	Tall man lettering	Lower case lettering	Accuracy of reading names of look-alike medications.	Tallman lettering on medication labels should be used help to reduce medication errors.	IIIB
146	Emmerton L, Rizk MFS, Bedford G, Lalor D. Systematic derivation of an Australian standard for tall man lettering to distinguish similar drug names. <i>J Eval Clin Pract</i> . 2015;21(1):85-90.	Nonexperimental	250 pairs of confusable drug names	Application of Tall Man lettering	No Tall Man Lettering	Confusable drug names	Tall Man lettering should be used on labels to identify confusable medications.	IIIB
147	Or CKL, Chan AHS. Effects of text enhancements on the differentiation performance of orthographically similar drug names. <i>Work</i> . 2014;48(4):521-528. Accessed 20140829.	Nonexperimental	60 individuals reviewed 120 pairs of drug names.	Label text enhancements (eg, Tall man lettering).	All labels contain lower case lettering.	Drug name differentiation	Text enhancement (eg, tall man lettering increases name differentiation of look-alike drugs.	IIIB
148	FDA name differentiation project. https://www.fda.gov/drugs/medication-errors-related-cder-regulated-drug-products/fda-name-differentiation-project . Updated 2020. Accessed 5/3, 2022.	Expert Opinion	n/a	n/a	n/a	n/a	The FDA provides a lists of confused drug names and use of tall man lettering.	VA
149	List of confused drug names. https://www.ismp.org/recommendations/confused-drug-names-list?check_logged_in=1 . Updated 2019. Accessed 5/3, 2022.	Expert Opinion	n/a	n/a	n/a	n/a	ISMP provides a list of confusing medication names.	VA
150	Look-alike drug names with recommended tall man letters. https://www.ismp.org/recommendations/tall-man-letters-list . Published November 20, 2016. Updated 2016. Accessed 5/3, 2022.	Position Statement	n/a	n/a	n/a	n/a	ISMP provides a list if look-alike medication names with recommended tall man letters that is more expanded from the FDA lists.	IVB
151	Guidelines for safe electronic communication of medication information. Institute for Safe Medication Practices (ISMP); 2019.	Guideline	n/a	n/a	n/a	n/a	Recommendations for safe communication of electronic medication information.	IVC
152	Grissinger M. Accidental iv infusion of heparinized irrigation in the operating room. <i>P T</i> . 2019;44(7):389-390.	Case Report	n/a	n/a	n/a	n/a	ISMP care report on medication errors associated with irrigation solutions.	VB
153	High-alert medications in acute care settings. https://www.ismp.org/recommendations/high-alert-medications-acute-list . Updated 2018. Accessed 5/4, 2022.	Position Statement	n/a	n/a	n/a	n/a	ISMP list of high-alert medications and associated recommendations.	IVC
154	Manias E, Williams A, Liew D, Rixon S, Braaf S, Finch S. Effects of patient-, environment- and medication-related factors on high-alert medication incidents. <i>Int J Qual Health Care</i> . 2014;26(3):308-320.	Nonexperimental	1,934 errors with high alert medications out of 6,984 incidences	n/a	n/a	Prescribing and administration incidents in high-alert medications in 5 settings	Increased numbers of patient transfers was associated with an increased risk for high-alert medication administration errors in perioperative care.	IIIB
155	Independent double checks: Worth the effort if used judiciously and properly. ISMP safety alert!. 2019;24(11):July 29, 2022.	Expert Opinion	n/a	n/a	n/a	n/a	ISMP recommends the select use of independent double checks for high-risk tasks, vulnerable patients, and high-alert medications.	VB

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156	Independent Double Checks: Undervalued and Misused: Selective Use of This Strategy Can Play an Important Role in Medication Safety. Featured Articles Web site. https://www.ismp.org/resources/independent-double-checks-undervalued-and-misused-selective-use-strategy-can-play . Published June 13, 2013. Updated 2013. Accessed 12/1, 2022	Expert Opinion	n/a	n/a	n/a	n/a	ISMP supports selective and judicious use of independent double checks for medication safety.	VB
157	Modic MB, Albert NM, Sun Z, et al. Does an insulin double-checking procedure improve patient safety?. J Nurs Adm. 2016;46(3):154-160. Accessed 20160224.	RCT	266 patients	Double checking of insulin	No double checking of insulin	Medication errors	Double checking of insulin reduced administration errors.	IB
158	Douglass AM, Elder J, Watson R, et al. A randomized controlled trial on the effect of a Double check on the detection of Medication Errors. Ann Emerg Med. 2018;71(1):74-82.e1.	RCT	49 paired RNs (98 RNs total)	Prompted use of a single check of medication	Prompted use of a double check of medication	Rate of double check usage, Use of a double check to identify medication errors	Use of a double check increases error detection rates in some circumstances but not in others.	IB
159	Schutijser BCFM, Jongerden IP, de Bruijne MC, Klopotoska JE, Portegijs S, Wagner C. Double checking injectable medication administration: Does the protocol fit clinical practice? Saf Sci. 2019;118:853-860.	Qualitative	Observations and 27 semi-structured RN interviews	Physical check of the medication	Digital check of the medication	Process variation	The digital check was routinely performed. The RNs performed the physical check based on a variety of environmental, medication, and patient factors.	IIIB
160	Cross R, Bennett PN, Ockerby C, Wang WC, Currey J. Nurses' attitudes toward the single checking of medications. Worldviews Evid Based Nurs. 2017;14(4):274-281.	Nonexperimental	299 RNs completed the survey from a group of 619 (response rate 48%)	n/a	n/a	Nurses attitudes of performing a single medication check	A single check caused less interruptions and time, allowed greater accountability, and increased control over drug administration.	IIIB
161	Alsulami Zayed, Choonara Imti, Conroy Sharon. Nurses' knowledge about the double-checking process for medicines administration.. Nursing Children and Young People. 2014;26(9): 21-26.	Qualitative	48 nurses	n/a	n/a	Adherence to the double checking process	Education on the double-checking process may increase nurses adherence to the process.	IIIB
162	Alsulami Zayed, Choonara Imti, Conroy Sharon. Paediatric nurses' adherence to the double-checking process during medication administration in a children's hospital: an observational study.. J Adv Nurs. 2014;70(6): 1404-1413.	Nonexperimental	2000 medication administration events	n/a	n/a	Types, frequency, and rates of medication administration errors	The medication administration error rate was 9.6%. Most frequent error was parental administration of medications. There was significant variability in adherence rates	IIIB
163	Kellett P, Gottwald M. Double-checking high-risk medications in acute settings: A safer process. Nursing Management (Harrow). 2015;21(9):16-22. Accessed 20150129.	Literature Review	n/a	n/a	n/a	n/a	High risk medications should be double checked prior to administration.	VC
164	Neuss MN, Gilmore TR, Belderson KM, et al. 2016 updated american society of clinical Oncology/Oncology nursing society chemotherapy administration safety standards, including standards for pediatric oncology. Oncol Nurs Forum. 2017;44(1):31-43.	Consensus	n/a	n/a	n/a	n/a	Recommendations for safe handling of hazardous drugs by the Oncology Nursing Society.	IVB

