

AORN Guideline for Safe Patient Handling and Movement  
Evidence Table

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
1	Safe Patient Handling and Mobility Guidebook. St Louis, MO: VHA Center for Engineering & Occupational Safety and Health (CEOSH); 2016.	Guideline	n/a	n/a	n/a	n/a	The purpose of this guidebook is to provide best practice guidance to develop, implement, and maintain an effective SPHM Program that minimizes the incidence and severity of job-related injuries related to SPHM activities. Derived from best practices within and outside of health care, the program elements described in this guidebook have been tested and are being fully implemented within Veterans Health Administration (VHA).	IVB
2	Owen BD. Preventing injuries using an ergonomic approach. AORN J. 2000;72(6):1031-1036.	Expert Opinion	n/a	n/a	n/a	n/a	Majority of overexertion injuries are the result of cumulative trauma. All nurses should take responsibility to protect themselves from injury by implementing improved techniques for performing patient handling tasks.	VB
3	Garb JR, Dockery CA. Reducing employee back injuries in the perioperative setting. AORN J. 1995;61(6):1046-1052.	Organizational Experience	14-room surgical suite	n/a	n/a	n/a	Following an assessment by an ergonomist of OR practices, there was a 25% reduction in the rate of back injuries among OR personnel after implementation of the recommended ergonomic changes.	VC
4	Waters TR. Introduction to ergonomics for healthcare workers. Rehabil Nurs. 2010;35(5):185-191.	Expert Opinion	n/a	n/a	n/a	n/a	The article provides an overview of ergonomics including what it is, how it can be used to help design safe work, and why all healthcare workers and administrators should know and understand how excessive work demands can lead to increased risk of work related MSDs.	VA
5	Gallagher S, Heberger JR. Examining the interaction of force and repetition on musculoskeletal disorder risk: a systematic literature review. Hum Factors. 2013;55(1):108-124.	Systematic Review	n/a	n/a	n/a	n/a	The evidence suggests a interdependence between force and repetition with respect to MSD risk. Repetition seems to result in modest increases in risk for low-force tasks but rapid increases in risk for high-force tasks. This interaction may be representative of a fatigue failure process in affected tissues.	IIIB
6	Arvidsson I, Gremark Simonsen J, Dahlqvist C, et al. Cross-sectional associations between occupational factors and musculoskeletal pain in women teachers, nurses and sonographers. BMC Musculoskelet Disord. 2016;17:35.	Qualitative	1591/women from 5 occupations ( ie, teacher, sonographer, anesthetists, theatre nurses, assistant nurses)	n/a	n/a	Musculoskeletal pain based on frequency and intensity of complaint from the neck, shoulders, hands, lower back, and feet	Both the physical workload and the psychosocial work environment were associated with pain in all body regions. Different factors affect different regions. The theatre nurses scored highest in strenuous work postures and movement.	IIIA
7	Lee G, Lee T, Dexter D, et al. Ergonomic risk associated with assisting in minimally invasive surgery. Surg Endosc. 2009;23(1):182-188.	Nonexperimental	7 right-handed subjects with varying levels of minimally invasive surgery (MIS) experience	n/a	n/a	Postural balancing (weight-loading ratio)	A high-risk ergonomic situation is created by the assistant's left or caudal leg disproportionately bearing 70-80% of the body weight over time. Ergonomic solutions minimizing ergonomic risks associated with laparoscopic assistance should be considered.	IIIC
8	Lucas-Hernández M, Pagador JB, Pérez-Duarte FJ, Castelló P, Sánchez-Margallo F. Ergonomics problems due to the use and design of dissector and needle holder: a survey in minimally invasive surgery. Surg Laparosc Endosc Percutan Tech. 2014;24(5):e170-e177.	Qualitative	118 surgeons	n/a	n/a	Assessment of laparoscopic dissector and needle holder, level of discomfort with the instruments, foot pedal, monitor, table height	The study identified ergonomic drawbacks including instrument design, operating table height, and the posture of surgeons.	IIIB

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9	Luttmann A, Jäger M, Sökeland J. Ergonomic assessment of the posture of surgeons performing endoscopic transurethral resections in urology. <i>J Occup Med Toxicol</i> . 2009;4:26.	Qualitative	The posture of 5 surgeons during 19 endoscopic transurethral resection procedures	Monitor endoscopy	Direct endoscopy versus monitor endoscopy	Analysis of postures using video recordings and observer posture estimation	During endoscopic transurethral prostate and bladder operations the preferred method from an ergonomic viewpoint is the video-assisted operation (ie, monitor endoscopy) instead of direct viewing of the operative site with the endoscope.	IIIC
10	Yoon SH, Jung MC, Park SY. Evaluation of surgeon's muscle fatigue during thoracoscopic pulmonary lobectomy using interoperative surface electromyography. <i>J Thorac Dis</i> . 2016;8(6):1162-1169.	Nonexperimental	EMG recording of one surgeon during 12 thoracoscopic lobectomy procedures	n/a	n/a	Muscle activity and fatigue from 16 muscle sites	Muscle fatigue was observed in muscles related to static posture.	IIIC
11	Welcker K, Kesieme EB, Internullo E, Kranenburg van Koppen LJ. Ergonomics in thoracoscopic surgery: results of a survey among thoracic surgeons. <i>Interact Cardiovasc Thorac Surg</i> . 2012;15(2):197-200.	Qualitative	216 thoracic surgeons	n/a	n/a	Monitor placement and height, table height, MSDS, awareness of ergonomic guidelines	Most of the thoracic surgeons are unaware of ergonomic guidelines and do not practice them. Therefore, they suffer varying degrees of physical discomfort attributable to ergonomic issues.	IIIB
12	Habibi E, Pourabdian S, Atabaki AK, Hoseini M. Evaluation of work-related psychosocial and ergonomics factors in relation to low back discomfort in emergency unit nurses. <i>Int J Prev Med</i> . 2012;3(8):564-568.	Qualitative	120 emergency room nurses	n/a	n/a	Daily assessment of psychosocial and ergonomic factors and intensity of low back discomfort	There is an indirect relationship between the intensity of low back discomfort and social support. There is a direct relationship between the intensity of low back discomfort and work demand, job content, ergonomic factors (ie, awkward postures [rotating and bending], manual patient handling, repetitiveness, standing continuously more than 30 minutes)	IIIB
13	Adhikari S, Dhakal G. Prevalent causes of low back pain and its impact among nurses working in Sahid Gangalal National Heart Centre. <i>J Nepal Health Res Council</i> . 2014;12(28):167-171.	Qualitative	50/Nurses-various departments in a national heart center	n/a	n/a	Prevalence of low back pain and perceived causes	78% of the respondents reported low back pain. The perceived causes were prolonged standing, heavy physical workload, and frequent bending and twisting.	IIIB
14	Hou JY, Shiao JS. Risk factors for musculoskeletal discomfort in nurses. <i>J Nurs Res</i> . 2006;14(3):228-236.	Qualitative	3950 nurses in Taiwan	n/a	n/a	Musculoskeletal complaints and risk factors (eg, bending, twisting, standing, lifting)	Personal risk factors were associated with pain in the shoulders/neck, back, and lower legs to different extents. Shoulder/neck pain more affected by aging process. Leg pain correlated more closely with number of hours worked per week. Preventive measures and equipment should be provided to reduce exposure.	IIIA
15	Mohseni-Bandpei MA, Fakhri M, Bagheri-Nesami M, Ahmad-Shirvani M, Khalilian AR, Shayesteh-Azar M. Occupational back pain in Iranian nurses: an epidemiological study. <i>Br J Nurs</i> . 2006;15(17):914-917.	Qualitative	1226 nursing personnel	n/a	n/a	Prevalence of low back pain and risk factors (eg, lifting, prolonged standing) for low back pain	Prevalence of low back pain is high in nurses. Identified risk factors for injury include lifting, prolonged standing, job dissatisfaction. Improving job satisfaction and social support may contribute to prevention of low back pain.	IIIB
16	Hopcia K, Dennerlein JT, Hashimoto D, Orecchia T, Sorensen G. Occupational injuries for consecutive and cumulative shifts among hospital registered nurses and patient care associates: a case-control study. <i>Workplace Health Saf</i> . 2012;60(10):437-444.	Nonexperimental	1004 direct care providers ( 502 injured workers; 502 single controls)	n/a	n/a	Consecutive shifts worked by care givers and contribution of cumulative shifts and cumulative hours in 2 durations of 7 days and 28 days	There is an increased risk of injury with consecutive work days and longer cumulative working hours. Shift patterns can be altered to decrease injuries to care providers. Additional research is needed.	IIIA
17	Dembe AE, Erickson JB, Delbos RG, Banks SM. The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States. <i>Occup Environ Med</i> . 2005;62(9):588-597.	Qualitative	10,793/ Americans participating in the National Longitudinal Survey of Youth	n/a	n/a	Occupational illnesses and injuries	Working in jobs with overtime is associated with a 61% higher injury rate and working at least 12 hours is associated with a 37% increased rate.	IIIA

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18	Trinkoff AM, Le R, Geiger-Brown J, Lipscomb J, Lang G. Longitudinal relationship of work hours, mandatory overtime, and on-call to musculoskeletal problems in nurses. <i>Am J Ind Med.</i> 2006;49(11):964-971.	Qualitative	2617 RNs	n/a	n/a	MSDs,-/*work schedules ( eg, hours per day, hours per week, weekends per month, breaks, full-time versus part-time status)	Schedule characteristics that increased MSD risk included 13+ hours/day, off-shifts, weekend work, overtime, on-call.	IIIA
19	Shieh SH, Sung FC, Su CH, Tsai Y, Hsieh VC. Increased low back pain risk in nurses with high workload for patient care: a questionnaire survey. <i>Taiwan J Obstet Gynecol.</i> 2016;55(4):525-529.	Qualitative	788 nurses	n/a	n/a	Low back pain	Longer daily working hours and a large number of patients per shift should be discouraged to prevent musculoskeletal problems in nurses.	IIIA
20	Geiger-Brown J, Lipscomb J. The health care work environment and adverse health and safety consequences for nurses. <i>Annu Rev Nurs Res.</i> 2010;28:191-231.	Literature Review	n/a	n/a	n/a	n/a	Nurses' working conditions are linked to the quality of care that is provided to patients and patients' safety. These same working conditions are associated with health and safety outcomes for nurses and other health care providers.	VA
21	Nelson A. <i>Safe Patient Handling and Movement: A Guide for Nurses and Other Health Care Providers.</i> New York, NY: Springer Publishing Co; 2006.	Expert Opinion	n/a	n/a	n/a	n/a	A comprehensive resource guide for nurses to safely move patients.	VA
22	Kim SS, Okechukwu CA, Buxton OM, et al. Association between work-family conflict and musculoskeletal pain among hospital patient care workers. <i>Am J Ind Med.</i> 2013;56(4):488-495.	Qualitative	1119 hospital patient care workers	n/a	n/a	Work-family conflict & MSDs	Work-family conflict could be a potential risk factor of musculoskeletal pain among hospital health care workers. The findings remained significant after adjustments for working conditions (ie, job title, second job, shift, hours per week worked), psychosocial factors (ie, demand, decision latitude, co-worker support, supervisor support), organizational ergonomic practice, physical work factors.	IIIA
23	Simon M, Tackenberg P, Nienhaus A, Estryn-Behar M, Conway PM, Hasselhorn HM. Back or neck-pain-related disability of nursing staff in hospitals, nursing homes and home care in seven countries—results from the European NEXT-Study. <i>Int J Nurs Stud.</i> 2008;45(1):24-34.	Nonexperimental	21516 nurses and auxiliary staff ( hospital-16770, nursing home-2140, home care-2606)	n/a	n/a	Physical and psychosocial risk factors associated with neck/back pain related disability and role of the type of institution	The findings show a pronounced association between psychosocial factors and back or neck pain related disability.	IIIA
24	Amin NA, Nordin R, Fatt QK, Noah RM, Oxley J. Relationship between psychosocial risk factors and work-related musculoskeletal disorders among public hospital nurses in Malaysia. <i>Ann Occup Environ Med.</i> 2014;26:23.	Qualitative	376/ public hospital nurses	n/a	n/a	Occurrence of work-related musculoskeletal disorders and presence of psychosocial risk factors	The study demonstrated the association between psychosocial risk factors and the prevalence of work-related musculoskeletal disorders among public hospital nurses.	IIIB
25	Schoenfisch AL, Lipscomb HJ. Job characteristics and work organization factors associated with patient-handling injury among nursing personnel. <i>Work.</i> 2009;33(1):117-128.	Qualitative	585 nurses and nurses' aides	n/a	n/a	Patient handling task load, patient handling injury, work organization factors	In the study group job strain defined by high-physical demand and low decision latitude was more strongly associated with musculoskeletal injury than the traditional definition of job strain of high psychological demand and low decision latitude.	IIIB

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26	Nützi M, Koch P, Baur H, Elfering A. Work-family conflict, task interruptions, and influence at work predict musculoskeletal pain in operating room nurses. <i>Saf Health Work</i> . 2015;6(4):329-337.	Qualitative	116 OR nurses	n/a	n/a	MSDs, psychosocial aspects of work (eg, work-family conflict, work interruptions, influence at work)	Musculoskeletal pain is widespread among OR nurses. The most affected body regions are the lumbar area (52.7%) and cervical (38.4%). Work stressors and interruptions promote back pain, but having an influence at work can prevent MSDs from developing or being aggravated.	IIIB
27	Smedley J, Inskip H, Buckle P, Cooper C, Coggon D. Epidemiological differences between back pain of sudden and gradual onset. <i>J Rheumatol</i> . 2005;32(3):528-532.	Qualitative	1366 hospital nurses	n/a	n/a	Risk factors for low back pain	Low back pain with gradual onset was significantly associated with psychological symptoms but not with sudden onset back pain. Low back pain with sudden onset at work was associated with exposure to a specific patient handling task.	IIIC
28	Smedley J, Inskip H, Trevelyan F, Buckle P, Cooper C, Coggon D. Risk factors for incident neck and shoulder pain in hospital nurses. <i>Occup Environ Med</i> . 2003;60(11):864-869.	Qualitative	1220 nurses	n/a	n/a	MSDs, time away from work due to injury, psychosocial factors at work	Neck/shoulder pain is common among hospital nurses. Patient handling tasks that involve reaching and pulling are the most important target for risk reduction strategies.	IIIB
29	Sabbath EL, Hurtado DA, Okechukwu CA, et al. Occupational injury among hospital patient-care workers: what is the association with workplace verbal abuse? <i>Am J Ind Med</i> . 2014;57(2):222-232.	Qualitative	2000 RNs, LPNs, patient care associates	n/a	n/a	Workplace abuse, workplace injury	Risk of injury was elevated among those reporting 3 different forms of workplace abuse( ie, being yelled/screamed at, receiving hostile/offensive gestures, being sworn at).Exposure to workplace abuse was generally a stronger risk factor for musculoskeletal injuries.	IIIB
30	Ellapen TJ, Narsigan S. Work related musculoskeletal disorders among nurses: systematic review. <i>J Ergonomics</i> . 2014;54:003. doi:10.4172/2165-7556.S4-003.	Systematic Review w/ Meta-Analysis	n/a	n/a	n/a	n/a	The most vulnerable site of work-related MSDs is the vertebral column followed by the shoulders, neck, knee, ankles, wrist, thighs and elbows. Predisposing factors include poor patient transfer techniques, high physical demand, poor conditioning of nurses and obesity.	IIIA
31	Videman T, Ojajärvi A, Riihimäki H, Troup JD. Low back pain among nurses: a follow-up beginning at entry to the nursing school. <i>Spine (Phila Pa 1976)</i> . 2005;30(20):2334-2341.	Nonexperimental	Nursing students-174 followed for 7.5 years	n/a	n/a	Prevalence of back pain, constitutional and behavioral factors, occupational exposures, disability	The lifetime cumulative prevalence of back pain increased from 31% at entry into nursing school to 72% at the end of nursing school and further to 82% after 5 years as a nurse.	IIIA
32	Lee SJ, Lee JH, Gershon RR. Musculoskeletal symptoms in nurses in the early implementation phase of California's safe patient handling legislation. <i>Res Nurs Health</i> . 2015;38(3):183-193.	Qualitative	396 nurses	n/a	n/a	Organizational safe patient handling practices, musculoskeletal symptoms and perceptions	As the safe patient handling laws were introduced in California, there was a high prevalence of musculoskeletal symptoms among the surveyed nurses. Findings will serve as baseline data.	IIIB
33	Arsalani N, Fallahi-Khoshknab M, Josephson M, Lagerström M. Musculoskeletal disorders and working conditions among Iranian nursing personnel. <i>Int J Occup Saf Ergon</i> . 2014;20(4):671-680.	Qualitative	520 hospital nursing personnel	n/a	n/a	Prevalence of MSDs and the association with organizational, physical, and psychosocial working conditions	The study results indicate a high prevalence of self-reported MSDs, lack of satisfactory patient transfer devices, lack of patient transfer training; and a physical/ergonomic organizational and psychological exposure association with MSDs.	IIIA