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165	Koyama AK, Maddox CS, Li L, Bucknall T, Westbrook JI. Effectiveness of double checking to reduce medication administration errors: A systematic review. <i>BMJ Qual Saf.</i> 2020;29(7):595.	Systematic Review	n/a	n/a	n/a	n/a	The evidence was insufficient to conclude the effectiveness of single versus double checking of medications during administration on errors or patient harm.	IIIB
166	Alsulami Z, Conroy S, Choonara I. Double checking the administration of medicines: what is the evidence? A systematic review. <i>Arch Dis Child.</i> 2012;97(9):833–837.	Systematic Review	n/a	n/a	n/a	n/a	The current evidence is insufficient to support or refute the practice of double checking medications. The researchers recommend clinical trials be performed.	IIIB
167	29 CFR 1910.1200: Hazard communication. Government Publishing Office (GPO); 2020.	Regulatory	n/a	n/a	n/a	n/a	Regulations on hazard communication.	n/a
168	Controlling occupational exposure to hazardous drugs. https://www.osha.gov/hazardous-drugs/controlling-occeex . Accessed 10/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	OSHA document outlining available evidence supporting recommendations for safe handlings of hazardous medications.	VB
169	Mellinger E, Skinker L, Sears D, Gardner D, Shult P. Safe handling of chemotherapy in the perioperative setting. <i>AORN J.</i> 2010;91(4):435-50.	Expert Opinion	n/a	n/a	n/a	n/a	Discussion of varied chemotherapeutic medications used in the OR.	VA
170	Markowiak T, Ried M, Larisch C, Nowak D, Rakete S, Hofmann H. Exposure to cisplatin in the operating room during hyperthermic intrathoracic chemotherapy. <i>Int Arch Occup Environ Health.</i> 2021.	Nonexperimental	10 Hyperthermic Intrathoracic chemotherapy (HITOC) procedures	n/a	n/a	Environmental contamination of cisplatin	High levels of variation in environmental contamination rates were noted. Some control samples taken before the procedure also had moderate or severe contamination levels.	IIIB
171	Dunn D. Cytoreductive surgery with hyperthermic intraperitoneal chemotherapy, part I: Introduction and indications. <i>AORN J.</i> 2019;110(5):479-499.	Expert Opinion	n/a	n/a	n/a	n/a	Comprehensive background information on HIPEC procedures.	VA
172	Ametsbichler P, Böhländt A, Nowak D, Schierl R. Occupational exposure to cisplatin/oxaliplatin during pressurized intraperitoneal aerosol chemotherapy (PIPAC)? <i>Eur J Surg Oncol.</i> 2018;44(11):1793-1799.	Nonexperimental	14 PIPAC procedures	n/a	n/a	air, surface, device, and trocar contamination	There was a wide range of contamination rates, some things were contaminated before the procedures, and the risk of aerosolization is low.	IIIB
173	Rodier S, Saint-Lorant G, Guilloit JM, et al. Is hyperthermic intraperitoneal chemotherapy (HIPEC) safe for healthcare workers? <i>Surg Oncol.</i> 2017;26(3):242-251.	Literature Review	n/a	n/a	n/a	n/a	Review of evidence on HIPEC procedures. Environmental contamination occurs, focus on employee biological sampling.	VB

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174	Foltz P, Wavrin C, Sticca R. Heated intraoperative intraperitoneal chemotherapy--the challenges of bringing chemotherapy into surgery. AORN J. 2004;80(6):1055-63; quiz 1065-8.	Organizational Experience	Not Reported	n/a	n/a	n/a	Review of safe patient care and handling of hazardous medications for personnel during HIPEC procedures.	VA
175	NIOSH list of antineoplastic and other hazardous drugs in healthcare settings, 2016. https://www.cdc.gov/niosh/docs/2016-161/default.html ed. National Institute for Occupational Safety and Health (NIOSH); 2016.	Expert Opinion	n/a	n/a	n/a	n/a	NIOSH list of hazardous medications and PPE for various activities.	VA
176	Hazardous drugs: Handling in healthcare settings (800). In: USP compounding compendium. 2021st ed. Rockville, MD: US Pharmacopeial Convention; 2021:80-97.	Guideline	n/a	n/a	n/a	n/a	US Pharmacopeia 800 Standard with recommendations for handling hazardous drugs.	IVC
177	Hon C, Teschke K, Shen H, Demers PA, Venners S. Antineoplastic drug contamination in the urine of canadian healthcare workers. International Archives of Occupational & Environmental Health. 2015;88(7):933-941. Accessed 20150910.	Nonexperimental	201 health care workers	n/a	n/a	Level of cyclophosphamide	The levels of a chemotherapeutic medication was higher in those who did not receive education on safe handling compared to those who received the education.	IIIB
178	Gomez-Olivan LM, Miranda-Mendoza GD, Cabrera-Galeana PA, et al. Oxidative stress induced in nurses by exposure to preparation and handling of antineoplastic drugs in mexican hospitals: A multicentric study. Oxidative medicine & cellular longevity. 2014;2014:858604. Accessed 20140410.	Nonexperimental	30 nurses in both control and experimental group.	n/a	n/a	Oxidative stress biomarkers	The levels of oxidative stress biomarkers were elevated in nurses who handle chemotherapeutic medications.	IIIB
179	Roussel C, Witt KL, Shaw PB, Connor TH. Meta-analysis of chromosomal aberrations as a biomarker of exposure in healthcare workers occupationally exposed to antineoplastic drugs. Mutation Research/Reviews in Mutation Research. 2019;781:207-217.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	There is a significant association between occupational exposure pf health care workers to antineoplastic agents and increases in chromosomal aberrations. Occupational exposure to antineoplastic drugs should be limited as much as possible.	IIIA
180	El-Ebiary AA, Abuelfadl AA, Sarhan NI. Evaluation of genotoxicity induced by exposure to antineoplastic drugs in lymphocytes of oncology nurses and pharmacists. Journal of Applied Toxicology. 2013;33(3):196-201. Accessed 20130125.	Nonexperimental	20 nurses, 18 pharmacists	n/a	n/a	Genome damage	Genome damage is found in nurses and pharmacists who handle chemotherapy medications therefore precautions need to be taken including regular biomonitoring.	IIIB
181	Musak L, Smerhovsky Z, Halasova E, et al. Chromosomal damage among medical staff occupationally exposed to volatile anesthetics, antineoplastic drugs, and formaldehyde. Scand J Work Environ Health. 2013;39(6):618-630. Accessed 20131105.	Nonexperimental	249 nurses exposed to antineoplastic medications, 250 nonexposed individuals.	n/a	n/a	Presence of structural chromosomal aberrations.	The nurses exposed to antineoplastic medications had more chromosomal aberrations than the nonexposed individuals.	IIIB

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182	Villarini M, Dominici L, Piccinini R, et al. Assessment of primary, oxidative and excision repaired DNA damage in hospital personnel handling antineoplastic drugs. <i>Mutagenesis</i> . 2011;26(3):359-369.	Nonexperimental	52 health care workers involved in preparation, transportation, administration and disposal of anticancer agents.	n/a	n/a	Presence of primary, oxidative and excision repaired DNA damage.	There is less primary DNA damage when personal protective equipment is used.	IIIB
183	Nassan FL, Chavarro JE, Johnson CY, et al. Prepregnancy handling of antineoplastic drugs and risk of miscarriage in female nurses. <i>Ann Epidemiol</i> . 2021;53:95-102.e2.	Nonexperimental	3,327 pregnancy from 2,440 nurses (from the Nurses' Health Study 3 data)	n/a	n/a	Risks of miscarriage in female nurses with exposures to antineoplastic drugs and the effect of PPE and engineering control use.	There was a suggestive positive association between occupational handling of antineoplastic agents and higher risks of miscarriage especially in nurses who did not consistently use PPE or engineering controls.	IIIA
184	Nassan FL, Lawson CC, Gaskins AJ, et al. Administration of antineoplastic drugs and fecundity in female nurses. <i>Am J Ind Med</i> . 2019;62(8):672-679.	Nonexperimental		n/a	n/a	Ability to get pregnant and the administration of antineoplastic agents, PPE use and engineering control and PPE use during administration	Nurses who administered antineoplastic agents for six years or more had a 27% longer duration of attempting to get pregnant than nurses who never handled antineoplastic agents. When the consistent use of engineering controls and PPE use was factored in, the length of time to get pregnant was similar for both groups of nurses suggesting a protective effect for nurses who consistently use engineering controls and PPE when administering antineoplastic agents.	IIIA
185	Connor TH, Lawson CC, Polovich M, McDiarmid MA. Reproductive health risks associated with occupational exposures to antineoplastic drugs in health care settings: A review of the evidence. <i>Journal of Occupational & Environmental Medicine</i> . 2014;56(9):901-910. Accessed 20140906.	Systematic Review	n/a	n/a	n/a	n/a	Health care workers who are exposed to chemotherapeutic agents seems to raise the risk of congenital malformations, miscarriage and subfertility. Precautions should be taken.	IIIB
186	Lawson CC, Rocheleau CM, Whelan EA, et al. Occupational exposures among nurses and risk of spontaneous abortion. <i>American Journal of Obstetrics & Gynecology</i> . 2012;206(4):327.e1-327.e8. Accessed 20120402.	Nonexperimental	7,482 female nurses	n/a	n/a	Spontaneous abortion after being exposed to chemotherapeutic medication.	There is an increased risk of spontaneous abortion when exposed to antineoplastic medications.	IIIA

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187	Hon CY, Abusitta D. Causes of health care workers' exposure to antineoplastic drugs: An exploratory study. <i>Can J Hosp Pharm.</i> 2016;69(3):216-223.	Nonexperimental	120 participants (response rate between 55% to 76%)	n/a	n/a	Causes of occupational exposure to hazardous drugs	15% of participants had been exposed to hazardous drugs at work and 21.7% were uncertain if they had an exposure. Immediate exposure causes were needlestick injuries, spills, direct contact and unintended exposures. Contributing factors included poor communication, inadequate controls, and lack of training.	IIIB
188	Celano P, Fausel C, Kennedy E, et al. Safe handling of hazardous drugs: ASCO standards <i>J Clin Oncol.</i> 2019;37(7):598-609.	Guideline	n/a	n/a	n/a	n/a	American Society of Clinical Oncology standards for safe handling of hazardous drugs.	IVB
189	Gulten T, Evke E, Ercan I, Evrensel T, Kurt E, Manavoglu O. Lack of genotoxicity in medical oncology nurses handling antineoplastic drugs: Effect of work environment and protective equipment. <i>Work.</i> 2011;39(4):485-489. Accessed 20110803.	Nonexperimental	9 nurses who administer antineoplastic medications using proper precautions, 9 nurses from same unit who do not administer antineoplastic medications, 10 nurses from other units.	n/a	n/a	Amount of genotoxicity	Nurses exposed to antineoplastic medications lack evidence of genotoxicity if PPE is worn and recommended technical equipment is used.	IIIB
190	ASHP guidelines on handling hazardous drugs. American Society of Health-System Pharmacy (ASHP) Guidelines.	Guideline	n/a	n/a	n/a	n/a	Comprehensive guideline on how to safely handle hazardous drugs from a pharmacist perspective.	IVB
191	Kennedy K, Vu K, Coakley N, et al, eds. Safe handling of hazardous drugs. Version: 3 ed. <i>Cancer Care Ontario (CCO)</i> ; 2022.	Guideline	n/a	n/a	n/a	n/a	Guideline recommendations on safe handling of hazardous drugs.	IVA
192	Boiano JM, Steege AL, Sweeney MH. Adherence to safe handling guidelines by health care workers who administer antineoplastic drugs. <i>J Pharm Pract.</i> 2014;11(11):728-740.	Qualitative	241 nurses, 183 pharmacy practitioners	n/a	n/a	Knowledge of standards on handling antineoplastic medications.	Nurses and pharmacists do not have adequate education on handling antineoplastic medications.	IIIB

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193	Lawson CC, Johnson CY, Nassan FL, et al. Antineoplastic drug administration by pregnant and nonpregnant nurses: An exploration of the use of protective gloves and gowns. <i>Am J Nurs.</i> 2019;119(1):28-35.	Nonexperimental	40,420 female nurses surveyed	n/a	n/a	Use of gowns and gloves while administering antineoplastic agents	Despite recommendations for minimum PPE use during administration of antineoplastic drugs many nurses, including pregnant nurses do not use them. 12% of nonpregnant nurses and 9% of pregnant nurses reported not wearing gloves and 42% of nonpregnant nurses and 38% of pregnant nurses reported never wearing a gown.	IIIA
194	Ensuring healthcare worker safety when handling hazardous drugs. joint position statement from the oncology nursing society and the Hematology/Oncology pharmacy association ensuring healthcare worker safety when handling hazardous drugs. <i>Oncology Nursing Society (ONS); 2019</i> Position Statements.	Position Statement	n/a	n/a	n/a	n/a	Joint position statement on safe handling of hazardous drugs by ONS, HOPA.	IVB
195	Preventing occupational exposure to antineoplastic and other hazardous drugs in health care settings. https://www.cdc.gov/niosh/docs/2016-161/default.html ed. National Institute for Occupational Safety and Health (NIOSH); [2016] NIOSH Alert.	Expert Opinion	n/a	n/a	n/a	n/a	NIOSH report on preventing exposure to hazardous drugs.	VA
196	Personal protective equipment for health care workers who work with hazardous drugs. https://www.cdc.gov/niosh/docs/wp-solutions/2009-106/ ed. National Institute for Occupational Safety and Health (NIOSH); 2008 Workplace Solutions.	Expert Opinion	n/a	n/a	n/a	n/a	NIOSH report of PPE to prevent exposures to hazardous drugs.	VB
197	Medical surveillance for healthcare workers exposed to hazardous drugs. National Institute for Occupational Safety and Health (NIOSH); 2012 Workplace Solutions.	Expert Opinion	n/a	n/a	n/a	n/a	NIOSH report on medical surveillance for health care workers exposed to hazardous drugs.	VB
198	Closed system drug-transfer device (CSTD) research. Hazardous Drug Exposures in Healthcare Web site. https://www.cdc.gov/niosh/topics/hazdrug/CSTD.html . Accessed 10/11, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	NIOSH information, testing protocols, and research on Closed system drug transfer devices.	VA
199	Hazardous drug exposures in healthcare. https://www.cdc.gov/niosh/topics/hazdrug/default.html?CDC_AA_refVal=https%3A%2Fwww.cdc.gov%2Fniosh%2Ftopics%2Fantineoplastic%2Fdefault.html . Accessed 10/11, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	NIOSH resources on hazardous drugs.	VA
200	What is a Health Hazard Evaluation? https://www.cdc.gov/niosh/hhe/hheprogram.html . Updated 2018. Accessed, August 10, 2022.	Expert Opinion	n/a	n/a	n/a	n/a	NIOSH Health Hazard Evaluation resources.	VA
201	Hazardous drugs. Safety and Health Topics Web site. https://www.osha.gov/hazardous-drugs . Accessed 10/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	OSHA website resources on hazardous drugs	VA