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34	Chung YC, Hung CT, Li SF, et al. Risk of musculoskeletal disorder among Taiwanese nurses cohort: a nationwide population-based study. BMC Musculoskelet Disord. 2013;14.	Qualitative	3,914 Nurses; 11,744 non-nurses; total 15,658	n/a	3914 nurses compared to 11744 non-nurses	Incidence and age-specific incidence of MSDs	The nurses in the study were at a higher risk of MSDs than the non-nurse population. Leading cause is lack of awareness education and training of risky work-related situations. Other causes are incorrect posture/movement, psychological issues, and rotating shifts. Education may be helpful in reducing the incidence of MSDs.	IIIB
35	Bos E, Krol B, van der Star L, Groothoff J. Risk factors and musculoskeletal complaints in non-specialized nurses, IC nurses, operation room nurses, and X-ray technologists. Int Arch Occup Environ Health. 2007;80(3):198-206.	Qualitative	3,169/ ICU nurses, OR nurses, X-ray technologists, and non-specialized nurses.	n/a	n/a	Prevalence rates of musculoskeletal complaints of the neck-shoulder and the low back.	Low back and neck-shoulder complaints are a major health problem in all four groups. The prevalence rate of neck-shoulder complaints in OR nurses is higher than the other nursing groups. All groups need preventive interventions specific for each group.	IIIC
36	de Castro AB, Cabrera SL, Gee GC, Fujishiro K, Tagalog EA. Occupational health and safety issues among nurses in the Philippines. AAOHN J. 2009;57(4):149-157.	Qualitative	655 nurses	n/a	n/a	Occupational injuries	Most of the nurses who had an injury did not report it. Top ranking concerns were stress and overwork. Future research should study organizational factors that contribute to these concerns and establish strong policies to promote health and safety.	IIIB
37	Sadeghian F, Hosseinzadeh S, Aliyari R. Do psychological factors increase the risk for low back pain among nurses? A comparing according to cross-sectional and prospective analysis. Saf Health Work. 2014;5(1):13-16.	Qualitative	246 university hospital nurses	n/a	n/a	Back pain, mental health score, expectation of back pain, lifting weights, belief about work causation of pain	The risk factors for prevalence of back pain differ at baseline and 1 year follow up.	IIIC
38	Naeem A, Umar M, Malik AN, ur Rehman S. Occupationally related low back pain and associated factors in nurses. Rawal Med J. 2015;40(2):145-147.	Qualitative	294 nurses	n/a	n/a	MSDs, contributing factors	High prevalence of back pain among nurses. Nurses hesitate to report their own back pain. Additional education and training is needed to prevent poor posture and to use proper handling techniques while transferring and lifting patients with or without assistance.	IIIB
39	Letvak S. We cannot ignore nurses' health anymore: a synthesis of the literature on evidence-based strategies to improve nurse health. Nurs Adm Q. 2013;37(4):295-308.	Systematic Review	n/a	n/a	n/a	n/a	The health of nurses have been described extensively but not how to fix the problems. More funding is needed for researching evidence-based strategies for improving the safety of work environments and improving the health of nurses.	IIA
40	Serranheira F, Cotrim T, Rodrigues V, Nunes C, Sousa-Uva A. Nurses' working tasks and MSDs back symptoms: results from a national survey. Work. 2012;41(Suppl 1):2449-2451.	Qualitative	2140 nurses	n/a	n/a	Prevalence of work related MSDs symptoms	There was a high prevalence of work related MSDs symptoms indicating that nurses are at a risk to develop work related MSDs. Symptoms occurred frequently in the lower and upper back.	IIIA
41	Nelson A, Matz M, Chen F, Siddharthan K, Lloyd J, Fragala G. Development and evaluation of a multifaceted ergonomics program to prevent injuries associated with patient handling tasks. Int J Nurs Stud. 2006;43(6):717-733.	Quasi-experimental	209 nurses / 23 high risk nursing units	ergonomic assessment protocol, patient handling assessment criteria and decision algorithms, peer leader role, equipment, after action reviews, no lift policy	Pre- and post-surveys	Impact of the program on injury rate, lost and modified work days, job satisfaction, self-reported unsafe patient handling tasks, level of support for the program, staff and patient acceptance, program effectiveness, costs, and return on investment	The program resulted in a statistically significant decrease in the rate of musculoskeletal injuries and the number of modified work days per injury	IIA

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42	Injuries, illnesses, and fatalities. Chart 5: Rates of injuries and illnesses for selected healthcare and protective service occupations, by ownership, 2015. US Bureau of Labor Statistics. <a href="https://data.bls.gov/cgi-bin/print.pl/iif/oshwc/osh/case/chart-data-2015.htm">https://data.bls.gov/cgi-bin/print.pl/iif/oshwc/osh/case/chart-data-2015.htm</a> . Updated October 20, 2017. Accessed May 10, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	Number and incidence rate of injuries in total and by occupation are described.	VA
43	Karahan A, Kav S, Abbasoglu A, Dogan N. Low back pain: prevalence and associated risk factors among hospital staff. <i>J Adv Nurs</i> . 2009;65(3):516-524.	Qualitative	1600/ hospital employees	n/a	n/a	Prevalence of low back pain and risk factors	Preventative measures should be taken to reduce the risk of low back pain including proper rest periods, educational programs and smoking cessation.	IIIB
44	Dennerlein JT, Hoppica K, Sembajwe G, et al. Ergonomic practices within patient care units are associated with musculoskeletal pain and limitations. <i>Am J Ind Med</i> . 2012;55(2):107-116.	Qualitative	1572/ patient care workers	n/a	n/a	MSDs for the past 3 months	Ergonomic practices seem to be associated with many of the musculoskeletal symptoms indicating their importance in preventing MSDs in the health care setting.	IIIA
45	Ngan K, Drebit S, Siow S, Yu S, Keen D, Alamgir H. Risks and causes of musculoskeletal injuries among health care workers. <i>Occup Med (Lond)</i> . 2010;60(5):389-394.	Nonexperimental	23742 health workers	n/a	n/a	Time loss from work, musculoskeletal injuries, cause of injuries, occupation	Over an 12 month period there were 944 injuries resulting in time away from work. 83% were musculoskeletal. RNs and care aides reported the highest incidence of musculoskeletal injuries. For non-patient care occupations 55% of the musculoskeletal injuries were due to material/equipment handling activities.	IIIA
46	Moreira RF, Sato TO, Foltran FA, Silva LC, Coury HJ. Prevalence of musculoskeletal symptoms in hospital nurse technicians and licensed practical nurses: associations with demographic factors. <i>Braz J Phys Ther</i> . 2014;18(4):323-333.	Qualitative	245 hospital nursing workers	n/a	n/a	Musculoskeletal symptoms and personal, occupational and health factors related to musculoskeletal symptoms	The surveyed workers presented a high prevalence of musculoskeletal symptoms with the most affected regions being low back (57%), shoulder (52%) and neck (48%). The results indicate a need for preventive programs to control the more severe musculoskeletal symptoms.	IIIB
47	Boyer J, Galizzi M, Cifuentes M, et al; Promoting Healthy Safe Employment (PHASE) in Healthcare Team. Ergonomic and socioeconomic risk factors for hospital workers' compensation injury claims. <i>Am J Ind Med</i> . 2009;52(7):551-562.	Nonexperimental	1468/ hospital employees	n/a	n/a	Number of Workers' compensation claims	Physical workload factors were associated with greater risk of strain and sprain and back injuries than work organization or psychosocial factors in this population.	IIIB
48	McDonald ME, Ramirez PT, Munsell MF, et al. Physician pain and discomfort during minimally invasive gynecologic cancer surgery. <i>Gynecol Oncol</i> . 2014;134(2):243-247.	Qualitative	350 gynecologic oncologists	n/a	n/a	Physical symptoms (eg, numbness, pain, stiffness, fatigue) surgical factors (eg, types of procedures)	Gynecologic oncologists report physical symptoms due to performing MIS procedures. Robotic surgery and female sex appear to be risk factors for physical discomfort. The ergonomics of MIS need to be improved.	IIIB
49	Shepherd JM, Harilingam MR, Hamade A. Ergonomics in laparoscopic surgery—a survey of symptoms and contributing factors. <i>Surg Laparosc Endosc Percutan Tech</i> . 2016;26(1):72-77.	Qualitative	50 laparoscopic surgery trainees/consultants	n/a	n/a	Surgery duration, symptoms related to instrument design, ergonomics training	45% of the respondents reported moderate/severe symptoms during long cases over 2 hours. Assistants reported worse back symptoms than the primary surgeon.	IIIB
50	Knudsen ML, Ludewig PM, Braman JP. Musculoskeletal pain in resident orthopaedic surgeons: results of a novel survey. <i>Iowa Orthop J</i> . 2014;34:190-196.	Qualitative	32 resident orthopedic surgeons	n/a	n/a	Musculoskeletal symptoms; cause	There are similar rates of musculoskeletal symptoms among resident orthopedists and practicing orthopedists. More attention is needed to the ergonomic and physical environments where they are trained.	IIIC

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51	Janki S, Mulder EEAP, IJermans JNM, Tran TCK. Ergonomics in the operating room. <i>Surg Endosc.</i> 2017;31(6):2457-2466	Qualitative	127 surgeons from various specialties	n/a	n/a	MSDs	The study demonstrated that MSD complaints and subsequent work absence is still happening especially among surgeons with a positive medical history for MSDs. There was not a significant difference among the specialties. Almost half of the respondents with MSD complaints have made ergonomic adjustments to prevent future problems.	IIIB
52	Kim-Fine S, Woolley SM, Weaver AL, Killian JM, Gebhart JB. Work-related musculoskeletal disorders among vaginal surgeons. <i>Int Urogynecol J.</i> 2013;24(7):1191-1200.	Qualitative	503 vaginal surgeons/ 27 non-surgeon physicians	n/a	Vaginal surgeons versus non-surgeon physicians to provide a baseline	MSDs	A large proportion (86.7%) reported work-related MSDs	IIIB
53	Tjiam IM, Goossens RH, Schout BM, et al. Ergonomics in endourology and laparoscopy: an overview of musculoskeletal problems in urology. <i>J Endourol.</i> 2014;28(5):605-611.	Qualitative	285 urologists	n/a	n/a	Type and frequency of musculoskeletal complaints, and knowledge of ergonomic conditions during minimally invasive surgery	The urologists experienced a high prevalence of musculoskeletal complaints particularly of the neck, back and shoulders, and indicated that they have a lack of knowledge about ergonomics in the OR.	IIIB
54	Esser AC, Koshy JG, Randle HW. Ergonomics in office-based surgery: a survey-guided observational study. <i>Dermatol Surg.</i> 2007;33(11):1304-1313; discussion 1313-1314.	Qualitative	17 Mohs surgeons	n/a	n/a	Symptoms of musculoskeletal injuries	Symptoms of musculoskeletal injuries are common in Mohs surgeons and may begin early in their career. By modifying footwear, flooring, table height, operating position, lighting and surgical instruments ergonomics in the office-based surgery suite may be improved.	IIIB
55	Little RM, Deal AM, Zanation AM, McKinney K, Senior BA, Ebert CS Jr. Occupational hazards of endoscopic surgery. <i>Int Forum Allergy Rhinol.</i> 2012;2(3):212-216.	Qualitative	62 otolaryngologists	n/a	n/a	Physical symptoms, ergonomics, OR environment	77% of the surgeons who regularly perform endoscopic endonasal surgery suffer physical discomfort or symptoms attributable to performing this type of surgery.	IIIB
56	Vijendren A, Yung M, Sanchez J, Duffield K. Occupational musculoskeletal pain amongst ENT surgeons—are we looking at the tip of an iceberg? <i>J Laryngol Otol.</i> 2016;130(5):490-496.	Qualitative	323 ENT surgeons	n/a	n/a	MSDs	Almost half (47.4%) of the respondents had experienced work-related musculo-skeletal disorders. More research and ergonomic interventions are needed for this specialty.	IIIB
57	Sari V, Nieboer TE, Vierhout ME, Stegeman DF, Kluivers KB. The operation room as a hostile environment for surgeons: physical complaints during and after laparoscopy. <i>Minim Invasive Ther Allied Technol.</i> 2010;19(2):105-109.	Qualitative	55 surgeons	n/a	n/a	Physical complaints during and after laparoscopic surgery and possible causes	Shoulder and neck pain are common complaints during and after laparoscopic procedures. Complaints decreased with laparoscopic experience. Causes included poor positioning due to table height, monitor position and instrument design.	IIIB
58	Sivak-Callcott JA, Diaz SR, Ducatman AM, Rosen CL, Nimbarte AD, Sedgeman JA. A survey study of occupational pain and injury in ophthalmic plastic surgeons. <i>Ophthal Plast Reconstr Surg.</i> 2011;27(1):28-32.	Qualitative	130 ophthalmic plastic surgeons	n/a	n/a	Pain associated with operating, use of loupe magnification, use of headlight, and OR modification	Many oculoplastic surgeons experience discomfort due to operating, A minority have stopped operating due to pain or neck injury.	IIIB
59	Ruitenburt MM, Frings-Dresen MH, Sluiter JK. Physical job demands and related health complaints among surgeons. <i>Int Arch Occup Environ Health.</i> 2013;86(3):271-279.	Qualitative	958 medical doctors	n/a	n/a	Physical work ability and prevalence of musculoskeletal complaints	More surgeons found their work to be physically strenuous and more were bothered by working in uncomfortable positions. These complaints can reduce the surgeon's work functioning.	IIIB

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60	Sutton E, Irvin M, Zeigler C, Lee G, Park A. The ergonomics of women in surgery. <i>Surg Endosc.</i> 2014;28(4):1051-1055.	Qualitative	314 laparoscopic surgeons	n/a	n/a	physical symptoms, ergonomics, environment/equipment	Women surgeons are experiencing more discomfort and receiving treatment for their hands than male surgeons. Redesign of laparoscopic instrument handles and improvements to table height comprise the most promising solutions to these ergonomic challenges.	IIIB
61	Godwin Y, Macdonald CR, Kaur S, Zhelin L, Baber C. The impact of cervical musculoskeletal disorders on UK consultant plastic surgeons: can we reduce morbidity with applied ergonomics? <i>Ann Plast Surg.</i> 2017;78(6):602-610.	Qualitative	328 plastic surgery consultants	n/a	n/a	Incidence of cervical spine morbidity	Cervical morbidity is a prevalent problem among plastic surgeons. Long procedures, static postures and neck flexion result in the "head forward" posture which may have an impact on long-term cervical morbidity.	IIIB
62	Adams SR, Hacker MR, McKinney JL, Elkadry EA, Rosenblatt PL. Musculoskeletal pain in gynecologic surgeons. <i>J Minim Invasive Gynecol.</i> 2013;20(5):656-660.	Qualitative	495/ Gynecological surgeons	n/a	n/a	Prevalence of musculoskeletal symptoms according to body part	Musculoskeletal symptoms are very prevalent among gynecological surgeons. Female surgeons had approximately a twofold risk of reported pain compared to male surgeons.	IIIB
63	Epstein S, Sparer EH, Tran BN, et al. Prevalence of work-related musculoskeletal disorders among surgeons and interventionalists: a systematic review and meta-analysis. <i>JAMA Surg.</i> 2018;153(2):e174947.	Qualitative	5828 physicians/ 21 studies	n/a	n/a	Prevalence of musculoskeletal disorders	Prevalence estimates of work-related MSDs among at risk physicians appear to be high. Further research is needed to develop and validate evidence based applied ergonomics to prevent these disorders in this population.	IIIA
64	AORN Guidance Statement: Safe Patient Handling and Movement in the Perioperative Setting. Denver, CO: AORN, Inc; 2007.	Guideline	n/a	n/a	n/a	n/a	In 2005, the AORN Workplace Safety Task Force was charged with identifying tasks performed in the perioperative area that pose a high risk for the development of MSDs and formulating evidence-based solutions to minimize the risks. The task force developed recommendations for seven high-risk perioperative tasks using the principles of ergonomics, scientific evidence, and clinical trials.	IVB
65	Ogden CL, Fakhouri TH, Carroll MD, et al. Prevalence of obesity among adults, by household income and education—United States, 2011-2014. <i>MMWR Morb Mortal Wkly Rep.</i> 2017;66(50):1369-1373.	Expert Opinion	n/a	n/a	n/a	n/a	Studies suggest that obesity prevalence varies by income and education, and patterns might differ in high and low income countries.	VA
66	Weinmeyer R. Safe patient handling laws and programs for health care workers. <i>AMA J Ethics.</i> 2016;18(4):416-421.	Expert Opinion	n/a	n/a	n/a	n/a	Work-related dangers faced by health care workers are real and frequent. With changing patient populations and working conditions, health care workers face unnecessary risks of disabling pain and suffering. Safe patient handling laws and the programs they support offer considerable benefits: reducing the injury rates of the hospital labor force, curtailing injury-related costs, enhancing patient care and safety, and acknowledging the physically demanding nature and overall value of nursing and other health care work.	VA
67	Flegal KM, Kruszon-Moran D, Carroll MD, Fryar CD, Ogden CL. Trends in obesity among adults in the United States, 2005 to 2014. <i>JAMA.</i> 2016;315(21):2284-2291.	Nonexperimental	2368 adult men, 2817 adult women	n/a	n/a	Obesity prevalence as determined by height and weight measurements	In this nationally representative study of adults in the USA, the age-adjusted prevalence of obesity in 2013-2014 was 35.0% for men and 40.4% among women.	IIIB
68	Position Statement on Elimination of Manual Patient Handling to Prevent Work-Related Musculoskeletal Disorders. Silver Spring, MD: American Nurses Association; 2003.	Position Statement	n/a	n/a	n/a	n/a	The statement articulates the professional nurse's role in patient handling, including lifting, repositioning, and transferring activities.	IVB



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69	Safe Patient Handling and Mobility: Interprofessional National Standards. Silver Spring, MD: American Nurses Association; 2013.	Guideline	n/a	n/a	n/a	n/a	Eight overarching SPHM standards of care organized into two parts addressing the responsibility of the healthcare organization and the responsibilities of the health care worker.	IVA
70	de Castro AB. Handle with Care: The American Nurses Association's campaign to address work-related musculoskeletal disorders. Orthop Nurs. 2006;25(6):356-365.	Literature Review	n/a	n/a	n/a	n/a	The campaign is building an industry-wide effort to prevent back and other musculoskeletal injuries by developing partnerships and coalitions, education and training, increasing use of assistive equipment and patient-handling devices, reshaping nursing education to incorporate safe patient handling, and pursuing federal and state ergonomics policy by highlighting technology-oriented safe-patient handling benefits for patients and nurses.	VA
71	Ergonomically healthy workplace practices: proposed AORN position statements for consideration by House of Delegates. AORN J. 2006;83(1):119-122.	Position Statement	n/a	n/a	n/a	n/a	Historical perspective of AORN's position on SPHM leading to the guidance statement and finally the guideline	IVB
72	NAON Position Statement: Safe Patient Handling and Movement in the Orthopaedic Setting. Chicago, IL: National Association of Orthopaedic Nurses; 2012.	Position Statement	n/a	n/a	n/a	n/a	Nurses can no longer rely solely on body mechanics and transfer techniques for moving and lifting patients. Injuries can be prevented by using evidence based solutions for high risk patient handling and movement tasks.	IVB
73	Position statement: safe patient and manual handling. In: 2014-2015 ACORN Standards for Perioperative Nursing: Including Nurses Roles, Guidelines, Position Statements, Competency Standards. Lyndoch, SA, Australia: Australian College of Operating Room Nurses Ltd; 2014:143-148.	Position Statement	n/a	n/a	n/a	n/a	The position statement provides direction and guidance to perioperative nurses to promote patient and health care worker safety while manually handling patients and equipment in the perioperative setting.	IVB
74	Position Statement: Safe Patient Handling. Association of Occupational Health Professionals in Healthcare. <a href="http://aohp.org/aohp/Portals/0/Documents/ToolsForYourWork/Position%20Statements/PositionStatements%20Jul%202017.pdf">http://aohp.org/aohp/Portals/0/Documents/ToolsForYourWork/Position%20Statements/PositionStatements%20Jul%202017.pdf</a> . Accessed May 10, 2018.	Position Statement	n/a	n/a	n/a	n/a	AOHP believes that manual handling is unsafe for the caregiver and the patient.	IVB
75	Nelson A, Waters T, Spratt D, Peterson C, Hughes N. Development of the AORN guidance statement: safe patient handling and movement in the perioperative setting. In: AORN Guidance Statement: Safe Patient Handling and Movement in the Perioperative Setting. Denver, CO: AORN, Inc; 2007:5-9.	Expert Opinion	n/a	n/a	n/a	n/a	Seven algorithms were developed by the task force to guide ergonomic workplace safety in the perioperative setting. These tools incorporate current ergonomic safety concepts, scientific evidence, and use patient handling equipment.	VA
76	Waters T, Collins J, Galinsky T, Caruso C. NIOSH research efforts to prevent musculoskeletal disorders in the healthcare industry. Orthop Nurs. 2006;25(6):380-389.	Expert Opinion	n/a	n/a	n/a	n/a	NIOSH has developed a comprehensive program of research aimed at preventing MSDs with work-related exposures due to patient handling; and slips, trips, and falls. Implementation of this research may significantly reduce injuries and illnesses for healthcare workers.	VA
77	Safe lifting becomes standard practice. Hosp Case Manag. 2013;21(2):26-28.	Expert Opinion	n/a	n/a	n/a	n/a	Safe patient handling should be standard practice not best practice.	VA
78	Knoblauch MD, Bethel SA. Safe patient-handling program "UPLIFTS" nurse retention. Nursing. 2010;40(2):67-68.	Organizational Experience	Small acute care satellite facility of a large hospital	n/a	n/a	n/a	For a safety initiative to be successful, every team member including leadership needs to be fully engaged and supportive of the program and each other. A true culture of safety results from fostering a positive outcome and the main objective of keeping the patient and the health care worker safe.	VB

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79	Dawson JM, Harrington S. Embracing safe patient handling. Nurs Manage. 2012;43(10):15-17.	Expert Opinion	n/a	n/a	n/a	n/a	Effective safe patient handling programs and policies and procedures have the potential to be beneficial. Nurses will benefit from work environments where their health and safety are a priority.	VA
80	Mayeda-Letourneau J. Safe patient handling and movement: a literature review. Rehabil Nurs. 2014;39(3):123-129.	Literature Review	n/a	n/a	n/a	n/a	A safe patient handling and movement program decreases overall work injury costs and improves job satisfaction. Reduced work injuries, decreased injury costs, improved patient outcomes validated in research and employees feeling the support of their employer will all contribute to a program that moves an organization toward a culture of safety.	VA
81	Guideline for positioning the patient. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2018:673-744.	Guideline	n/a	n/a	n/a	n/a	This document provides guidance to perioperative team members for positioning patients undergoing operative and other invasive procedures in the perioperative practice setting.	IVA
82	Guideline for preoperative patient skin antisepsis. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2018:51-74.	Guideline	n/a	n/a	n/a	n/a	This document provides guidance for preoperative patient skin preparation, including preoperative, including preoperative patient bathing; preoperative hair removal; selection of skin antiseptics; application of antiseptics; and safe handling, storage, and disposal of antiseptics.	IVA
83	Cadmus E, Brigley P, Pearson M. Safe patient handling: is your facility ready for a culture change? Nurs Manage. 2011;42(11):12-15.	Organizational Experience	n/a	n/a	n/a	n/a	Creating a safe patient handling program requires a strategic plan, leadership support and staff engagement. Over two years there was a 80.5% reduction in lost days and 57.1% reduction in workplace injuries. The return on investment was realized in 29.5 months.	VA
84	Hooper J, Charney W. Creation of a safety culture: reducing workplace injuries in a rural hospital setting. AAOHN J. 2005;53(9):394-398.	Organizational Experience	72 bed rural hospital	n/a	n/a	n/a	Success in improving the hospital-wide safety record was administrative commitment to making the workplace safer for both the patients and the healthcare worker. Interventions include a zero lift program and a patient handling specialist.	VB
85	Koppelaar E, Knibbe JJ, Miedema HS, Burdorf A. The influence of individual and organisational factors on nurses' behaviour to use lifting devices in healthcare. Appl Ergon. 2013;44(4):532-537.	Qualitative	19 hospitals, 19 nursing homes	n/a	n/a	Individual and organizational factors	Important determinants of nurses' behavior to use lifting devices were knowledge of workplace procedures, strict guidance on required lifting devices, and sufficient lifting devices. Management support and a supportive management climate were associated with these determinants. An integral approach addressing the individual and organizational levels is necessary to facilitate implementation of ergonomic interventions.	IIIB
86	Koppelaar E, Knibbe JJ, Miedema HS, Burdorf A. Individual and organisational determinants of use of ergonomic devices in healthcare. Occup Environ Med. 2011;68(9):659-665.	Nonexperimental	186 nurses, 735 patient handling tasks	n/a	n/a	Use of ergonomic devices	The use of ergonomic devices is associated with less forceful movements and awkward back postures which likely contribute to the prevention of low back pain among nurses.	IIIB
87	Guideline for team communication. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2018:745-772.	Guideline	n/a	n/a	n/a	n/a	This document provides guidance for improving perioperative team communication through a culture of safety, team training and simulation training, standardized transfer of patient information, briefings, time outs, surgical safety checklists, and debriefings.	IVA

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88	Improving Patient and Worker Safety: Opportunities for Synergy, Collaboration and Innovation. Oakbrook Terrace, IL: The Joint Commission; 2012. <a href="http://www.jointcommission.org/assets/1/18/TJC-improvingpatientandworkersafety-monograph.pdf">http://www.jointcommission.org/assets/1/18/TJC-improvingpatientandworkersafety-monograph.pdf</a> . Accessed May 10, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	Safety does not differentiate between patients and health care workers. Health care safety programs should incorporate both patient safety and health care worker safety utilizing the same tools of organizational culture, principles, and methods.	VA
89	Committee on the Work Environment for Nurses and Patient Safety, Institute of Medicine. Page A, ed. Keeping Patients Safe: Transforming the Work Environment of Nurses. Washington, DC: National Academies Press; 2004.	Literature Review	n/a	n/a	n/a	n/a	The report presents guidance on how to design nurses' work environments to enable them to provide safer patient care.	VA
90	Gallagher S; American Nurses Association. Implementation Guide to the Safe Patient Handling and Mobility Interprofessional National Standards. Silver Spring, MD: American Nurses Association; 2013.	Expert Opinion	n/a	n/a	n/a	n/a	Implementation Guide complements the ANA standards and is written for individuals who currently do not have a SPHM program in their work environment or who are in the early stages of developing a program. It offers those individuals the opportunity to fast track to success and is designed to work in conjunction with the SPHM national standards.	VA
91	Engkvist IL. Nurses' expectations, experiences and attitudes towards the intervention of a "no lifting policy." J Occup Health. 2007;49(4):294-304.	Qualitative	457/ registered nurses and clinical assistants	n/a	n/a	Attitudes towards implementation of a "No Lift" system, expectations, experiences, use of patient transfer equipment	Most of the respondents were positive towards the "No Lift" system where it had been implemented and where it was to be implemented. The intervention was successful at the current "No Lift" facility.	IIIA
92	Hignett S, Wilson JR, Morris W. Finding ergonomic solutions—participatory approaches. Occup Med (Lond). 2005;55(3):200-207.	Literature Review	n/a	n/a	n/a	n/a	Participatory ergonomic interventions includes interventions at the macro level (eg, organizational, systems) and at the micro level (eg, individual) where workers are given the opportunity and power to use their knowledge to address ergonomic problems related to their own work activities.	VA
93	Kim SL, Lee JE. Development of an intervention to prevent work-related musculoskeletal disorders among hospital nurses based on the participatory approach. Appl Ergon. 2010;41(3):454-460.	Organizational Experience	Medium-size university hospital	n/a	n/a	n/a	Using the participatory approach, the program was developed to prevent work-related MSDs in hospital nurses.	VA
94	Krill C, Staffileno BA, Raven C. Empowering staff nurses to use research to change practice for safe patient handling. Nurs Outlook. 2012;60(3):157-162.	Qualitative	134 RNs, 76 patient care technicians	n/a	n/a	Staff's perceived barriers and attitudes towards SPHM, and staff's need for equipment and education.	Obtaining information regarding barriers to safe patient handling before implementing a program from front line care givers is essential.	IIIB
95	Caspi CE, Dennerlein JT, Kenwood C, et al. Results of a pilot intervention to improve health and safety for health care workers. J Occup Environ Med. 2013;55(12):1449-1455.	Quasi-experimental	269/healthcare workers-84% staff nurses	Unit ergonomics and safety; safe patient handling; worker physical fitness	Pre- and post-survey scores	Safety practices, coworker support, supervisor support, pain, work interference, physical activity	Safe patient handling, ergonomics, and safety practices are targets for worker safety and wellness interventions. Interventions may reduce the risk of MSDs.	IIB
96	Enos L. Texas passes first safe patient handling legislation. Oreg Nurse. 2005;70(3):3.	Expert Opinion	n/a	n/a	n/a	n/a	There is no safe way to manually lift patients.	VA

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97	Hudson MA. Texas passes first law for safe patient handling in America: landmark legislation protects health-care workers and patients from injury related to manual patient lifting. J Long-Term Eff Med Implants. 2005;15(5):559-566.	Expert Opinion	n/a	n/a	n/a	n/a	Overview of the first safe patient handling legislation signed into law in Texas in 2005	VA
98	Emerging issue: keeping patients and nurses safe. Nursing and musculoskeletal disorders. N J Nurse. 2005;35(1):12-13.	Expert Opinion	n/a	n/a	n/a	n/a	Overview of the federal and state legislative attempts and ANA's advocacy	VC
99	Hughes NL. Update on Handle with Care: the American Nurses Association's campaign to address work-related musculoskeletal disorders. Orthop Nurs. 2006;25(6):357.	Expert Opinion	n/a	n/a	n/a	n/a	Overview of ANA's Handle with Care program to address MSDs.	VB
100	Sparkman CA. Ergonomics in the workplace. AORN J. 2006;84(3):379-382.	Expert Opinion	n/a	n/a	n/a	n/a	Overview of the musculoskeletal injuries suffered by nurses, state standards, state legislation, and AORN guidance.	VB
101	White KM. Policy spotlight: patient care ergonomics. Nurs Manage. 2007;38(4):26-30.	Expert Opinion	n/a	n/a	n/a	n/a	Legislation, regulation, research, and administrative policy development are all strategies to take to protect healthcare workers from injury.	VB
102	OSH Act of 1970. Occupational Safety and Health Administration. <a href="https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=OSHACT&amp;p_id=2743">https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=OSHACT&amp;p_id=2743</a> . Accessed May 10, 2018.	Regulatory	n/a	n/a	n/a	n/a	n/a	n/a
103	OSHA general duty clause. Occupational Safety and Health Administration. <a href="https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=OSHACT&amp;p_id=3359">https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=OSHACT&amp;p_id=3359</a> . Accessed May 10, 2018.	Regulatory	n/a	n/a	n/a	n/a	n/a	n/a
104	Wallis L. OSHA gets serious about workplace safety for nurses. Am J Nurs. 2015;115(9):13.	Expert Opinion	n/a	n/a	n/a	n/a	OSHA inspection procedures to determine if there is a system in place to prevent ergonomic injuries.	VC
105	de Castro AB, Hagan P, Nelson A. Prioritizing safe patient handling: the American Nurses Association's Handle with Care campaign. J Nurs Adm. 2006;36(7-8):363-369.	Expert Opinion	n/a	n/a	n/a	n/a	Manual patient handling is unsafe for nurses.	VC
106	Safe patient handling. Safety and Health Topics: Healthcare. Occupational Safety and Health Administration. <a href="https://www.osha.gov/SLTC/healthcarefacilities/safepatienthandling.html">https://www.osha.gov/SLTC/healthcarefacilities/safepatienthandling.html</a> . Accessed May 10, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	One major source of injury to healthcare workers is musculoskeletal disorders (MSDs). In 2010, nursing aides, orderlies, and attendants had the highest rates of MSDs. There were 27,020 cases, which equates to an incidence rate of 249 per 10,000 workers, more than seven times the average for all industries.	VA
107	Grayson D, Dale AM, Bohr P, Wolf L, Evanoff B. Ergonomic evaluation: part of a treatment protocol for musculoskeletal injuries. AAOHN J. 2005;53(10):450-457; quiz 458-459.	Quasi-experimental	133 participants with acute work related musculoskeletal disorder (WMSD) employed by a healthcare system, university, and an airline	Ergonomic evaluation and case coordination	n/a	Implementation of recommendations for behavioral and administrative/ equipment changes.	Introducing a limited ergonomic program early in the treatment program for workers with WMSDs resulted in modification of job stressors. Simple behavior changes were more likely to occur. The program was most effective when the worker and manager were motivated to incorporate the recommendations from the evaluation.	IIC