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202	Frequently Asked Questions: <800> Hazardous Drugs: Handling in Healthcare Settings. United States Pharmacopeia (USP); 2020. https://www.usp.org/frequently-asked-questions/hazardous-drugs-handling-healthcare-settings	Expert Opinion	n/a	n/a	n/a	n/a	USP 800 FAQ resource.	VA
203	Gorski LA, Hadaway L, Hagle ME, et al, eds. Infusion therapy standards of practice. 8th ed. ed. Norwood, MA: Infusion Nurses Society (INS); 2021; No. 44.	Guideline	n/a	n/a	n/a	n/a	Infusion Nurses Society guidance on infusion therapy.	IVB
204	ASTM D6978 05 (reapproved 2019): Standard practice for assessment of resistance of medical gloves to permeation by chemotherapy drugs. West Conshohocken, PA: ASTM International; 2019.	Consensus	n/a	n/a	n/a	n/a	Consensus document on assessment of medical gloves to chemotherapy permeation.	IVC
205	DeJoy DM, Smith TD, Woldu H, Dyal MA, Steege AL, Boiano JM. Effects of organizational safety practices and perceived safety climate on PPE usage, engineering controls, and adverse events involving liquid antineoplastic drugs among nurses. J Occup Environ Hyg. 2017;14(7):485-493.	Nonexperimental	1814 nurses who had administered liquid antineoplastic medications in the previous 7 days	n/a	n/a	Hazardous drug safety practices, culture of safety, use of PPE, engineering controls, and rates of adverse events	Use of PPE and engineering controls was variable. The odds of an adverse event was lower when engineering controls and PPE use was greater.	IIIA
206	He B, Mendelsohn-Victor K, McCullagh MC, Friese CR. Personal protective equipment use and hazardous drug spills among ambulatory oncology nurses. Oncol Nurs Forum. 2017;44(1):60-65.	Nonexperimental	252 oncology nurses who administer hazardous drugs	n/a	n/a	Use of PPE during spill management	PPE use during spills is low.	IIIB
207	Silver SR, Steege AL, Boiano JM. Predictors of adherence to safe handling practices for antineoplastic drugs: A survey of hospital nurses. J Occup Environ Hyg. 2016;13(3):203-212.	Nonexperimental	1,094 nurses who had administered hazardous medications in the previous week	n/a	n/a	Rates of PPE use, adequate time to use PPE and other safety precautions, safety precautions used during spill management	Most (95.4%) had received safety training but only 34% had training in the past year. Most (92%) had access to PPE but only 85.8% felt they had time to take safety precautions. Potential environmental contamination was associated with RNs that worked more years as an RN, worked more days in the past week, had higher levels of education and worked in rural facilities.	IIIB
208	Wood A. Guideline for Transmission-Based Precautions. Wood A, ed. AORN Inc.; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations on transmission-based precautions for perioperative personnel.	IVA
209	29 CFR 1910.134: Respiratory protection. . Government Publishing Office (GPO); 2020.	Regulatory	n/a	n/a	n/a	n/a	Regulations on respiratory protection.	n/a
210	29 CFR 1910.1030: Bloodborne pathogens. Government Publishing Office (GPO); 2020.	Regulatory	n/a	n/a	n/a	n/a	OSHA regulations for bloodborne pathogens.	n/a

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211	21 CFR Part 878: Medical Devices; Exemption From Premarket Notification: Class II Devices; Surgical Apparel. Final Order. Vol 83. Food and Drug Administration, HHS.; 2018	Regulatory	n/a	n/a	n/a	n/a	FDA Premarket notification exemption.	n/a
212	Konate A, Poupon J, Villa A, et al. Evaluation of environmental contamination by platinum and exposure risks for healthcare workers during a heated intraperitoneal perioperative chemotherapy (HIPEC) procedure. J Surg Oncol. 2011;103(1):6-9.	Nonexperimental	15 surfaces sampled, 17 personnel providing urine samples, and 3 locations of air sampling	Urine samples pre-and post-procedure from personnel involved in the HIPEC	Urine samples pre-and post-procedure from medical students with no exposure to patients receiving antineoplastics	Air, surface, and personnel oxaliplatin contamination	Urinary samples were below the level of detection, surgeon gloves had high levels of contamination, air tests were either undetectable or close to a blank value. There were detectable, but low levels on the OR table and floor before the procedure. There was detectable contamination on the forceps and patient's abdomen. There were high levels after the procedure on the floor near the table, on the operating field, and on the surgeon's shoes. The surgeon's gloves were the highest contaminated item.	IIIB
213	Kushnir CL, Fleury AC, Couch J, Hill MC, Spirtos NM. Evaluation of exposures to healthcare personnel from cisplatin during a mock demonstration of intra-operative intraperitoneal chemotherapy administration. Gynecol Oncol. 2013;130(2):350-353.	Organizational Experience	Not Reported	n/a	n/a	n/a	Personnel exposure risk to antineoplastic agents is low during HIPEC procedures. This was a NIOSH health hazard evaluation that was published.	VC
214	Dunn D, Ciccarelli E, Moltzen N. Cytooreductive surgery with hyperthermic intraperitoneal chemotherapy, part II: Implementation. AORN J. 2019;110(6):606-625.	Organizational Experience	Not Reported	n/a	n/a	n/a	Comprehensive review of perioperative care of patients having a HIPEC procedure and safe handling of hazardous medications for personnel.	VA
215	Personal protective equipment for use with hazardous drugs. Oncology Nursing Society (ONS); 2016Standards.	Expert Opinion	n/a	n/a	n/a	n/a	Information on PPE to use for handling hazardous medications.	VB
216	29 CFR 1910.133: Eye and face protection. . Government Publishing Office (GPO); 2021	Regulatory	n/a	n/a	n/a	n/a	Regulatory requirements on face and eye protection.	n/a