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108	Collins JW, Wolf L, Bell J, Evanoff B. An evaluation of a "best practices" musculoskeletal injury prevention program in nursing homes. <i>Inj Prev.</i> 2004;10(4):206-211.	Quasi-experimental	1728 nursing staff members in six nursing homes	Musculoskeletal injury prevention program using mechanical lifts, repositioning aids, a zero lift policy, and employee training on the devices	Injury incidence rates, workers' compensation costs, lost work day injury rates, and restricted work days for three years pre-intervention and three years post-intervention.	Injury incidence rates, workers' compensation costs, lost work day injury rates, and restricted work days	The musculoskeletal injury prevention program significantly reduced injuries for full-time and part-time nurses in all age groups, all lengths of experience in all study sites.	IIA
109	Enos L. Hidden costs: the case for ergonomics and safe patient handling. <i>Oreg Nurse.</i> 2010:5	Expert Opinion	n/a	n/a	n/a	n/a	Identification of the true costs and benefits of safe patient handling can demonstrate the financial feasibility of these programs as well as achieving the health care organizations' objectives.	VB
110	2010 Health Guidelines Revision Committee. Specialty Subcommittee on Patient Movement. Patient Handling and Movement Assessments: A White Paper. Dallas, TX: Facility Guidelines Institute; 2010.	Expert Opinion	n/a	n/a	n/a	n/a	To reduce injuries using the Facility Guidelines Institute requirement to conduct a patient handling and movement assessment and patient handling movement program and for every health care construction or renovation project, this white paper may serve as catalysts both to encourage innovative health care projects based on further equipment research and development, and to guide project decision-makers toward the realization of safe patient handling and movement throughout the nation's health care facilities.	VA
111	Restrepo TE, Schmid FA, Gucer PW, Shuford HL, Shyong CJ, McDiarmid MA. Safe lifting programs at long-term care facilities and their impact on workers' compensation costs. <i>J Occup Environ Med.</i> 2013;55(1):27-35.	Qualitative	265 directors of nursing; 656 CMS certified long term care facilities	n/a	n/a	Survey elements included policies and procedures, caregiver training, resident lift-assist identification, use of powered mechanical lifts, safety and injury reporting procedures, staff retention and turnover, attitudes towards lifts, barriers, injury and turnover	The higher the safe lift index score, the lower the claims and costs. A comprehensive safe lift program, endorsed and promoted by the directors of nursing, reduces caregiver injury as measured by workers' compensation claims frequency and costs.	IIIA
112	Charney W, Simmons B, Lary M, Metz S. Zero lift programs in small rural hospitals in Washington state: reducing back injuries among health care workers. <i>AAOHN J.</i> 2006;54(8):355-358.	Quasi-experimental	38/ rural hospitals	Zero lift patient handling program	Frequency rate per 100 FTEs; time lost frequency rate, average total incurred lose per claim pre and post intervention	Effect of implementing a zero lift program on injury rates	Patient handling claims decreased by 43% in the participating hospitals. Time lost frequency decreased by 50%.	IIB
113	Haglund K, Kyle J, Finkelstein M. Pediatric safe patient handling. <i>J Pediatr Nurs.</i> 2010;25(2):98-107.	Nonexperimental	Caregivers at a pediatric hospital. Effectiveness of SPH equipment pre-survey- 277, post-survey- 274; Perception of risk pre-survey-319, post-survey-285.	n/a	n/a	Employee injuries and associated costs, risk of provider injury while handling patients, caregivers' opinions of the effectiveness of SPH equipment	The SPH program led the way to providing safe and effective alternatives to manual handling of pediatric patients creating a more responsible patient lift culture.	IIIC

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114	Powell-Cope G, Toyinbo P, Patel N, et al. Effects of a national safe patient handling program on nursing injury incidence rates. J Nurs Adm. 2014;44(10):525-534.	Quasi-experimental	141 VA medical centers	Implementation of SPH technologies and program	Musculoskeletal injury rates before and after implementation of SPH technologies and program	Musculoskeletal injuries	The safe patient handling program is effective in reducing the risk for patient handling related musculoskeletal injuries among nurses.	IIA
115	Wardell H. Reduction of injuries associated with patient handling. AAOHN J. 2007;55(10):407-412.	Quasi-experimental	Pre-implementation caregivers-21; post-implementation caregivers-38	Introduction of SPHM equipment and training	Data collection of patient handling equipment before and after SPHM training	Amount of equipment, reliability of equipment, training in use of equipment	The appropriate use of patient-handling techniques must be integrated into the accountability of every caregiver. Creating an environment conducive to safe patient handling includes the safety of caregivers as well as patients.	IIB
116	Zadvinskis IM, Salsbury SL. Effects of a multifaceted minimal-lift environment for nursing staff: pilot results. West J Nurs Res. 2010;32(1):47-63.	Quasi-experimental	77 nursing personnel	Multi-faceted minimal-lift environment including engineering, administrative and behavioral controls	Engineering controls only versus a multi-faceted minimal-lift environment including engineering, administrative and behavioral controls	Effect of a multi-faceted minimal-lift environment on reported minimal-lift equipment use, frequency of injury, and cost.	The nurses in the multifaceted minimal lift environment reported significantly greater use of the equipment and reported fewer patient handling injuries.	IIB
117	Nelson A, Baptiste AS. Update on evidence-based practices for safe patient handling and movement. Orthop Nurs. 2006;25(6):367-368.	Expert Opinion	n/a	n/a	n/a	n/a	The evidence-base continues to grow regarding the benefits of implementing a safe patient handling program.	VA
118	Kutash M, Short M, Shea J, Martinez M. The lift team's importance to a successful safe patient handling program. J Nurs Adm. 2009;39(4):170-175.	Organizational Experience	958 bed hospital with 5900 employees	n/a	n/a	n/a	The lift team program has proven to be very successful and is a valuable resource to the nursing staff.	VB
119	Hunter B, Branson M, Davenport D. Saving costs, saving health care providers' backs, and creating a safe patient environment. Nurs Econ. 2010;28(2):130-134.	Organizational Experience	Southwestern hospital	n/a	n/a	n/a	Establishing an enhanced culture of safety for patients and staff in an established organization is a slow process. The safe patient handling program fosters a sense of freedom to provide safe patient care while protecting the caregiver's own health. MSDs decreased significantly and associated costs of injuries also decreased significantly.	VA
120	Meeks-Sjostrom D, Lopuszynski SA, Bairan A. The wisdom of retaining experienced nurses at the bedside: a pilot study examining a minimal lift program and its impact on reducing patient movement related injuries of bedside nurses. Medsurg Nurs. 2010;19(4):233-236.	Quasi-experimental	92 nurses-pre-intervention; 88 nurses-post-intervention	Use of minimal lift equipment and minimal lift program interventions	Pre- and post-surveys	Nurses' satisfaction with the minimal lift equipment, ability to conduct safer and more efficient bedside care	Minimal lift equipment and programs may help reduce injuries and keep experienced nurses in the workforce longer.	IIC
121	Vieira ER, Kumar S, Coury HJ, Narayan Y. Low back problems and possible improvements in nursing jobs. J Adv Nurs. 2006;55(1):79-89.	Qualitative	Orthopedic nurses- 23; ICU nurse-24	n/a	n/a	Low back pain	There are workload differences between nursing jobs. Lifting, biomechanical training, bigger rooms, adequate set-up and additional staff are suggested improvements.	IIIB
122	42 CFR 482: Conditions of participation for hospitals. US Government Publishing Office. <a href="https://www.gpo.gov/fdsys/granule/CFR-2011-title42-vol5/CFR-2011-title42-vol5-part482">https://www.gpo.gov/fdsys/granule/CFR-2011-title42-vol5/CFR-2011-title42-vol5-part482</a> . Accessed May 10, 2018.	Regulatory	n/a	n/a	n/a	n/a	n/a	n/a
123	State Operations Manual Appendix L—Guidance for Surveyors: Ambulatory Surgical Centers. Rev. 137; 2015. Centers for Medicare & Medicaid Services. <a href="https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_l_ambulatory.pdf">https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_l_ambulatory.pdf</a> . Accessed May 10, 2018.	Regulatory	n/a	n/a	n/a	n/a	n/a	n/a

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124	PTD: Prevention through design. Centers for Disease Control and Prevention. <a href="https://www.cdc.gov/niosh/topics/ptd/default.html">https://www.cdc.gov/niosh/topics/ptd/default.html</a> . Accessed May 10, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	One of the best ways to prevent and control occupational illnesses and injuries is to "design out" or minimize hazards and risks.	VB
125	Ng I. Integrated intra-operative room design. <i>Acta Neurochir Suppl.</i> 2011;109:199-205.	Organizational Experience	3 intraoperative OR's and 1 radiology suite	n/a	n/a	n/a	Optimization of ergonomics and workflow included suspending when possible the surgical equipment such as ESU, suction, and drills to minimize clutter on the floor.	VB
126	Samii A, Gerganov VM. The dedicated endoscopic operating room. <i>World Neurosurg.</i> 2013;79(2 Suppl):S15.e19-S15.e22.	Expert Opinion	n/a	n/a	n/a	n/a	A dedicated neuro-endoscopic OR should provide workflow optimization, ergonomic solutions, and patient safety.	VB
127	Sikkink CJ, Reijnen MM, Zeebregts CJ. The creation of the optimal dedicated endovascular suite. <i>Eur J Vasc Endovasc Surg.</i> 2008;35(2):198-204.	Literature Review	n/a	n/a	n/a	n/a	The most important feature of working in a dedicated endovascular suite is the ability to provide the best treatment for the patient. Ergonomic benefits include monitor placement directly across from the scrubbed team, no movement of mobile systems, fewer cables on the floor, and decreased time connecting cables.	VB
128	Hudorović N, Rogan SA, Lovričević I, Zovak M, Schmidt S. The vascular hybrid room—operating room of the future. <i>Acta Clin Croat.</i> 2010;49(3):289-298.	Expert Opinion	n/a	n/a	n/a	n/a	Important issues for the vascular hybrid OR include quality imaging equipment, radiation burden, ease of use of equipment, specially trained personnel, ergonomics, ability to perform both open and percutaneous procedures, sterile environment, and quality and efficient patient care.	VA
129	Koneczny S. The operating room: architectural conditions and potential hazards. <i>Work.</i> 2009;33(2):145-164.	Qualitative	424 surgeons, 188 OR Nurses, 130 OR employees	n/a	n/a	Uncomfortable or painful working postures	All the deficiencies noted demonstrate the need for implementation of ergonomics in the OR and for individual solutions.	IIIA
130	Klein M, Andersen LP, Alamili M, Gögenur I, Rosenberg J. Psychological and physical stress in surgeons operating in a standard or modern operating room. <i>Surg Laparosc Endosc Percutan Tech.</i> 2010;20(4):237-242.	Quasi-experimental	10 experienced surgeons	Use of a optimized ergonomics and technical aids in a modern OR	Standard OR	Preoperative and postoperative physical strain and pain measurements	The surgeon's physical strain was reduced when performing laparoscopic cholecystectomy in the modern OR compared with the standard OR.	IIB
131	Anastasakis E, Protopapas A, Daskalakis G, Papadakis M, Milingos S, Antsaklis A. Transforming a conventional theatre into a gynaecological endoscopy unit. <i>Clin Exp Obstet Gynecol.</i> 2007;34(2):99-101.	Organizational Experience	n/a	n/a	n/a	n/a	The design of a specialty OR is a multidisciplinary task. Clear communication among all team members is crucial to the success of the project.	VB
132	Muir M, Heese GA, McLean D, Bodnar S, Rock BL. Handling of the bariatric patient in critical care: a case study of lessons learned. <i>Crit Care Nurs Clin North Am.</i> 2007;19(2):223-240.	Case Report	697 pound patient	n/a	n/a	n/a	Review of the techniques, equipment, and difficulties with a bariatric patient admission.	VA
133	Ginsberg GG, Pickett-Blakely O. Endoscopy unit considerations in the care of obese patients. <i>Gastrointest Endosc Clin N Am.</i> 2011;21(2):265-274.	Expert Opinion	n/a	n/a	n/a	n/a	Endoscopy units should address the unique design and equipment needs of obese patients in both short-term and long-term planning.	VB
134	Bariatric Safe Patient Handling and Mobility Guidebook: A Resource Guide for Care of Persons of Size. St Louis, MO: VHA Center for Engineering & Occupational Safety and Health (CEOSH); 2015.	Guideline	n/a	n/a	n/a	n/a	Special challenges arise with the obese patient because excess weight and weight distribution interfere with the caregiver's ability to provide patient care	IVB
135	Rose MA, Drake DJ, Baker G, Watkins FR Jr, Waters W, Pokorny M. Caring for morbidly obese patients: safety considerations for nurse administrators. <i>Nurs Manage.</i> 2008;39(11):47-50.	Expert Opinion	n/a	n/a	n/a	n/a	Providing care to morbidly obese patient and providing a safe working environment are extremely challenging goals.	VC

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136	Choi SD, Brings K. Work-related musculoskeletal risks associated with nurses and nursing assistants handling overweight and obese patients: a literature review. <i>Work</i> . 2015;53(2):439-448.	Literature Review	n/a	n/a	n/a	n/a	To decrease MSDs and injuries among nurses and nursing assistants handling overweight and obese patients, additional research and development of safe patient handling interventions are needed.	VA
137	Schoenfisch AL, Myers DJ, Pompeii LA, Lipscomb HJ. Implementation and adoption of mechanical patient lift equipment in the hospital setting: the importance of organizational and cultural factors. <i>Am J Ind Med</i> . 2011;54(12):946-954.	Qualitative	80 participants in 13 focus groups	n/a	n/a	Experiences with the lift equipment, feelings about the policy shift, barriers to implementation, adequacy of training, ongoing support	Barriers to implementation include time which encompassed training, comfort, feelings of competence, equipment access, room configurations, patient conditions, and lack of support.	IIIB
138	de Ruiter HP, Liaschenko J. To lift or not to lift: patient-handling practices. <i>AAOHN J</i> . 2011;59(8):337-343.	Qualitative	32/ nurses	n/a	n/a	Complexity of care, patient treatment goals, time, knowledge, equipment issues	By incorporating the factors of complexity of care, patient treatment goals, time, knowledge, and equipment issues into safe patient handling guidelines and programs, the risk of harm to patient and health care workers will be reduced. Additional research on the interface between nurses' use of technology and their clinical judgment is needed to develop best practices.	IIIB
139	Safe Patient Handling and Mobility (SPHM) Technology—Coverage & Space Recommendations. 2016 Revision. Washington, DC: US Department of Veterans Affairs, Veterans Health Administration; 2016.	Expert Opinion	n/a	n/a	n/a	n/a	The document gives direction in determining design, installation, and storage requirements for SPHM technology that is used to handle and mobilize patients and residents in new and existing construction.	VA
140	Nelson A, Baptiste AS. Evidence-based practices for safe patient handling and movement. <i>Online J Issues Nurs</i> . 2004;9(3):4.	Literature Review	n/a	n/a	n/a	n/a	Outdated approaches such as body mechanics should be replaced with evidence-based strategies that include patient handling equipment and devices, patient ergonomic assessments, no lift policies, and patient lift teams.	VA
141	Guideline for a safe environment of care, part 2. In: <i>Guidelines for Perioperative Practice</i> . Denver, CO: AORN, Inc; 2018:269-294.	Guideline	n/a	n/a	n/a	n/a	The physical design and environment of the perioperative suite should support safe patient care, workplace safety, and security. The guideline provides guidance for the design of the building structure; movement of patients, personnel, supplies, and equipment through the suite; safety during construction; environmental controls (eg, heating, ventilation, air conditioning [HVAC]); maintenance of structural surfaces; power failure response planning; security	IVA
142	Thomas-Olson L, Gee M, Harrison D, Helal N. Evaluating the use of ceiling lifts in the operating room. <i>ORNAC J</i> . 2015;33(1):13-16, 22-23, 26-28 passim.	Qualitative	29 OR personnel	n/a	n/a	Barriers to using the ceiling lifts in the OR	The survey results showed that the OR staff felt the ceiling lifts are a practical and effective ergonomic engineering control.	IIIC
143	Hodgson MJ, Matz MW, Nelson A. Patient handling in the Veterans Health Administration: facilitating change in the health care industry. <i>J Occup Environ Med</i> . 2013;55(10):1230-1237.	Organizational Experience	Veterans Health Administration's patient handling program	n/a	n/a	n/a	Program evolution comes from collaborative practice and interactions between individual practitioners, organizational needs and interests, and manufacturers.	VA
144	Waters TR, Nelson A, Proctor C. Patient handling tasks with high risk for musculoskeletal disorders in critical care. <i>Crit Care Nurs Clin North Am</i> . 2007;19(2):131-143.	Literature Review	n/a	n/a	n/a	n/a	No nurse is free from the risk of injury when moving patients. The article describes high-risk patient handling tasks, delineates the physical demands associated with each task, identifies physical demands associated with each task, identifies technological solutions, and outlines safety tips for making each task safer.	VA



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145	McCoskey KL. Ergonomics and patient handling. AAOHN J. 2007;55(11):454-462.	Qualitative	283 nursing personnel	n/a	n/a	Physical symptoms or conditions within the last 12 months, by body part, lost or limited work time, treatments, and perception of etiology	Patient-handling injuries take an unacceptable toll on the health and wellness of the nursing population. Identifying types of transfers performed on specific units assists with prioritization for the types of needed interventions.	IIIB
146	Randall SB, Pories WJ, Pearson A, Drake DJ. Expanded Occupational Safety and Health Administration 300 log as metric for bariatric patient-handling staff injuries. Surg Obes Relat Dis. 2009;5(4):463-468	Nonexperimental	OSHA 300 log bariatric patient handling injuries	n/a	n/a	Type of patient handling activity, job title, lost work days, restricted work days, department	Understanding the increased risk of injury associated with manual bariatric patient handling should help organizations identify deficiencies in their current injury prevention program and allocate resources for safer bariatric patient handling solutions.	IIIB
147	Stucke S, Menzel NN. Ergonomic assessment of a critical care unit. Crit Care Nurs Clin North Am. 2007;19(2):155-165.	Qualitative	Critical care nursing unit	n/a	n/a	High risk tasks in critical care areas	In addition to the risks on all nursing units, the critical care area has additional risks including preponderance of dependent, obese patients; amount of modern technology in an architectural space not designed for it; repetitive tasks, and awkward postures.	IIIC
148	Guideline for medical device and product evaluation. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2018:183-190.	Guideline	n/a	n/a	n/a	n/a	This document provides guidance to perioperative team members for developing and implementing a process for evaluating US Food and Drug Administration cleared medical devices and products for use in the perioperative setting.	IVA
149	Baptiste A. Technology solutions for high-risk tasks in critical care. Crit Care Nurs Clin North Am. 2007;19(2):177-186.	Expert Opinion	n/a	n/a	n/a	n/a	There are safer technology solutions available for high-risk patient handling tasks. Without the technology and processes patient and worker safety are compromised.	VA
150	Baptiste A, Boda SV, Nelson AL, Lloyd JD, Lee WE 3rd. Friction-reducing devices for lateral patient transfers: a clinical evaluation. AAOHN J. 2006;54(4):173-180.	RCT	77/ hospital caregivers including RNs, nurse practitioners, and nursing aides	Use of lateral transfer devices	Control-draw sheet/ compared to 7 other types of devices	Comfort, ease of use, effectiveness in reducing injuries, efficient use of caregiver's time, patient safety	A draw sheet is a poor device for lateral transfer. It is important to use assistive devices to perform lateral transfers. Air-assisted devices were clinically preferred to other types of lateral transfer devices.	IB
151	Lloyd JD, Baptiste A. Friction-reducing devices for lateral patient transfers: a biomechanical evaluation. AAOHN J. 2006;54(3):113-119.	Nonexperimental	11 lateral transfer devices	n/a	Moving a mannequin from bed to stretcher using different types and brands of lateral transfer devices	Spinal forces,% of population capable of task execution, applied force	Although these devices are beneficial during lateral transfer of patients, they do have limitations. When moving bariatric patients mechanical rather than manual devices should be used.	IIIB
152	Bartnik LM, Rice MS. Comparison of caregiver forces required for sliding a patient up in bed using an array of slide sheets. Work. 2013;61(9):393-400.	Nonexperimental	29/healthy volunteers	n/a	n/a	hand forces and compression and shear forces of the lumbar region	The use of assistive technologies (eg, friction-reducing slide sheets) may be part of a safe handling program and key to reducing MSDs in the workplace. Friction-reducing slide sheets produced less internal spinal loads compared to cotton draw sheets.	IIIB
153	Pellino TA, Owen B, Knapp L, Noack J. The evaluation of mechanical devices for lateral transfers on perceived exertion and patient comfort. Orthop Nurs. 2006;25(1):4-12.	Nonexperimental	60 personnel performing 192 transfers	n/a	n/a	Perceived exertion, number of personnel, total transfer time, patient comfort and security	The use of a mechanical device for patient transfer provided lower exertion ratings, used less personnel and time and was more comfortable for the patient. There are barriers to use of mechanical equipment such as resistance to change and retrieving the device.	IIIB

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154	<i>Healthcare Recipient Sling and Lift Hanger Bar Compatibility Guidelines. Tampa, FL: American Association for Safe Patient Handling &amp; Movement; 2016. <a href="http://aasphm.org/wp-content/uploads/AASPHM-Sling-Hanger-Bar-Guidelines-2016.pdf">http://aasphm.org/wp-content/uploads/AASPHM-Sling-Hanger-Bar-Guidelines-2016.pdf</a>. Accessed May 10, 2018.</i>	Guideline	n/a	n/a	n/a	n/a	The guideline provides information and recommendations regarding the compatibility of patient slings and lift hanger bars.	IVB
155	Waters TR, Dick R, Lowe B, Werren D, Parsons K. Ergonomic assessment of floor-based and overhead lifts. <i>Am J Safe Patient Handl Mov.</i> 2012;2(4):119-113.	Nonexperimental	Single female operator performing all the simulated patient handling tasks	n/a	n/a	Operating hand forces and resulting biomechanical spinal loading for overhead mounted lifts versus floor based lifts across various floor surfaces and patient weight conditions.	Floor based lifts exceeded recommended exposure limits for pushing and pulling for may of the floor/weight conditions. The overhead mounted lifts did not.	IIIB
156	Marras WS, Knapik GG, Ferguson S. Lumbar spine forces during manoeuvring of ceiling-based and floor-based patient transfer devices. <i>Ergonomics.</i> 2009;52(3):384-397	Quasi-experimental	10 subjects	Use of patient handling devices	Pushing/ pulling tasks using ceiling-based lift system versus a floor-based lift system	Compression, A/P shear and lateral shear forces occurring at the inferior and superior levels of each intervertebral disc levels between S1 and T12	Ceiling-based patient lift systems have little spine biomechanical loading risk associated with the manipulation of these devices compared to either one- or two-caregiver manual patient handling techniques. Floor-based patient handling systems provide a benefit over manual lifting of patients.	IIB
157	Lee SJ, Faucett J, Gillen M, Krause N. Musculoskeletal pain among critical-care nurses by availability and use of patient lifting equipment: an analysis of cross-sectional survey data. <i>Int J Nurs Stud.</i> 2013;50(12):1648-1657.	Qualitative	361 critical care nurses	n/a	n/a	Low back pain, neck and shoulder pain, lift availability, lift use, physical and psychosocial job factors	Greater availability and use of lifts were associated with less musculoskeletal pain. The findings suggest that for lift interventions to be effective, lifts must be readily available when needed and removal of barriers to using lifts.	IIIB
158	Burdorf A, Koppelaar E, Evanoff B. Assessment of the impact of lifting device use on low back pain and musculoskeletal injury claims among nurses. <i>Occup Environ Med.</i> 2013;70(7):491-497.	Systematic Review	n/a	n/a	n/a	n/a	Implementation of lifting devices is required to reduce low back pain. The health impact assessment may guide program implementation to reduce manual lifting of patients.	IIIA
159	D'Arcy LP, Sasai Y, Stearns SC. Do assistive devices, training, and workload affect injury incidence? Prevention efforts by nursing homes and back injuries among nursing assistants. <i>J Adv Nurs.</i> 2012;68(4):836-845.	Qualitative	2692/ nursing assistants	n/a	n/a	MSDs, use of lifts, training	Availability of lifts and workplace injury prevention training decreased lifting-related injuries.	IIIC
160	Pompeii LA, Lipscomb HJ, Schoenfisch AL, Dement JM. Musculoskeletal injuries resulting from patient handling tasks among hospital workers. <i>Am J Ind Med.</i> 2009;52(7):571-578.	Nonexperimental	19487 healthcare workers	n/a	n/a	Musculoskeletal injuries resulting from patient handling activities	Mechanical lift equipment could significantly reduce the risk of some patient handling injuries. Smaller high risk groups should not be neglected in prevention efforts.	IIIB
161	Weinel D. Successful implementation of ceiling-mounted lift systems. <i>Rehabil Nurs.</i> 2008;33(2):63-66, 87.	Organizational Experience	Spinal cord injury unit	n/a	n/a	n/a	The involvement of bedside nurses during the implementation of the ceiling lifts was vital and resulted in a sense of ownership. This was one of the key driving factors for the successful implementation.	VA
162	Baptiste A, McCleery M, Matz M, Evitt CP. Proper sling selection and application while using patient lifts. <i>Rehabil Nurs.</i> 2008;33(1):22-32.	Expert Opinion	n/a	n/a	n/a	n/a	Desired clinical outcomes are achievable through the integration of the best technology and processes.	VA
163	Guideline for environmental cleaning. In: <i>Guidelines for Perioperative Practice.</i> Denver, CO: AORN, Inc; 2018:7-28.	Guideline	n/a	n/a	n/a	n/a	There is a high risk of pathogen transmission in the perioperative setting due to multiple contacts among patients, perioperative team members, and environmental surfaces. Thorough cleaning and disinfection of perioperative areas is essential to preventing the spread of potentially pathogenic microorganisms.	IVA

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164	Guideline for a safe environment of care, part 1. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2018:243-268.	Guideline	n/a	n/a	n/a	n/a	The guideline provides guidance for providing a safe environment of care related to patients and perioperative personnel and the equipment used in the perioperative environment.	IVA
165	van't Veen A, van der Zee A, Nelson J, Speelberg B, Kluytmans JA, Buiting AG. Outbreak of infection with a multiresistant <i>Klebsiella pneumoniae</i> strain associated with contaminated roll boards in operating rooms. <i>J Clin Microbiol.</i> 2005;43(10):4961-4967.	Nonexperimental	21 ICU patients	n/a	ICU patients positive for multidrug resistant <i>Klebsiella pneumoniae</i> (MRKP) N=7 and unmatched controls of ICU patients N=14	Positive culture of MRKP	Cultures in the OR revealed that the contamination of the roll boards used to transfer patients from the bed to the OR table was with multidrug resistant <i>Klebsiella pneumoniae</i> . Two ORs played a significant role in the transmission of multidrug resistant <i>Klebsiella pneumoniae</i> strain between 7 ICU patients during the outbreak with 4 fatalities.	IIIB
166	Nelson AL, Collins J, Knibbe H, Cookson K, de Castro AB, Whipple KL. Safer patient handling. <i>Nurs Manage.</i> 2007;38(3):26-32.	Expert Opinion	n/a	n/a	n/a	n/a	Safe patient handling policies as part of a comprehensive program resulted in a decreased risk for musculoskeletal injuries for nursing staff particularly back pain.	VA
167	Durham CF. Safe patient handling and movement: time for a culture change. <i>Tar Heel Nurse.</i> 2007;69(4):16-18.	Expert Opinion	n/a	n/a	n/a	n/a	The use of lift devices is a culture change similar to wearing gloves to prevent BBP exposure. Manual transfers are no longer part of the student curriculum. Nursing students are encouraged to only seek employment with minimal lift policies.	VB
168	Clemes SA, Haslam CO, Haslam RA. What constitutes effective manual handling training? A systematic review. <i>Occup Med (Lond).</i> 2010;60(2):101-107.	Literature Review	n/a	n/a	n/a	n/a	Manual handling training is largely ineffective in reducing MSDs. Multidimensional interventions that incorporate exercise training to promote strength and flexibility are needed.	VA
169	Kay K, Glass N, Evans A. It's not about the hoist: a narrative literature review of manual handling in healthcare. <i>J Res Nurs.</i> 2014;19(3):226-245.	Literature Review	n/a	n/a	n/a	n/a	Systematic literature reviews have demonstrated the inadequacy of training to decrease manual handling tasks, especially when used as the primary and sole intervention. More comprehensive strategies to resolve manual handling issues have been identified. Manual handling injuries for nurses persists despite research and technological advancements.	VA
170	Sedlak CA, Doheny MO, Nelson A, Waters TR. Development of the National Association of Orthopaedic Nurses guidance statement on safe patient handling and movement in the orthopaedic setting. <i>Orthop Nurs.</i> 2009;28(2 Suppl):S2-S8.	Organizational Experience	National Association of Orthopedic Nurses (NAON)	n/a	n/a	n/a	A NAON task force developed solutions for the orthopedic tasks with high risk for MSDs based on principles of ergonomics and scientific evidence.	VA
171	Menzel NN, Hughes NL, Waters T, Shores LS, Nelson A. Preventing musculoskeletal disorders in nurses: a safe patient handling curriculum module for nursing schools. <i>Nurse Educ.</i> 2007;32(3):130-135.	Expert Opinion	26 nursing schools	n/a	n/a	n/a	The participating faculty members were able to successfully integrate SPHM into their existing curricula.	VA

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172	Nelson AL, Waters TR, Menzel NN, et al. Effectiveness of an evidence-based curriculum module in nursing schools targeting safe patient handling and movement. <i>Int J Nurs Educ Scholarsh.</i> 2007;4(1):1-19.	Quasi-experimental	29 nursing schools	Faculty training, curriculum materials and instructions on safe patient handling, and evidence-based curriculum modules for the students	Pre/post evaluation of outcomes from an intervention group compared to a control group	Assessment of knowledge, attitudes and beliefs of nurse educators and nursing students about safe patient handling; process evaluation, teaching methods, equipment, level of acceptance, and intention to continue with the new curriculum	This new curriculum module is ready for dissemination to all US nursing schools. Partnerships with state nursing organizations, state nursing student organizations, and state nursing education programs could be used to facilitate implementation by offering "train the trainer" programs at multiple locations.	IIA
173	Collins JW, Bell JL, Grönqvist R. Developing evidence-based interventions to address the leading causes of workers' compensation among healthcare workers. <i>Rehabil Nurs.</i> 2010;35(6):225-261.	Expert Opinion	n/a	n/a	n/a	n/a	Evidence based scientific research demonstrates that multifaceted safety and health initiatives can be effective in reducing injuries associated with patient handling and slips, trips, and falls.	VA
174	Waters TR, Nelson AL, Hughes N, Menzel N. Safe Patient Handling Training for Schools of Nursing: Curricular Materials. Columbus, OH: National Institute for Occupational Safety and Health; 2009. <a href="https://www.cdc.gov/niosh/docs/2009-127/pdfs/2009-127.pdf">https://www.cdc.gov/niosh/docs/2009-127/pdfs/2009-127.pdf</a> . Accessed May 10, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	A comprehensive program to provide education and training o SPHM theory and practical application.	VA
175	State Operations Manual Appendix A—Survey Protocol, Regulations and Interpretive Guidelines for Hospitals. Rev. 151; 2015. Centers for Medicare & Medicaid Services. <a href="https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_a_hospitals.pdf">https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_a_hospitals.pdf</a> . Accessed May 10, 2018.	Regulatory	n/a	n/a	n/a	n/a	n/a	n/a
176	42 CFR 416: Ambulatory surgical services. US Government Publishing Office. <a href="https://www.gpo.gov/fdsys/granule/CFR-2011-title42-vol3/CFR-2011-title42-vol3-part416">https://www.gpo.gov/fdsys/granule/CFR-2011-title42-vol3/CFR-2011-title42-vol3-part416</a> . Accessed May 10, 2018.	Regulatory	n/a	n/a	n/a	n/a	n/a	n/a
177	Price C, Sanderson LV, Talarek DP. Don't pay the price: utilize safe patient handling. <i>Nursing.</i> 2013;43(12):13-15.	Organizational Experience	11000 employee Magnet healthcare system	n/a	n/a	n/a	A health care organization can operate more efficiently when fewer staff members are injured or working in pain. Safe patient movement can improve the quality and safety of patient care which improves patient satisfaction. Job satisfaction also improves when the environment is less stressful.	VB
178	Anderson MP, Carlisle S, Thomson C, et al. Safe moving and handling of patients: an interprofessional approach. <i>Nurs Stand.</i> 2014;28(46):37-41.	Organizational Experience	Student nurses, medical students and physiotherapy students	n/a	n/a	n/a	Interprofessional e-learning resource for safe moving and handling of patients addressed a gap in the medical students' curriculum and also met a learning need for undergraduates in nursing and physiotherapy.	VA
179	Juibari L, Sanagu A, Farrokhi N. The relationship between knowledge of ergonomic science and the occupational health among nursing staff affiliated to Golestan University of Medical Sciences. <i>Iran J Nurs Midwifery Res.</i> 2010;15(4):185-189.	Qualitative	423 nurses	n/a	n/a	Knowledge of ergonomics and occupational health	A significant number of nursing personnel suffered from a mild level of occupational injuries and MSD symptoms.	IIA