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217	AAMI PB70: 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; 2012.	Consensus	n/a	n/a	n/a	n/a	Classification of protective apparel and drapes. Liquid barrier performance measures.	IVC
218	Bussieres J, Tanguay C, Touzin K, Langlois E, Lefebvre M. Environmental contamination with hazardous drugs in quebec hospitals. Can J Hosp Pharm. 2012;65(6):428-435. Accessed 20130104.	Nonexperimental	12 measurement sites within each of 25 hospitals	n/a	n/a	Environmental contamination with cyclophosphamide, ifosfamide, and methotrexate.	Periodic surface contamination should be performed when using cyclophosphamide, ifosfamide, and methotrexate to measure the effectiveness of current practices.	IIIA
219	Breukels O, van der Gronde T, Simons-Sanders K, Crul M. PURCHASE antineoplastic drug contamination on the outside of prepared infusion bags. Int J Pharm Compd. 2018;22(4):345-349.	Nonexperimental	146 wipe samples from antineoplastic infusion bags	n/a	n/a	IV bag contamination	No detectable level of contamination was found. The pharmacies followed European standards for cleaning the surface of the infusion bag before transport to the ward.	IIIB
220	Kyle E, Wood A. Guideline for Care and Cleaning of Surgical Instruments. Kyle E, ed. AORN Inc.; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for care and cleaning of surgical instruments.	IVA
221	Schierl R, Novotna J, Piso P, Bohlandt A, Nowak D. Low surface contamination by cis/oxaliplatin during hyperthermic intraperitoneal chemotherapy (HIPEC). European Journal of Surgical Oncology. 2012;38(1):88-94	Nonexperimental	151 wipe samples during 19 procedures.	n/a	n/a	Presence of platinum.	If careful precautions are followed the levels of platinum are small and safe.	IIIB
222	Bohlandt A, Groeneveld S, Fischer E, Schierl R. Cleaning Efficiencies of Three Cleaning Agents on Four Different Surfaces after Contamination by Gemcitabine and 5-fluorouracile. Journal of Occupational & Environmental Hygiene. 2015;12(6):384-392	Nonexperimental	Four cleaning agents used on wood laminate, glass, stainless steel, polyvinylchloride intentionally contaminated with 5-fluorouracile and gemcitabine.	n/a	n/a	Presence of antineoplastic medications on surfaces after cleaning.	Cleaning procedures should be adapted to the medication and to the surface type.	IIIB
223	Queruau Lamerie T, Nussbaumer S, Decaudin B, et al. Evaluation of decontamination efficacy of cleaning solutions on stainless steel and glass surfaces contaminated by 10 antineoplastic agents. Ann Occup Hyg. 2013;57(4):456-469	Nonexperimental	Laboratory study	n/a	n/a	Effectiveness of cleaning agent	Various cleaning agents were more effective than others but effectiveness of each agent varied with the contaminate.	IIIB
224	Spruce L. Guideline for Prevention of Perioperative Pressure Injury. Kyle E, ed. AORN Inc.; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations to prevent or reduce the risk of patient pressure injuries.	IVA
225	deKay K. Guideline for Environmental Cleaning. Wood A, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Recommendations for environmental cleaning in perioperative settings.	IVA

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226	Education of the Registered Nurse Who Administers and Cares for the Individual Receiving Antineoplastic Therapies. Oncology Nursing Society (ONS); 2020	Position Statement	n/a	n/a	n/a	n/a	ONS recommendation for education and competency of RNs administering antineoplastic therapies.	IVC
227	29 CFR 1910.132: General requirements. Government Publishing Office (GPO); 2019	Regulatory	n/a	n/a	n/a	n/a	Regulatory requirements on workplace hazard assessments.	n/a
228	Connor TH, Zock MD, Snow AH. Surface wipe sampling for antineoplastic (chemotherapy) and other hazardous drug residue in healthcare settings: Methodology and recommendations. Journal of occupational and environmental hygiene. 2016;13(9):658-667	Expert Opinion	n/a	n/a	n/a	n/a	Foundational article on basic components of hazardous medication environmental surface contamination methods.	VA
229	Palamini M, Gagné S, Caron N, Bussi�eres J. Cross-sectional evaluation of surface contamination with 9 antineoplastic drugs in 93 canadian healthcare centers: 2019 results. J ONCOL PHARM PRACT. 2020;26(8):1921-1930.	Nonexperimental	93 hospitals for a total of 1045 surfaces samples	n/a	n/a	Environmental contamination of antineoplastic agents	Environmental contamination by antineoplastic agents was found in patient care and pharmacy areas. These areas should be considered contaminated.	IIIB
230	Cohen MR, Smetzer JL. ISMP Medication Error Report Analysis - Tragedy in the Postanesthesia Care Unit; Mix-ups between Risperidone and Ropinirole. Hosp Pharm. 2013;48(7):538-541	Case Report	n/a	n/a	n/a	n/a	Case report describing a mix-up in names and a case of inadequate monitoring.	VC
231	Benze C, Spruce L, Groah L, eds. Perioperative nursing: Scope and standards of practice. Denver, CO: AORN, Inc.	Position Statement	n/a	n/a	n/a	n/a	Perioperative nursing practice standards.	IVA
232	Ziaieian B, Araujo KLB, Van Ness PH, Horwitz LI. Medication reconciliation accuracy and patient understanding of intended medication changes on hospital discharge. Journal of General Internal Medicine. 2012;27(11):1513-1520	Nonexperimental	377 patients	n/a	n/a	Patient understanding of medication changes and accuracy of medication lists.	Patients had very little or no knowledge of medication changes between admission and discharge, and medication reconciliation needs to improve.	IIIB
233	Acker M, Deem N. The development of a pediatric medication administration guideline for preprocedure nurse callers. J Perianesth Nurs. 2019;34(3):559-566. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed20&NEWS=N&AN=628069589 . doi: http://dx.doi.org/10.1016/j.jopan.2018.06.102 .	Organizational Experience	Not Reported	n/a	n/a	n/a	Discussion of the process and outcomes of a pediatric preadmission medication administration caregiver instruction process.	VB
234	Pfeifer K, Slawski B, Nelson V, Manley A, Haines M. Improving preoperative medication compliance with standardized instructions. Minerva Anesthesiol. 2016;82(1):44-49.	Organizational Experience	461 pre, 147 post phase 1, 143 post phase 2.	n/a	n/a	n/a	Patient compliance is improved with the use of a standardized, electronically produced preoperative medication instruction sheet.	VA

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235	Goldszmidt RB, Buttendorf AR, Filho GS, Souza JM, Bianchini MA. Impact of generic labels on the consumption of and adherence to medication: A randomized controlled trial. <i>Eur J Public Health</i> . 2019;29(1):12-17.	Quasi-experimental	101 dental surgery patients	Generic label group (n=50)	Brand name label group (n=51)	Number of pills taken, percentage of non adherent patients, pain levels, perceived medication efficacy	Patients taking generic medication had higher levels of pain, were more likely to take additional nonprescribed medications, and discontinue the prescribed medication early.	IIB
236	Borgsteede SD, Karapinar-Carkit F, Hoffmann E, Zoer J, van den Bemt, Patricia M L A. Information needs about medication according to patients discharged from a general hospital. <i>Patient Education & Counseling</i> . 2011;83(1):22-28	Qualitative	21 usual care, 10 intervention group	Consultation regarding medications	No Consultation	Amount of information desired.	Medication counselling should combine verbal and written instructions, and be tailored to the patient's needs.	IIIB
237	Lion KC, Kieran K, Desai A, Hencz P, Ebel BE, Adem A, Forbes S, Kraus J, Gutman C, Horn, I. Audio-recorded discharge instructions for limited english proficient parents: A pilot study. <i>Joint commission journal on quality and patient safety</i> . 2019;45(2):98.	Quasi-experimental	83 parents with limited English proficiency	Use of a language specific card to provide discharge instructions and usual discharge processes	Use of standard discharge instruction processes	Card usage, satisfaction with the card	Use of the card had high satisfaction, most parents shared the card with others and 45.2% listened to the card more than 5 times.	IIB
238	Solomon A, Calotta N, Kolarich A, et al. Surgical residents as certified bilingual speakers: A quality improvement initiative. <i>Jt Comm J Qual Patient Saf</i> . 2020;46(6):359-364.	Organizational Experience	65 surgical residents	n/a	n/a	n/a	18 of the 65 residents responded that they were proficient in another language. Of the 12 who took the exam, 9 passed. The number of residents certified to be bilingual staff interpreters increased significantly.	VB
239	Fernandez PG, Brockel MA, Lipscomb LL, Ing RJ, Tailounie M. Utilization of a text and translation application for communication with a foreign deaf family: A call for validation of this technology - A case report. <i>A A Case Rep</i> . 2017;9(2):47-49.	Case Report	n/a	n/a	n/a	n/a	Perioperative communication with deaf family that required translation to a foreign language was performed using mobile technology. The authors reported successful translation but use of the technology is not validated for this purpose.	VC
240	Title 40, chapter I, subchapter I, parts 239-299. solid wastes. 2021.	Regulatory	n/a	n/a	n/a	n/a	Solid waste disposal act	n/a
241	21 CFR 1317: Disposal [of controlled substances]. ; 2020.	Regulatory	n/a	n/a	n/a	n/a	Federal regulations on disposal of controlled substances.	n/a
242	Unused pharmaceuticals in the health care industry: Interim report. <i>United States Environmental Protection Agency (EPA)</i> ; 2008.	Expert Opinion	n/a	n/a	n/a	n/a	EPA report detailing issues with medication waste.	VA
243	Federal water pollution control act (33 U.S.C. 1251 et seq.) [as amended through P.L. 107–303, november 27, 2002]. . 2002.	Regulatory	n/a	n/a	n/a	n/a	Regulations on water pollution.	n/a