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
180	Theis JL, Finkelstein MJ. Long-term effects of safe patient handling program on staff injuries. <i>Rehabil Nurs.</i> 2014;39(1):26-35.	Quasi-experimental	55 health care workers	Safe patient handling program	Number of injuries before and after the introduction of the program	Health care worker injury	The number of injuries were significantly reduced after training compared to baseline. The reductions were not sustained long term. The cost benefit of \$3.71 for every dollar invested in retraining based on injury reduction was realized during the post training period.	IIB
181	Paul A. A pilot study on awareness of ergonomics and prevalence of musculoskeletal injuries among nursing professionals. <i>Int J Nurs Educ.</i> 2012;4(1):1-4.	Qualitative	34 nurses	n/a	n/a	Awareness of ergonomics and safety measures, and prevalence of musculoskeletal injuries	The physical performance of nurses can be improved with awareness and training on ergonomics, safety measures, patient lifting and transfer techniques starting in the nursing school curriculum.	IIIC
182	Lemo A, Silva AG, Tucheran M, Talerman C, Guastelli RL, e Borba CL. Risk reduction in musculoskeletal practice assistance professional nursing pilot in semi intensive care unit. <i>Work.</i> 2012;41(Suppl 1):1869-1872.	Qualitative	71 caregivers	n/a	n/a	Activities that caused pain included patient transfer, changing positions in bed, bath or shower	A program of physical activity associated with a practical training on the mobilization and transfer of patients and ergonomic actions in the work process can reduce the number of days away from work related to MSDs.	IIIC
183	Resnick ML, Sanchez R. Reducing patient handling injuries through contextual training. <i>J Emerg Nurs.</i> 2009;35(6):504-508.	Quasi-experimental	16 nurses	Training protocols	4 different training protocols	Trunk flexion and rotation, and task analysis	Training participants on the proper use of body mechanics, friction-reducing sheets and risk-minimizing methods significantly improved torso postures and increased compliance with safe lifting practices	IIC
184	Tompa E, Dolinschi R, Alamgir H, Sarnocinska-Hart A, Guzman J. A cost-benefit analysis of peer coaching for overhead lift use in the long-term care sector in Canada. <i>Occup Environ Med.</i> 2016;73(5):308-314.	Quasi-experimental	15 long-term care facilities	Introduction of a peer coaching program to use overhead ceiling lifts	Patient handling injuries before and after introduction of peer coaching	Injury rate and benefit-to-cost ratio	Implementing a peer-coaching program to increase the effective use of overhead lifts prevented additional patient handling injuries but added modest incremental costs.	IIB
185	Knibbe HJ, Knibbe NE, Klaassen AJ. Safe patient handling program in critical care using peer leaders: lessons learned in the Netherlands. <i>Crit Care Nurs Clin North Am.</i> 2007;19(2):205-211.	Qualitative	4129 hospital nurses	n/a	n/a	Prevalence of MSDs	There are large differences in the prevalence of MSDs between different specialties in a hospital. Surgery, CCU, ICU, ER, cardiology, orthopedics and neurology reported a higher prevalence of MSDs.	IIIB
186	Knibbe H, Knibbe NE, Klaassen A. Ergocoaches: peer leaders promoting ergonomic changes—exploring their profile and effect. <i>Am J Safe Patient Handl Mov.</i> 2012;2(3):93-99.	Literature Review	5662 ErgoCoaches	n/a	n/a	Effectiveness of ErgoCoaches	Significant and positive influence of ErgoCoaches are important drivers or stimuli behind the implementation of safe patient handling guidelines and ergonomic changes.	VA
187	Haney LL, Wright L. Sustaining staff nurse support for a patient care ergonomics program in critical care. <i>Crit Care Nurs Clin North Am.</i> 2007;19(2):197-204.	Expert Opinion	n/a	n/a	n/a	n/a	Sustainable patient handling change requires a change in beliefs about the value of SPHM tasks and the importance of protecting the patient and the caregiver.	VB
188	Uğurlu Z, Karahan A, Ünlü H, et al. The effects of workload and working conditions on operating room nurses and technicians. <i>Workplace Health Saf.</i> 2015;63(9):399-407.	Qualitative	74 OR nurses and technicians	n/a	n/a	Effects of working conditions in the OR, time required to complete work, work intensity, and perception of individuals of their workloads.	20.3% of the participants reported falling in the OR due to slippery floors, tripping over cables, etc. Over 63% stated they had previously had lumbar pain in the last year and 36.5% at the time of the study. Contributing factors included standing for long periods of time, lifting patients and heavy equipment, working in same position of long periods, and heavy workloads.	IIIB
189	Drysdale S. The incidence of upper extremity injuries in Canadian endoscopy nurses. <i>Gastroenterol Nurs.</i> 2011;34(1):26-33.	Nonexperimental	147 endoscopy nurses	n/a	n/a	Prevalence of upper extremity injuries	32% of the nurses in this study missed work because of upper extremity pain representing a significant number of sick days. This is a cause for concern, exploration, and prevention measures.	IIIB

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190	Drysdale SA. The incidence of upper extremity injuries in endoscopy nurses. <i>Gastroenterol Nurs.</i> 2007;30(3):187-192.	Qualitative	38/ endoscopy nurses	n/a	n/a	Upper extremity disability and symptoms	Upper extremity disability does occur among endoscopy nurses. Full-time nurses are at the highest risk of injury in this practice setting. It is important to implement ergonomic solutions in this practice area.	IIIC
191	Drysdale SA. The incidence of upper extremity injuries in endoscopy nurses working in the United States. <i>Gastroenterol Nurs.</i> 2013;36(5):329-338.	Nonexperimental	215 / endoscopy nurses	n/a	n/a	Incidence of upper extremity injuries, factors in the workplace associated with increased risk, and risk of certain subgroups	Numerous factors interact to increase the incidence of musculoskeletal injuries in nurses. 22% of the respondents missed work due to an upper extremity injury. Research is needed on stress-reduction techniques and their effect on the healthcare team.	IIIB
192	Drysdale SA. The incidence of neck and back injuries in endoscopy nurses working in the United States of America. <i>Gastroenterol Nurs.</i> 2014;37(2):187-188.	Expert Opinion	n/a	n/a	n/a	n/a	Additional information reported on the published 2013 study. Findings included significant higher scores associated with moving heavy patients and missing work for upper extremity and back symptoms.	VA
193	Choobineh A, Movahed M, Tabatabaie SH, Kumashiro M. Perceived demands and musculoskeletal disorders in operating room nurses of Shiraz city hospitals. <i>Ind Health.</i> 2010;48(1):74-84.	Qualitative	375/ OR nurses	n/a	n/a	MSDs and perceived job demands	The OR is physically and psychologically demanding. Any intervention program for prevention or reduction of MSDs should focus on reducing the physical demands and consider the psychological aspects of the work environment.	IIIB
194	Sienkiewicz Z, Paszek T, Wronska I. Strain on the spine—professional threat to nurses' health. <i>Adv Med Sci.</i> 2007;52(Suppl 1):131-135.	Qualitative	937 nurses	n/a	n/a	Tiresome tasks (eg, patient lifting, object lifting, nursing tasks, operational tasks), MSDs, reasons	Health problems related to lower back pain were reported by 61% of respondents. Strain on the spine is a serious issue creating health problems that decrease work quality.	IIIB
195	Murty M. Musculoskeletal disorders in endoscopy nursing. <i>Gastroenterol Nurs.</i> 2010;33(5):354-361.	Qualitative	12 endoscopy nurses	n/a	n/a	Nurses' perceived risk factors (eg, static postures, repetition) leading to MSDs	The parts of the body most exposed to high or very high risk exposure are the neck and back. Duration of exposure is the most influential factor in exposure levels. There are moderating factors that influence the development of MSDs.	IIIC
196	Vural F, Sutsunbuloglu E. Ergonomics: an important factor in the operating room. <i>J Perioper Pract.</i> 2016;26(7):174-178.	Expert Opinion	n/a	n/a	n/a	n/a	There is little research regarding MSDs among OR personnel. Additional research is needed to identify strategies to alleviate MSDs in operating room nurses.	VA
197	Sheikhzadeh A, Gore C, Zuckerman JD, Nordin M. Perioperating nurses and technicians' perceptions of ergonomic risk factors in the surgical environment. <i>Appl Ergon.</i> 2009;40(5):833-839.	Qualitative	50 perioperative nurses and technicians	n/a	n/a	Results of a musculoskeletal symptom survey, job description questionnaire, psychometric evaluation questionnaire, and focus group findings	There is a high prevalence of work-related MSDs among OR personnel with lower back pain the most prevalent at 84% followed by ankle/foot at 74% and shoulder at 74%.	IIIB
198	Waters T, Baptiste A, Short M, Plante-Mallon L, Nelson A. AORN Ergonomic Tool 1: Lateral transfer of a patient from a stretcher to an OR bed. <i>AORN J.</i> 2011;93(3):334-339.	Expert Opinion	n/a	n/a	n/a	n/a	Lateral transfer of a surgical patient from a stretcher to the OR bed is a frequently performed task that presents risk factors for development of MSDs particularly lower back and shoulder injuries.	VA

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199	Waters TR, Putz-Anderson V, Garg A. Applications Manual for the Revised NIOSH Lifting Equation. Cincinnati, OH: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Division of Biomedical and Behavioral Science; 1994. <a href="https://www.cdc.gov/niosh/docs/94-110/pdfs/94-110.pdf">https://www.cdc.gov/niosh/docs/94-110/pdfs/94-110.pdf</a> . Accessed May 10, 2018.	Literature Review	n/a	n/a	n/a	n/a	The Revised NIOSH Lifting Equation was designed to assist in the identification of ergonomic solutions for reducing physical stresses associated with manual handling.	VA
200	Waters TR. When is it safe to manually lift a patient? Am J Nurs. 2007;107(8):53-58.	Expert Opinion	n/a	n/a	n/a	n/a	Lifting is complex; no single factor can define a safe lift.	VA
201	Tarr ME, Brancato SJ, Cunkelman JA, Polcari A, Nutter B, Kenton K. Comparison of postural ergonomics between laparoscopic and robotic sacrocolpopexy: a pilot study. J Minim Invasive Gynecol. 2015;22(2):234-238.	Qualitative	16 surgeons performing 86 robotic and laparoscopic surgeries.	n/a	n/a	Musculoskeletal discomfort and mental strain	Surgeons performing minimally invasive sacrocolpopexy experienced less neck, shoulder and back discomfort when performed robotically.	IIIB
202	Lawson EH, Curet MJ, Sanchez BR, Schuster R, Berguer R. Postural ergonomics during robotic and laparoscopic gastric bypass surgery: a pilot project. J Robot Surg. 2007;1(1):61-67.	Quasi-experimental	1 minimally invasive surgery fellow performing 4 laparoscopic and 4 robotic Roux-en-Y gastric bypass procedures	Roux-en-Y gastric bypass procedures	laparoscopic versus robotic Roux-en-Y gastric bypass procedures	Musculoskeletal discomfort and ergonomic positioning	In this pilot study the data suggests that the robotic Roux-en-Y gastric bypass procedure results in less musculoskeletal stress to the upper back and possibly the upper extremities than standard laparoscopic techniques	IIA
203	Saglam R, Muslumanoglu AY, Tokatli Z, et al. A new robot for flexible ureteroscopy: development and early clinical results (IDEAL stage 1-2b). Eur Urol. 2014;66(6):1092-1100.	Nonexperimental	7 surgeons treating 81 patients	n/a	n/a	Discomfort of the operator during robot assisted surgery, maneuverability, treatment time, fragmentation time, complications	The robot provided significant improvement of ergonomics.	IIIC
204	Tung KD, Shorti RM, Downey EC, Bloswick DS, Merryweather AS. The effect of ergonomic laparoscopic tool handle design on performance and efficiency. Surg Endosc. 2015;29(9):2500-2505.	Quasi-experimental	23 medical students	Surgical evaluation tasks	Traditional pinch grip handle laparoscopic instrument versus pistol grip handle laparoscopic instrument	Difficulty, discomfort, exertion, awkwardness, perceived performance, time to task completion,	Participants indicated a preference for the pistol grip handle. Due to the high degree of variability in the error data, it was not possible to draw any meaningful conclusions about the effect of tool design on the number or degree of errors made.	IIB
205	Manukyan GA, Waseda M, Inaki N, et al. Ergonomics with the use of curved versus straight laparoscopic graspers during rectosigmoid resection: results of a multiprofile comparative study. Surg Endosc. 2007;21(7):1079-1089.	Quasi-experimental	30 experimental laparoscopic sigmoid resections by one surgeon, 5 clinical laparoscopic sigmoid resections by one surgeon	Use of curved and straight laparoscopic graspers	Curved grasper in excentral trocar position, straight forceps in excentral trocar position, straight grasper in central position	EMG measurement of 5 muscles in the left upper extremity, three-dimensional motion analysis of the area of grasper movement, simultaneous observation of the left upper extremity from 3 overview positions, ergonomic questionnaire responses	The combination of the curved grasper and the excentral trocar position in relation to the telescope trocar is the best ergonomic adjustment for laparoscopic recto sigmoid surgery.	IIB
206	Long JA, Tostain J, Lanchon C, et al. First clinical experience in urologic surgery with a novel robotic lightweight laparoscope holder. J Endourol. 2013;27(1):58-63.	Qualitative	20 urologic laparoscopic robotic surgery patients	Robotic endoscope holder	n/a	Overall set-up time, operative time, number of assistants, post-operative outcomes	The use of the robotic laparoscope holder is safe and feasible with the surgeon's complete autonomy over camera control.	IIIC

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207	Büchel D, Mårvik R, Hallabrin B, Matern U. Ergonomics of disposable handles for minimally invasive surgery. <i>Surg Endosc.</i> 2010;24(5):992-1004.	Nonexperimental	25 volunteers/ surgeons, medical students, ergonomists	n/a	n/a	Effectiveness, efficiency, and satisfaction of laparoscopic handles	None of the handles could fulfill all of the requirements. Each handle had advantages and disadvantages.	IIIB
208	Dorion D, Darveau S. Do micropauses prevent surgeon's fatigue and loss of accuracy associated with prolonged surgery? An experimental prospective study. <i>Ann Surg.</i> 2013;257(2):256-259.	Quasi-experimental	16/ surgeons	Micropauses	Muscular fatigue before the start of an operation, after a prolonged reproducible operation of 2 hours with and without micropauses	Muscle fatigue and loss of accuracy	Micropauses of 20 seconds every 20 minutes significantly improved strength, precision, and fatigue associated with operations over 2 hours. The micropauses improved surgeon comfort and potentially in the long term chronic pain and disability.	IIB
209	Fan Y, Kong G, Meng Y, et al. Comparative assessment of surgeons' task performance and surgical ergonomics associated with conventional and modified flank positions: a simulation study. <i>Surg Endosc.</i> 2014;28(11):3249-3256.	Quasi-experimental	21 novice surgeons	Modified position of 30 degrees with respect to the long axis of the surgical desk to perform four simulation tasks.	Conventional versus a modified position	Task performance and surgical ergonomics	Conventional positioning of patients for retroperitoneoscopic upper urinary tract surgery is associated with poor body alignment and asymmetrical posture in surgeons. During simulation using a modified patient position of 30 degrees forward, task performance and surgical ergonomics were improved. Further studies are needed.	IIB
210	Albayrak A, Van Veelen MA, Prins JF, Snijders CJ, De Ridder H, Kazemier G. A newly designed ergonomic body support for surgeons. <i>Surg Endosc.</i> 2007;21(10):1835-1840.	Nonexperimental	7 surgeons	n/a	n/a	Comfort, ease of use, muscle activity	Concept design of supporting the body is an effective way to reduce muscle activity with the potential to reduce physical problems and discomfort over the long term. The device can be used in open and minimally invasive procedures.	IIIC
211	van Det MJ, Meijerink WJ, Hoff C, Totté ER, Pierie JP. Optimal ergonomics for laparoscopic surgery in minimally invasive surgery suites: a review and guidelines. <i>Surg Endosc.</i> 2009;23(6):1279-1285.	Literature Review	n/a	n/a	n/a	n/a	Monitor position is an important ergonomic factor during minimally invasive surgery, Guidance is provided for exact placement of the monitors.	VA
212	Szeto GP, Ho P, Ting AC, Poon JT, Tsang RC, Cheng SW. A study of surgeons' postural muscle activity during open, laparoscopic, and endovascular surgery. <i>Surg Endosc.</i> 2010;24(7):1712-1721.	Nonexperimental	25 surgeons	n/a	Surface electromyography of cervical erector spinae, upper trapezius, anterior deltoid muscles	Muscle activities of cervical erector spinae, upper trapezius, anterior deltoid muscles during endovascular, laparoscopic and open surgery procedures.	Open surgery imposed significantly greater physical demands on the neck muscles compared to endovascular or laparoscopic surgeries. Open surgery may require more dynamic movements and more forceful exertions.	IIIB
213	Prielipp RC, Weinkauff JL, Esser TM, Thomas BJ, Warner MA. Falls from the OR or procedure table. <i>Anesth Analg.</i> 2017;125(3):846-851.	Case Report	n/a	n/a	n/a	n/a	The goal of the review and mini case reports was to inform anesthesia and perioperative personnel about the common patient, provider, and environmental risk factors that may contribute to falls and to suggest strategies to minimize the risks.	VA
214	Chaffin DB, Andersson GBJ, Martin BJ. Chapter 3: Anthropometry in occupational biomechanics. In: <i>Occupational Biomechanics</i> . 3rd ed. Hoboken, NJ: Wiley; 1999:73.	Expert Opinion	n/a	n/a	n/a	n/a	A sound understanding and application of biomechanical principles is important for both prevention of musculoskeletal injuries and improvement in manual working conditions and worker performance.	VA
215	Chaffin DB, Andersson GBJ, Martin BJ. Chapter 2: The structure and function of the musculoskeletal system. In: <i>Occupational Biomechanics</i> . 4th ed. Hoboken, NJ: Wiley; 2006:27.	Expert Opinion	n/a	n/a	n/a	n/a	A sound understanding and application of biomechanical principles is important for both prevention of musculoskeletal injuries and improvement in manual working conditions and worker performance.	VA



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216	Snook SH, Ciriello VM. The design of manual handling tasks: revised tables of maximum acceptable weights and forces. <i>Ergonomics</i> . 1991;34(9):1197-1213.	Nonexperimental	12 female and 10 male industrial workers performing 51 variations of lifting, lowering, pushing, pulling, and carrying tasks	n/a	n/a	Heart rate, oxygen consumption, anthropometric characteristics	The results of the four experiments were integrated with the results of seven similar experiments published previously by this lab. The integrated data were used to revise the maximum acceptable weights and forces published in 1978.	IIIB
217	Cherry C, Moss J. Best practices for preventing hospital-acquired pressure injuries in surgical patients. <i>Can Oper Room Nurs J</i> . 2011;29(1):6-8, 22-26.	Expert Opinion	n/a	n/a	n/a	n/a	All surgical patients should be considered at risk for pressure injury development. A comprehensive approach is essential to prevent perioperative pressure injuries	VB
218	Fleisch MC, Bremerich D, Schulte-Mattler W, et al. The prevention of positioning injuries during gynecologic operations. Guideline of DGGG (S1-Level, AWMF Registry No. 015/077, February 2015). <i>Geburtshilfe Frauenheilkd</i> . 2015;75(8):792-807.	Guideline	n/a	n/a	n/a	n/a	Guideline provides direction for properly positioning gynecologic patients.	IVB
219	Chaffin DB, Andersson GBJ, Martin BJ. Chapter 4: Mechanical work capacity evaluation. In: <i>Occupational Biomechanics</i> . 4th ed. Hoboken, NJ: Wiley; 2006:65.	Expert Opinion	n/a	n/a	n/a	n/a	A sound understanding and application of biomechanical principles is important for both prevention of musculoskeletal injuries and improvement in manual working conditions and worker performance.	VA
220	Asiedu GB, Lowndes BR, Huddleston PM, Hallbeck S. "The Jackson table is a pain in the . . .": a qualitative study of providers' perception toward a spinal surgery table. <i>J Patient Saf</i> . January 7, 2016. [Epub ahead of print].	Qualitative	43 surgical staff members	n/a	n/a	Safety of spinal positioning/ repositioning for the staff and patient	Providers recommended best practices for using the Jackson table achieved through standardized practice of patient transfer, educational tools, and checklists for equipment before patient transfer and positioning. The research identified important practice opportunities for improving provider and patient safety in spine surgery.	IIIB
221	Waters T, Short M, Lloyd J, et al. AORN Ergonomic Tool 2: Positioning and repositioning the supine patient on the OR bed. <i>AORN J</i> . 2011;93(4):445-449.	Expert Opinion	n/a	n/a	n/a	n/a	The extended reach and excessive weight lifted during patient positioning require the use of large muscle forces. These forces are large enough to cause damage to the spinal tissues, which could result in severe low-back or shoulder pain and lead to permanent disability.	VA
222	Waters T, Spera P, Petersen C, Nelson A, Hernandez E, Applegarth S. AORN Ergonomic Tool 3: Lifting and holding the patient's legs, arms, and head while prepping. <i>AORN J</i> . 2011;93(5):589-592.	Expert Opinion	n/a	n/a	n/a	n/a	Prepping patient limbs often require the person performing the prep to lift and hold the body part for prolonged periods.	VA
223	Waters TR, Sedlak CA, Howe CM, et al. Recommended weight limits for lifting and holding limbs in the orthopaedic practice setting. <i>Orthop Nurs</i> . 2009;28(2 Suppl):S28-S35.	Expert Opinion	n/a	n/a	n/a	n/a	The orthopedic clinical tool provides guidance based on the patient's weight. Additional caregivers or use of assistive technology is recommended when manual handling is unacceptable.	VA
224	Mulligan A, Young LS, Randall S, et al. Best practices for perioperative nursing care for weight loss surgery patients. <i>Obes Res</i> . 2005;13(2):267-273.	Systematic Review	n/a	n/a	n/a	n/a	Details the unique nursing responsibilities involved in care of the severely obese weight loss patient and provides guidance for the safest possible patient care that promotes the patient's physical and emotional well-being.	IIIB
225	Hughes NL, Nelson A, Matz MW, Lloyd J. AORN Ergonomic Tool 4: Solutions for prolonged standing in perioperative settings. <i>AORN J</i> . 2011;93(6):767-774.	Expert Opinion	n/a	n/a	n/a	n/a	Solutions are provided for alleviating MSDs associated with prolonged standing in the OR.	VA

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226	Abdollahzade F, Mohammadi F, Dianat I, Asghari E, Asghari-Jafarabadi M, Sokhanvar Z. Working posture and its predictors in hospital operating room nurses. Health Promot Perspect. 2016;6(1):17-22.	Nonexperimental	147 OR nurse	n/a	n/a	Working body postures using the Rapid Entire Body Assessment(REBA) method	The overall REBA score among the studied nurses was 7.7 which is relatively high and indicates abnormal working posture. The nurses are at the high risk level and needed urgent change in their working posture.	IIIA
227	Messing K, Tissot F, Stock S. Distal lower-extremity pain and work postures in the Quebec population. Am J Public Health. 2008;98(4):705-713.	Qualitative	30386- interviewer administered surveys; 20776- self-administered surveys	n/a	n/a	MSDs, work postures, handling heavy loads, repetitive hand and arm movements, and exposure to whole-body vibration, work-related psychological demands, decision latitude	Standing at work without the freedom to sit down at will is strongly associated with pain in the lower leg or calf.	IIIB
228	Waters TR, Dick RB. Evidence of health risks associated with prolonged standing at work and intervention effectiveness. Rehabil Nurs. 2015;40(3):148-165.	Literature Review	n/a	n/a	n/a	n/a	Use of interventions and following suggested guidelines on hours of standing from governmental and professional organizations should reduce the health risks of prolonged standing.	VA
229	Kaya OI, Moran M, Ozkardes AB, Taskin EY, Seker GE, Ozmen MM. Ergonomic problems encountered by the surgical team during video endoscopic surgery. Surg Laparosc Endosc Percutan Tech. 2008;18(1):40-44.	Qualitative	82, multidisciplinary surgical team members performing video endoscopic surgery	n/a	n/a	MSDs	The problems encountered by the surgical team during endoscopic surgery and the insufficient ergonomics of the OR affect the productivity of the team and the safety and efficiency of the surgery. Redesigning the instruments and the OR is needed.	IIIB
230	Szeto GP, Cheng SW, Poon JT, Ting AC, Tsang RC, Ho P. Surgeons' static posture and movement repetitions in open and laparoscopic surgery. J Surg Res. 2012;172(1):e19-e31.	Nonexperimental	14 surgeons	n/a	n/a	real time movements of the cervical spine and shoulder joints	There are long durations of static postures in laparoscopic surgery which are closely associated with low-level muscle tension leading to an increased risk of development of MSDs.	IIIC
231	Supe AN, Kulkarni GV, Supe PA. Ergonomics in laparoscopic surgery. J Minim Access Surg. 2010;6(2):31-36.	Expert Opinion	n/a	n/a	n/a	n/a	While laparoscopic surgery is less painful for the patient, it is more demanding for the surgeon. The technological complexity and poorly adapted equipment leads to complaints of surgeon fatigue and discomfort during laparoscopic surgery.	VA
232	Meijssen P, Knibbe HJ. Prolonged standing in the OR: A Dutch research study. AORN J. 2007;86(3):399-414.	Qualitative	225 operating room personnel	n/a	n/a	Uninterrupted standing time and total standing time per day	A reduction in the strain caused by prolonged standing is the most effective way to prevent occupational health problems. Taking "microbreaks" to relax or move and job duty rotation could help reduce excessive physical stress.	IIIB
233	Reddy PP, Reddy TP, Roig-Francoli J, et al. The impact of the Alexander technique on improving posture and surgical ergonomics during minimally invasive surgery: pilot study. J Urol. 2011;186(4 Suppl):1658-1662.	Quasi-experimental	7 urology surgery residents	Alexander technique instruction/ intervention	Subjects served as their own controls-pre- and post-intervention	Posture and laparoscopic skills	Alexander technique training program resulted in a significant improvement in posture. Improved surgical ergonomics, endurance, and posture decrease surgical fatigue and the incidence of repetitive stress injuries to laparoscopic surgeons.	IIIC
234	Seagull FJ. Disparities between industrial and surgical ergonomics. Work. 2012;41:4669-4672.	Literature Review	n/a	n/a	n/a	n/a	Disparities exist between accepted industrial ergonomic principles and surgical ergonomics. Examples include poor surgical handle design, awkward and stressful postures, prolonged standing without breaks and anti-fatigue mats.	VA
235	Hullfish KL, Trowbridge ER, Bodine G. Ergonomics and gynecologic surgery: "Surgeon protect thyself." J Pelvic Med Surg. 2009;15(6):435-439.	Expert Opinion	n/a	n/a	n/a	n/a	The authors present strategies to improve the ergonomic environment of the OR to reduce fatigue and injury.	VA

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
236	Papp A, Feussner H, Seitz T, et al. Ergonomic evaluation of the scrub nurse's posture at different monitor positions during laparoscopic cholecystectomy. <i>Surg Laparosc Endosc Percutan Tech.</i> 2009;19(2):165-169.	Nonexperimental	10 video recordings of scrub nurses	n/a	n/a	Dynamic and static postures during different monitor placements	Static stress can be decreased with the placement of an additional monitor for the scrub nurse's viewing.	IIIC
237	Choi SD. A review of the ergonomic issues in the laparoscopic operating room. <i>J Healthc Eng.</i> 2012;3(4):587-603.	Literature Review	n/a	n/a	n/a	n/a	Laparoscopic OR staff (surgeons, nurses, technicians) frequently experience physical and mental ergonomic risks while working in static and awkward body positions.	VA
238	Meijssen P, Knibbe HJJ. Work-related musculoskeletal disorders of perioperative personnel in the Netherlands. <i>AORN J.</i> 2007;86(2):193-208.	Qualitative	463 operating room personnel	n/a	n/a	Musculoskeletal symptoms	More attention is needed to the physical working conditions of perioperative personnel.	IIIB
239	Haramis G, Rosales JC, Palacios JM, et al. Prospective randomized evaluation of FOOT gel pads for operating room staff COMFORT during laparoscopic renal surgery. <i>Urology.</i> 2010;76(6):1405-1408.	RCT	100 laparoscopic renal procedures/18 subjects (OR team)	Use of a gel floor mat	No gel floor mat compared to the use of the gel mat	Foot discomfort/pain, knee discomfort/pain, back discomfort/pain, number of breaks, number of breaks, level of energy	The use of a foot gel pad during laparoscopic renal surgery provides a simple and effective way to reduce surgical staff discomfort.	IC
240	Harper Z. It's hard work being tall. <i>Surg Technol.</i> 2013;45(2):64-65.	Expert Opinion	n/a	n/a	n/a	n/a	Interrupting the process of stiff or static postures often can relieve neck stiffness by doing shoulder rolls and chin tucks.	VC
241	Manasnayakorn S, Cuschieri A, Hanna GB. Ergonomic assessment of optimum operating table height for hand-assisted laparoscopic surgery. <i>Surg Endosc.</i> 2009;23(4):783-789.	Quasi-experimental	10 surgeons	Adjustment of table height	Elbow level, 10 cm above, 15 cm above, 10 cm below, 5 cm below, 5 cm above	Execution times, placement error scores (mm), leakage pressure(mmHg), number of execution errors, muscle workload, back discomfort	The optimal table height for hand-assisted laparoscopic surgery allows the working surface to be at or 5cm above the elbow level	IIIB
242	Park JY, Kim KH, Kuh SU, Chin DK, Kim KS, Cho YE. Spine surgeon's kinematics during discectomy according to operating table height and the methods to visualize the surgical field. <i>Eur Spine J.</i> 2012;21(12):2704-2712.	Nonexperimental	12 experienced spine surgeons	n/a	3 different table heights and 3 different visualization methods (eg, loupe)	Whole spine angles	Use of loupes and a table height midway between the umbilicus and sternum are optimal for reducing surgeon musculoskeletal fatigue.	IIIB
243	Soueid A, Oudit D, Thiagarajah S, Laitung G. The pain of surgery: pain experienced by surgeons while operating. <i>Int J Surg.</i> 2010;8(2):118-120.	Qualitative	77 surgeons	n/a	n/a	Pain experienced while operating	The back and neck were the most common areas of pain, followed by the hand. Causes were attributed to table height, microscope use, and standing.	IIIB
244	Marcos P, Seitz T, Bubbs H, Wichert A, Feussner H. Computer simulation for ergonomic improvements in laparoscopic surgery. <i>Appl Ergon.</i> 2006;37(3):251-258.	Nonexperimental	3 D human models for a male surgeon, male assistant, and female scrub nurse	n/a	n/a	Most comfortable positions for image displays for the surgeon, nurse, and assistant, distance between the image display and the observers, height of image display, OR table and Mayo stand	The results of this study should be useful for the development of team adapted, user friendly integrated OR suites	IIIB
245	Matern U. Ergonomic deficiencies in the operating room: examples from minimally invasive surgery. <i>Work.</i> 2009;33(2):165-168.	Expert Opinion	n/a	n/a	n/a	n/a	Ergonomic issues in the OR for MIS include monitor placement, OR table height, instrument design, and body postures	VA
246	Zehetner J, Kaltenbacher A, Wayand W, Shamiyeh A. Screen height as an ergonomic factor in laparoscopic surgery. <i>Surg Endosc.</i> 2006;20(1):139-141.	Nonexperimental	8 Surgeons	n/a	Monitor screen height at 185cm versus 120 cm	Inclination/reclination angle of the cervical spine when using laparoscopy towers	Monitors on laparoscopic towers should be adapted to the surgeon's preferred screen height; at eye level frontally with a neutral or slight inclination of the cervical spine.	IIIC
247	Reijnen MM, Zeebregts CJ, Meijerink WJ. Future of operating rooms. <i>Surg Technol Int.</i> 2005;14:21-27	Expert Opinion	n/a	n/a	n/a	n/a	Future design of ORs will improve ergonomics with the use of moveable arms and monitors.	VB