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244	Chiarello M, Minetto L, Giustina SVD, Beal LL, Moura S. Popular pharmaceutical residues in hospital wastewater: Quantification and qualification of degradation products by mass spectroscopy after treatment with membrane bioreactor. <i>Environmental Science and Pollution Research</i> . 2016;23(16):16079-16089.	Nonexperimental	100 Liters of hospital waste water.	n/a	n/a	Presence of medication or medication byproducts.	Medication or medication byproducts were found in hospital wastewater.	IIIB
245	Frédéric O, Yves P. Pharmaceuticals in hospital wastewater: Their ecotoxicity and contribution to the environmental hazard of the effluent. <i>Chemosphere</i> . 2014;115(1):31-39.	Nonexperimental	Samples of wastewater from a previous study.	n/a	n/a	Presence of medications in wastewater.	Pharmaceuticals are found in various amounts in hospital wastewater.	IIIC
246	Barbariol F, Deana C, Lucchese F, et al. Evaluation of drug wastage in the operating rooms and intensive care units of a regional health service. <i>Anesth Analg</i> . 2021;132(5):1450-1456.	Nonexperimental	13,078 medication syringes	n/a	n/a	Amount of medication waste in the ICU and OR	Medication waste averaged 38% with a range from 7.8% to 85.7%. Estimated financial cost was \$92,569, weighing 4968 kg, and taking 1512 working hours.	IIIB
247	Bhatter P, Cypen SG, Carter SL, Tao JP. Pharmaceutical and supply waste in oculo-facial plastic surgery at a hospital-based outpatient surgery center. <i>Ophthalmic Plast Reconstr Surg</i> . 2020.	Nonexperimental	34 consecutive oculo-facial plastic surgery procedures performed in an ASC	n/a	n/a	Percentage of unused medication and disposable supplies and greenhouse gas emissions.	Average medication waste varied based on the medication with a range of 26.7% to 96.1%. Green house gas emissions for medications were calculated to be 103kg of carbon equivalent gasses (kg CO ₂ -e).	IIIB
248	What is an infusion pump? https://www.fda.gov/medical-devices/infusion-pumps/what-infusion-pump . Updated 2017. Accessed 8/9, 2022.	Expert Opinion	n/a	n/a	n/a	n/a	FDA Guidance on infusion pumps.	VA
249	Metsämuuronen R, Kokki H, Naaranlahti T, Kurttila M, Heikkilä R. Nurses' perceptions of automated dispensing cabinets – an observational study and an online survey. <i>BMC NURS</i> . 2020;19(1):1-9.	Nonexperimental	Observed 5 ICU RNs and 5 OR RNs, Survey of 81 out of 346 RNs (response rate 23%).	n/a	n/a	RN perceptions of ADC and the impact on their work	For OR RNs, time spent retrieving, preparing and labeling medications decreases by an average of 32 minutes, and they collected less medications outside of the OR during the operations.	IIIB
250	Giuliano KK, Penoyer D, Mahuren RS, Bennett M. Intravenous smart pumps during actual clinical use: A descriptive comparison of primary and secondary infusion practices. <i>J INFUSION NURS</i> . 2021;44(3):128-136.	Nonexperimental	301 medications administered via infusion pump	102 linear peristaltic IV smart pump	199 for cassette pump	Adherence to set up requirements of infusion pumps and delay of secondary medication administration (ie, piggy back) between the two systems	There was 0% compliance for primary lines and 84% compliance for secondary lines with linear peristaltic pumps. Cassette IV pumps may improve the process for administration of medications via a secondary line (ie, piggy back).	IIIB
251	Guidelines for optimizing safe implementation and use of smart infusion pumps. Institute for Safe Medication Practices (ISMP); 2020.	Guideline	n/a	n/a	n/a	n/a	ISMP guideline on use of infusion pumps.	IVC

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252	Kyle E, Spruce L. Guideline for Medical Device and Product Evaluation. Kyle E, ed. AORN, Inc; 2023	Guideline	n/a	n/a	n/a	n/a	Perioperative practice recommendations for evaluation of medical devices and products.	IVA
253	Guidelines for the safe use of automated dispensing cabinets. Institute for Safe Medication Practices (ISMP); 2019.	Guideline	n/a	n/a	n/a	n/a	ISMP guideline on use of ADCs.	IVB
254	Automated dispensing cabinets. https://www.ecri.org/components/HRC/Pages/Pharm2_1.aspx . Published 2020 Jul 8. Updated 2020. Accessed 11/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	ECRI recommendations on use of ADCs.	VB
255	Mulac A, Mathiesen L, Taxis K, Gerd Granås A. Barcode medication administration technology use in hospital practice: A mixed-methods observational study of policy deviations. <i>BMJ Qual Saf.</i> 2021;30(12):1021.	Nonexperimental	44 RNs administering 884 medications to 213 patients	n/a	n/a	Use of barcode technology, number and type of policy deviations and their causes	More than half of the observations had policy deviations. The type of policy deviations varied with task-related policy deviations being the highest.	IIIB
256	Barakat S, Franklin BD. An evaluation of the impact of barcode patient and medication scanning on nursing workflow at a UK teaching hospital. <i>Pharmacy (Basel)</i> . 2020;8(3). http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=pmnm&NEWS=N&AN=32824909 . doi: 10.2196/162888	Organizational Experience	Medication administration - 46 in barcode group, 43 in nonbarcoded group	n/a	n/a	n/a	Barcode assisted medication administration may increase efficiency and standardization. It increased patient identification scans but some	VB
257	ASHP statement on bar-code verification during inventory, preparation, and dispensing of medications. <i>AM J HEALTH SYST PHARM AJHP</i> . 2011;68(5):442-445.	Position Statement	n/a	n/a	n/a	n/a	ASHP's position statement on use of bar code technology during inventory, preparation, and dispensing of medications.	IVB
258	ASHP statement on bar-code-enabled medication administration technology. <i>AM J HEALTH SYST PHARM AJHP</i> . 2009;66(6):588-590.	Position Statement	n/a	n/a	n/a	n/a	ASHP's position on use of bar code technology during medication administration.	IVB
259	Bar-coded medication administration systems. https://www.ecri.org/components/HRC/Pages/Pharm7.aspx . Published 2020 Jun 3. Updated 2020. Accessed 11/8, 2021.	Expert Opinion	n/a	n/a	n/a	n/a	Discussion and recommendations on ensuring effectiveness of bar code medication administration.	VB

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260	Recommendations for healthcare organizations to reduce medication errors associated with the label, labeling, and packaging of pharmaceutical (drug) products and related devices. https://www.nccmerp.org/recommendations-health-care-organizations-reduce-medication-errors-associated-related-devices . Updated 2014. Accessed 10/27, 2021.	Guideline	n/a	n/a	n/a	n/a	Recommendations to reduce errors from medication labeling and packaging.	IVC
261	Grissinger M. Medication errors involving overrides of healthcare technology. PENN PATIENT SAF ADVIS. 2015;12(4):141-148.	Expert Opinion	n/a	n/a	n/a	n/a	Discussion of reports on device overrides.	VB
262	JCSentinel event alert 63: Optimizing smart infusion pump safety with DERS. The Joint Commission (TJC); 2021.	Expert Opinion	n/a	n/a	n/a	n/a	Joint commission recommendations on use of smart pumps.	VB
263	van der Veen W, van den Bemt P,M.L.A., Wouters H, et al. Association between workarounds and medication administration errors in bar-code-assisted medication administration in hospitals. J Am Med Inform Assoc. 2018;25(4):385-392.	Nonexperimental	5793 medication administration occurrences in 1230 patients	n/a	n/a	medication administration events with at least 1 error, frequency of work arounds and the contribution to errors	Work arounds were associated with medication administration errors. Common errors included no scanning, no scanning of patients, scanning the incorrect medication, scanning multiple medications at once, and giving wrong medication doses.	IIIB
264	Medication errors occurring with the use of bar-code administration technology. Pa Patient Saf Advis. 2008;5(4):122-126.	Expert Opinion	n/a	n/a	n/a	n/a	Discussion of reports on errors with bar code technology.	VB
265	ANA's principles for nursing documentation: Guidance for registered nurses. Silver Spring, MD: American Nurses Association (ANA); 2010.	Guideline	n/a	n/a	n/a	n/a	ANA recommendations for nursing documentation.	IVA
266	45 CFR 170.300: Applicability. Government Publishing Office (GPO); 2020	Regulatory	n/a	n/a	n/a	n/a	Applicability of health IT certification criteria.	n/a
267	45 CFR 170.315: 2015 Edition health IT certification criteria. Government Publishing Office (GPO); 2020	Regulatory	n/a	n/a	n/a	n/a	IT health education certification criteria.	n/a

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268	Alqubaisi M, Tonna A, Strath A, Stewart D. Exploring behavioural determinants relating to health professional reporting of medication errors: A qualitative study using the theoretical domains framework. <i>Eur J Clin Pharmacol.</i> 2016;72(7):887-895.	Qualitative	29 semi-structured interviews (10 RNs, 10 Pharmacists, 9 Physicians)	n/a	n/a	Behavioral determinants around reporting medication errors	Organizational structure, goals, and intentions favored reporting medication errors but several key elements deterred reporting including beliefs about the consequences of reporting, emotions, and other issues related to environmental context, such as the time it takes to report the error.	IIIB
269	#3A: Medication errors. Patient Safety Movement; 2020Actionable Patient Safety Solutions™ (APSS™).	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations on reducing medication errors from the Patient Safety Movement Foundation.	VB
270	Anjalee JAL, Rutter V, Samaranyake NR. Application of failure mode and effects analysis (FMEA) to improve medication safety in the dispensing process - a study at a teaching hospital, Sri Lanka. <i>BMC Public Health</i> . 2021;21(1):1430.	Organizational Experience	Two teams of pharmacists	n/a	n/a	n/a	Consensus of FMEA data between groups	VB
271	Boytim J, Ulrich B. Factors contributing to perioperative medication errors: A systematic literature review: 2.1 www.aornjournal.org/content/cme . <i>AORN J.</i> 2018;107(1):91-107.	Systematic Review	n/a	n/a	n/a	n/a	Incorrect dose, omission, and wrong medication given accounted for over 70% of medication errors. Wrong dosage was the least common type of medication error. Contributing factors to medication errors included performance deficit, distraction, communication, haste, and inattention. Literature in this systematic review was mostly based on anesthesia literature.	IIIB
272	FDA adverse event reporting system (FAERS) public dashboard. . 2021. https://fis.fda.gov/sense/app/d10be6bb-494e-4cd2-82e4-0135608ddc13/sheet/7a47a261-d58b-4203-a8aa-6d3021737452/state/analysis .	Expert Opinion	n/a	n/a	n/a	n/a	Visual display of adverse event data reported to the FDA from MedWatch and manufacturers.	VA
273	Meyer-Massetti, C., Cheng, C. M., Schwappach, D. L. B., Paulsen, L., Ide, B., Meier, C. R., et al. (2011). Systematic review of medication safety assessment methods. <i>Am J Health-System Pharmacy.</i> 68(3), 227-240.	Systematic Review	n/a	n/a	n/a	n/a	The four medication safety assessment methodologies (eg, review of incident reports, review of charts, direct observation, trigger tools) all have strengths and weaknesses.	IIIB

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274	Brosterhaus M, Hammer A, Kalina S, et al. Applying the global trigger tool in german hospitals: A pilot in surgery and neurosurgery. <i>J Patient Saf.</i> 2020;16(4):e340-e351.	Nonexperimental	120 surgical and neurosurgical patient records	n/a	n/a	Adverse medication events	The IHI Global Trigger Tool can be adapted to departmental specific quality data measurement.	IIIB
275	Harkanen M, Kervinen M, Ahonen J, Voutilainen A, Turunen H, Vehvilainen-Julkunen K. Patient-specific risk factors of adverse drug events in adult inpatients - evidence detected using the global trigger tool method. <i>J Clin Nurs.</i> 2015;24(3-4):582-591. Accessed 20150128.	Nonexperimental	463 patient records	n/a	n/a	Adverse drug events	Trigger tools are an efficient method for identifying adverse drug events.	IIIC
276	Naessens JM, O'Byrne TJ, Johnson MG, Vansuch MB, McGlone CM, Huddleston JM. Measuring hospital adverse events: Assessing inter-rater reliability and trigger performance of the global trigger tool. <i>Int J Qual Health Care.</i> 2010;22(4):266-274.	Nonexperimental	1138 patient medical records	n/a	n/a	Inter-rater agreement	Good levels of reliability were reported.	IIIB
277	Classen DC, Lloyd RC, Provost L, Griffin FA, Resar R. Development and evaluation of the institute for healthcare improvement global trigger tool. <i>Journal of Patient Safety.</i> 2008;4(3).	Nonexperimental	15 records used in training and 50 records containing adverse events	n/a	n/a	Level and percentage of agreement between reviewers of adverse events	The refined method for trigger tool detection of adverse events had high levels of agreement on the presence and severity of adverse events.	IIIB
278	Adler L, Denham CR, McKeever M, et al. Global trigger tool: Implementation basics. <i>Journal of Patient Safety.</i> 2008;4(4).	Expert Opinion	n/a	n/a	n/a	n/a	Seminal article on implementation of the IHI Global Trigger Tool for identification of adverse events.	VA
279	Elliott, P., Martin, D., & Neville, D. (2014). Electronic clinical safety reporting system: A benefits evaluation. <i>JMIR Medical Informatics.</i> 2(1), e12.	Quasi-experimental	205 employees	Electronic system	Paper system	Number of error reports.	An increase of medication error reporting occurred after the implementation of an electronic error reporting system.	IIIB
280	Kung, K., Carrel, T., Wittwer, B., Engberg, S., Zimmermann, N., & Schwendimann, R. (2013). Medication errors in a swiss cardiovascular surgery department: A cross-sectional study based on a novel medication error report method. <i>Nursing Research and Practice.</i> 2013;671820.	Nonexperimental	19 nurses	MESRT reporting system	Usual reporting system	Number of reported medication errors	The chosen method of self reporting of medication error reporting was more effective at catching medication errors than the existing medication error report.	IIIB
281	Westbrook JI, Li L, Lehnbohm EC, Baysari MT, Braithwaite J, Burke R, Conn C, Day RO. What are incident reports telling us? A comparative study at two Australian hospitals of medication errors identified at audit, detected by staff and reported to an incident system. <i>Int J Qual Health Care.</i> 2015 Feb;27(1):1-9. doi: 10.1093/intqhc/mzu098. Epub 2015 Jan 12. PMID: 25583702; PMCID: PMC4340271.	Nonexperimental	3291 Patient medical records	n/a	n/a	The frequency of prescribing errors and medication error rates by audit, observation, and incident reports	12,567 prescribing errors were identified. Only 1.2/1000 errors had incident reports. Drug administration errors were significantly lower but no errors were reported.	IIIB

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Evidence Table

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
282	Munn, Z., Scarborough, A., Pearce, S., McArthur, A., Kavanagh, S., Girdler, M., et al. (2015). The implementation of best practice in medication administration across a health network: A multisite evidence-based audit and feedback project. <i>JB I Database of Systematic Reviews and Implementation Reports</i> , 13(8), 338-352.	Quasi-experimental	1,500 medication administrations baseline and 827 medication administrations during follow-up.	Audit and feedback process	No feedback process	Compliance with standards for medication administration.	The use of an audit and feedback process improved compliance with best practices in medication administration.	IIIB
283	Donaldson, N., Aydin, C., Fridman, M., & Foley, M. (2014). Improving medication administration safety: Using naive observation to assess practice and guide improvements in process and outcomes. <i>Journal for Healthcare Quality</i> , 36(6), 58-68.	Nonexperimental	Medications administered to 8,594 patients.	n/a	n/a	Medication errors	Direct observation is an effective tool to use for determining medication errors.	IIIB
284	Härkänen M, Turunen H, Vehviläinen-Julkunen K. Differences between methods of detecting medication errors: a secondary analysis of medication administration errors using incident reports, the global trigger tool method, and observations. <i>J Patient Saf.</i> 2020;16(2):168-176.	Nonexperimental	Medication errors found on 671 incident reports, 153 global trigger tool results, and 235 observations.	n/a	n/a	Presence of medication errors	The three methods for error detection revealed different information on the medication errors, therefore the different methods should be combined. The researchers also	IIIA
285	Goeckner B, Gladu M, Bradley J, Garmon Bibb SC, Hicks RW. Differences in perioperative medication errors with regard to organization characteristics. <i>AORN Journal</i> . 2006;83(2):351-368.	Nonexperimental	5,210 perioperative medication errors reported to Medmarx database	n/a	n/a	Differences in error rates and harm levels based on facility characteristics	There are differences in error rates and harm levels based on facility characteristics.	IIIB
286	Smeulders, M., Verweij, L., Maaskant, J. M., de Boer, M., Krediet, C. T. P., Nieveen van Dijkum, Els J M., et al. (2015). Quality indicators for safe medication preparation and administration: A systematic review. <i>PLoS ONE [Electronic Resource]</i> , 10(4), e0122695.	Systematic Review	n/a	n/a	n/a	n/a	Quality indicators centered on medication safety need to be individualized to the practice setting.	IIIB
287	Beckett, R. D., Yazdi, M., Hanson, L. J., & Thompson, R. W. (2014). Improving medication safety through the use of metrics. <i>Journal of Pharmacy Practice</i> , 27(1), 61-64.	Nonexperimental	45 health systems	n/a	n/a	Presence of safety metrics, and the reporting venue.	The researchers recommend the use of quality metrics which apply to each individual facility and that the metrics be	IIIA
288	de Boer, M., Ramrattan, M. A., Boeker, E. B., Kuks, P. F. M., Boermeester, M. A., & Lie-A-Huen, L. (2014). Quality of pharmaceutical care in surgical patients. <i>PLoS ONE [Electronic Resource]</i> , 9(7), e101573.	Nonexperimental	252 medical records	n/a	n/a	Adverse drug events	Using a set of quality indicators is an effective way to identify and quantify adverse drug events.	IIIB
289	Keane, K. (2014). Reducing medication errors by educating nurses on bar code technology. <i>MEDSURG Nursing</i> , 23(5), Su.	Expert Opinion	n/a	n/a	n/a	n/a	Nurses must be trained on the use of the technology.	VC

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
290	Rack, L. L., Dudjak, L. A., & Wolf, G. A. (2012). Study of nurse workarounds in a hospital using bar code medication administration system. <i>Journal of Nursing Care Quality</i> , 27(3), 232-239.	Qualitative	220 surveys; 6 focus groups consisting of 43 participants.	n/a	n/a	Type of and reasons for technological work-arounds.	When a bar coding system is in place the RN staff administering medications use various workarounds to avoid use of the technology. The workarounds were created because not enough outlets were available to charge the units, lack of education on what to do during emergencies, and alterations in work flow reducing efficiency. The researchers recommend that hospital leaders understand the barriers that lead to workarounds and take steps to prevent them.	IIIB
291	Van Der Sijs, H., Rootjes, I., & Aarts, J. (2011). The shift in work arounds upon implementation of computerized physician order entry. <i>Studies in Health Technology & Informatics</i> , 169, 290-294.	Qualitative	A resident, medical specialist, senior nurse, second nurse, and pharmacist on two units one with electronic ordering and one with paper ordering.	n/a	n/a	Workarounds	Work arounds exist in both paper and electronic prescribing systems.	IIIB
292	Miller, D. F., Fortier, C. R., & Garrison, K. L. (2011). Bar code medication administration technology: Characterization of high-alert medication triggers and clinician workarounds. <i>Annals of Pharmacotherapy</i> , 45(2), 162-168.	Nonexperimental	548,405 scanned medications	n/a	n/a	Nursing and pharmacy workarounds.	Nursing and pharmacy work arounds are present and may decrease effectiveness of alert system therefore workflows must be continually reviewed.	IIIA