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248	Liang B, Qi L, Yang J, et al. Ergonomic status of laparoscopic urologic surgery: survey results from 241 urologic surgeons in China. <i>PLoS ONE</i> . 2013;8(7).	Qualitative	300 laparoscopic surgeons	n/a	n/a	Operating table height, monitor placement, foot pedal use, body support, musculoskeletal symptoms, awareness of ergonomic guidelines	Most of the laparoscopic surgeons were unaware of ergonomic guidelines for the OR. They have been experiencing discomfort caused by ergonomic issues.	IIIB
249	Berguer R. Surgery and ergonomics. <i>Arch Surg</i> . 1999;134(9):1011-1013.	Expert Opinion	n/a	n/a	n/a	n/a	Overview of ergonomic issues relevant to the OR environment.	VA
250	Wauben LS, van Veelen MA, Gossot D, Goossens RH. Application of ergonomic guidelines during minimally invasive surgery: a questionnaire survey of 284 surgeons. <i>Surg Endosc</i> . 2006;20(8):1268-1274	Qualitative	284 endoscopic surgeons	n/a	n/a	MSDs and awareness of ergonomic guidelines	Almost 80% reported discomfort in the neck, shoulders, and back. 89% were unaware of ergonomic guidelines. The lack of ergonomic awareness is a major problem.	IIIB
251	Glickson J. Surgeons experience more ergonomic stress in the OR. <i>Bull Am Coll Surg</i> . 2012;97(4):20-26.	Expert Opinion	n/a	n/a	n/a	n/a	Surgeons are facing an ergonomic crisis.	VB
252	Fingerhut A, Chouillard E. Ergonomic and technical aspects of laparoscopy for trauma and nontrauma emergencies. <i>Eur Surg</i> . 2005;37(1):8-14.	Literature Review	n/a	n/a	n/a	n/a	High-tech equipment and procedures have modified the needs for the OR set-up. Emergency laparoscopic procedures must use ergonomic principles.	VA
253	Guideline for minimally invasive surgery. In: <i>Guidelines for Perioperative Practice</i> . Denver, CO: AORN, Inc; 2016:589-616.	Guideline	n/a	n/a	n/a	n/a	This document provides guidance for improving perioperative team communication through a culture of safety that incorporates team training, simulation training, standardized transfer of patient information (commonly referred to as hand overs or hand offs), briefings, time outs, surgical safety checklists, and debriefings.	IVA
254	van Det MJ, Meijerink WJ, Hoff C, van Veelen MA, Pierie JP. Ergonomic assessment of neck posture in the minimally invasive surgery suite during laparoscopic cholecystectomy. <i>Surg Endosc</i> . 2008;22(11):2421-2427.	Quasi-experimental	16 surgeons, assistants, and scrub nurses	Intraoperative video analysis of the cervical spine	Evaluation and comparison of neck posture in relation to monitor position in a dedicated minimally invasive (MIS) OR suite compared to a conventional OR	Flexion and rotation of the cervical spine, posture in relation to the monitor position	Neck rotation was significantly reduced in the MIS suite for the surgeon and assistant. Neck flexion was significantly improved in the MIS suite for the surgeon and scrub nurse. There were fewer musculoskeletal complaints from the OR team in the MIS suite. Ergonomic quality of neck posture is significantly improved in the MIS suite.	IIC
255	Spera P, Lloyd JD, Hernandez E, et al. AORN Ergonomic Tool 5: Tissue retraction in the perioperative setting. <i>AORN J</i> . 2011;94(1):54-58.	Expert Opinion	n/a	n/a	n/a	n/a	Manual retraction poses a high risk for MSDs including strain, discomfort, and fatigue. This type of retraction requires prolonged standing, torso flexion, neck flexion, and holding the arms above optimal working height for prolonged periods of time.	VA
256	Kim FJ, Sehr DE, Molina WR, Huh JS, Rassweiler J, Turner C. Initial experience of a novel ergonomic surgical chair for laparoscopic pelvic surgery. <i>Int Braz J Urol</i> . 2011;37(4):455-460.	Qualitative	14 (7 surgeons/ 7 assistants)	Use of an ergonomic surgical chair	Positional stresses of the standing assistants versus the sitting surgeons	Conversion to open procedures; stress on back and upper extremities.	The system enabled the surgeon to operate seated in a comfortable position with ergonomic chest, arms, and back supported effectively reducing muscle activity and discomfort which led to improved surgeon satisfaction.	IIIC
257	Steinhilber B, Hoffmann S, Karlovic K, et al. Development of an arm support system to improve ergonomics in laparoscopic surgery: study design and provisional results. <i>Surg Endosc</i> . 2015;29(9):2851-2858.	Nonexperimental	14 laparoscopic surgery observations	n/a	n/a	Physical stress and strain	Increased levels of physical stress were found during laparoscopic surgery. Asymmetric strains were common. The concept of supporting the elbow from below seems to be a promising concept for arm support.	IIIC

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258	Galleano R, Carter F, Brown S, Frank T, Cuschieri A. Can armrests improve comfort and task performance in laparoscopic surgery? <i>Ann Surg.</i> 2006;243(3):329-333.	RCT	19 subjects with no previous laparoscopic experience	Arm rest supports during laparoscopic surgery	No armrests/armrests	Error rates, task efficiency and discomfort measures	The use of armrests during laparoscopic surgery produced measurable comfort and task performance benefits but no significant change in task completion time.	IC
259	Flore R, Gerardino L, Santoliquido A, Catananti C, Pola P, Tondi P. Reduction of oxidative stress by compression stockings in standing workers. <i>Occup Med.</i> 2007;57(5):337-341.	Quasi-experimental	55 theatre nurses, 23 industrial iron workers, 65 outpatient department nurses, 35 laundry workers	Use of compression stockings	Control group-laundry workers and OP department nurses compared to the theatre nurses and iron workers	Reactive oxygen species and venous pressure of the lower limbs	The data indicated that there may be a preventive role for compression stockings against oxidative stress in healthy workers with a standing occupation.	IIA
260	Guideline for sterile technique. In: <i>Guidelines for Perioperative Practice.</i> Denver, CO: AORN, Inc; 2018:75-104.	Guideline	n/a	n/a	n/a	n/a	This document provides guidance for establishing and maintaining a sterile field by following the principles and implementing the processes of sterile technique.	IVA
261	Andreassi MG, Piccaluga E, Guagliumi G, Del Greco M, Gaita F, Picano E. Occupational health risks in cardiac catheterization laboratory workers. <i>Circ Cardiovasc Interv.</i> 2016;9(4):e003273.	Nonexperimental	746/ Survey and personal interview of radiology & electrophysiology workers	n/a	Workers exposed to radiation and non-exposed subjects	Health problems	The findings support previous observations for primary risks of and an increased rate of orthopedic illness related to long hours of standing and wearing heavy lead aprons.	IIIB
262	Yasobant S, Rajkumar P. Work-related musculoskeletal disorders among health care professionals: a cross-sectional assessment of risk factors in a tertiary hospital, India. <i>Indian J Occup Environ Med.</i> 2014;18(2):75-81.	Qualitative	965 healthcare professionals from various clinical sites	n/a	n/a	MSDs, job risk factors, worker perceptions	A high proportion of health care professionals reported work-related MSDs with the low back as the most affected area. The occurrence of work-related MSDs is higher among nurses than other health care professionals. The most commonly reported job risk factors for the development of work-related MSDs include working in the same position for long periods, working in awkward positions, and handling patients.	IIIA
263	Freitag S, Ellegast R, Dulon M, Nienhaus A. Quantitative measurement of stressful trunk postures in nursing professions. <i>Ann Occup Hyg.</i> 2007;51(4):385-395.	Nonexperimental	24 shift measurements	n/a	n/a	Body postures recorded with the CUELA (computer-assisted recording and long-term analysis of musculoskeletal loads) measurement system	Many stressful trunk postures are assumed in nursing during a shift. Future preventative measures should be consider not only load handling but also task that require an awkward posture.	IIIC
264	Steele PRC, Curran JF, Mountain RE. Current and future practices in surgical retraction. <i>Surgeon.</i> 2013;11(6):330-337.	Expert Opinion	n/a	n/a	n/a	n/a	Hand held metal retractors are often of a poor ergonomic design.	VB
265	Noldus J, Graefen M, Hartwig H. Major postoperative complications secondary to use of the bookwalter self-retaining retractor. <i>Urology (Ridgewood, N.J.).</i> 2002;60(6):964-967.	Nonexperimental	4000 procedures using the Bookwalter retractor	n/a	n/a	Damage to internal organs and neuropathies	The Bookwalter self-retaining retractor is a helpful and safe device in exposing the intraoperative site. Care must be taken in patients with risk factors, such as immunosuppression and diverticulitis, and particularly in retroperitoneal operations when tightening the blades.	IIIB
266	Nozaki T, Kato T, Komiya A, Fuse H. Retraction-related acute liver failure after urological laparoscopic surgery. <i>Curr Urol.</i> 2013;7(4):199-203.	Case Report	n/a	n/a	n/a	n/a	This is the first reported case of massive liver ischemic changes due to a sustained pressure injury inflicted by using a laparoscope holder device for liver retraction. This report emphasizes the need for awareness of these injuries and we recommend that the liver retractor should therefore be removed intermittently during prolonged surgery to re-establish hepatic lobe circulation.	VA

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267	Lyall A, Ulaner GA. False-positive FDG PET/CT due to liver parenchymal injury caused by a surgical retractor. Clin Nucl Med. 2012;37(9):910-911.	Case Report	n/a	n/a	n/a	n/a	Tissue injury from surgical retraction can produce FDG-avid lesions that need to be distinguished from malignancy on PET/CT.	VB
268	Tamhankar A, Kelty CJ, Jacob G. Retraction-related liver lobe necrosis after laparoscopic gastric surgery. JSL. 2011;15(1):117-121.	Case Report	n/a	n/a	n/a	n/a	Massive liver necrosis following laparoscopic liver retraction is rare and can be catastrophic. Prolonged surgery, fatty liver, and the reverse Trendelenburg position increase the risk of such injury. We recommend that the liver retractor should be removed intermittently during prolonged surgery in a similar situation to re-establish hepatic lobe circulation.	VA
269	Simonsen JG, Arvidsson I, Nordander C. Ergonomics in the operating room. Work. 2012;41(Suppl 1):5644-5646.	Nonexperimental	99 female theatre nurses, 93 assistant nurses	n/a	n/a	MSDs	Sixty-eight percent of the theatre nurses reported awkward postures and repetitive movements compared to 52% of the assistant nurses; 44% of the theatre nurses and 61% of the assistant nurses reported high physical loads in the exposure category.	IIIB
270	Waters T, Baptiste A, Short M, Plante-Mallon L, Nelson A. AORN Ergonomic Tool 6: Lifting and carrying supplies and equipment in the perioperative setting. AORN J. 2011;94(2):173-179.	Expert Opinion	n/a	n/a	n/a	n/a	The extended reach and high weight limits involved in lifting supplies require the use of large muscle forces. These forces are large enough to cause damage to the spinal tissues, which could result in severe low-back or shoulder pain and lead to permanent disability.	VA
271	Genevay S, Cedraschi C, Courvoisier DS, et al. Work related characteristics of back and neck pain among employees of a Swiss university hospital. Joint Bone Spine. 2011;78(4):392-397.	Qualitative	1298 hospital employees	n/a	n/a	Self-reported spinal pain, consequences of pain, and work characteristics	Being a nurse, working at a poorly adapted work place and having to maintain positions for long periods of time were independently related to spinal pain.	IIIB
272	Waters TR, Baron SL, Piacitelli LA, et al. Evaluation of the revised NIOSH lifting equation. A cross-sectional epidemiologic study. Spine (Phila Pa 1976). 1999;24(4):386-394; discussion 395.	Literature Review	n/a	n/a	n/a	n/a	Although low back pain is a common disorder, the lifting index appears to be a useful indicator for determining the risk of low back pain caused by manual lifting.	VA
273	Waters TR, Putz-Anderson V, Garg A, Fine LJ. Revised NIOSH equation for the design and evaluation of manual lifting tasks. Ergonomics. 1993;36(7):749-776.	Literature Review	n/a	n/a	n/a	n/a	As the lifting index increases the risk of low back pain increases.	VA
274	Guideline for sterilization. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2018:957-984.	Guideline	n/a	n/a	n/a	n/a	The guideline provide guidance for sterilizing items to be used in the perioperative setting. The creation and maintenance of an aseptic environment has direct influence on patient outcomes	IVA
275	ANSI/AAMI ST79: Comprehensive Guide to Steam Sterilization and Sterility Assurance in Health Care Facilities. Arlington, VA: Association for the Advancement of Medical Instrumentation; 2017.	Guideline	n/a	n/a	n/a	n/a	The purpose of the guidelines in this document is to help ensure the steam sterilization of products in health care facilities and the maintenance of the sterility of processed items until the point of use.	IVC
276	Waters T, Lloyd JD, Hernandez E, Nelson A. AORN Ergonomic Tool 7: Pushing, pulling, and moving equipment on wheels. AORN J. 2011;94(3):254-260.	Expert Opinion	n/a	n/a	n/a	n/a	Pushing and pulling can create high spinal shear forces that could result in injury and potential disability for OR personnel.	VA
277	Kao HC, Lin CJ, Lee YH, Chen SH. The effects of direction of exertion, path, and load placement in nursing cart pushing and pulling tasks: an electromyographical study. PLoS One. 2015;10(10):e0140792.	Nonexperimental	10 university students	n/a	Pushing versus pulling; straight path versus uphill	Electromyographic (EMG) data of 4 muscle groups bilaterally	When using a cart healthcare workers should push the cart forward instead of pulling it backward; the work environment should be designed without uphill paths; and the load distribution should have the heavier materials near the handle and in the middle and bottom of the cart to reduce physical load during the operation of the cart.	IIIB

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278	Using Carts in Healthcare: A Resource Guide for Reducing Musculoskeletal Injury. Vancouver, BC, Canada: Occupational Health and Safety Agency for Healthcare (OHSAH); 2005. <a href="http://www.phsa.ca/Documents/Occupational-Health-Safety/GuideUsingCartsinHealthcareAresourceguideforreduci.pdf">http://www.phsa.ca/Documents/Occupational-Health-Safety/GuideUsingCartsinHealthcareAresourceguideforreduci.pdf</a> ; <a href="http://www.ohsah.bc.ca">http://www.ohsah.bc.ca</a> . Accessed May 10, 2018	Expert Opinion	n/a	n/a	n/a	n/a	Practical information on the safe use of carts in the health care environment. The guide focuses on using carts to reduce physical effort required for transporting supplies and the risk of musculoskeletal injuries associated with manual materials handling.	VA
279	Brace T. The dynamics of pushing and pulling in the workplace: assessing and treating the problem. AAOHN J. 2005;53(5):224-231.	Literature Review	n/a	n/a	n/a	n/a	When push and pull forces are excessive, engineering or administrative controls are needed. Use of an objective table can help identify the tasks placing the individual at greater risk for MSDs.	VA
280	Garg A, Waters T, Kapellusch J, Karwowski W. Psychophysical basis for maximum pushing and pulling forces: a review and recommendations. Int J Ind Ergon. 2014;44(2):281-291.	Literature Review	n/a	n/a	n/a	n/a	Presently it is unclear whether pushing or pulling is favored. Also, it is unclear what is the optimal handle heights for pushing and pulling.	VA
281	Diccini S, de Pinho PG, da Silva FO. Assessment of risk and incidence of falls in neurosurgical inpatients. Rev Lat Am Enfermagem. 2008;16(4):752-757.	Nonexperimental	97/ neurosurgical patients	n/a	n/a	Fall-related risk factors	Most post-operative falls can be prevented through an improvement in hospital policy and procedures and the introduction of a falls prevention program.	IIIB
282	Moe K, Brockopp D, McCowan D, Merritt S, Hall B. Major predictors of inpatient falls: a multisite study. J Nurs Adm. 2015;45(10):498-502.	Nonexperimental	281,865 high-risk falls assessments	n/a	n/a	Risk of falling	The findings identified 3 risk factors for inpatient falls including a fall within the last 6 months, confusion, and taking a laxative.	IIIB
283	Oliver D, Daly F, Martin FC, McMurdo ME. Risk factors and risk assessment tools for falls in hospital in-patients: a systematic review. Age Ageing. 2004;33(2):122-130.	Systematic Review	n/a	n/a	n/a	n/a	A number of significant falls risk factors emerged consistently including gait instability, confusion, urinary incontinence, falls history, and sedative drugs.	IIB
284	Beyea SC. Preventing patient falls in perioperative settings. AORN J. 2005;81(2):393-395.	Expert Opinion	n/a	n/a	n/a	n/a	Falls in the OR are a risk and can be prevented by identifying patients at risk and intervening appropriately.	VB
285	McNamara SA. Reducing fall risk for surgical patients. AORN J. 2011;93(3):390-394.	Expert Opinion	n/a	n/a	n/a	n/a	Effective fall prevention must begin with the pre-op assessment of the patient's risks ( eg, age, vision, mental status) and the environmental risks.	VA
286	Dauber MH, Roth S. Operating table failure: another hazard of spine surgery. Anesth Analg. 2009;108(3):904-905.	Case Report	Obese spine surgery patient	n/a	n/a	n/a	All anesthesia personnel should be familiar with the intricacies of specialized OR equipment (eg, beds). Copies of the instructions should be readily available.	VB
287	Choi YS, Lawler E, Boenecke CA, Ponatoski ER, Zimring CM. Developing a multi-systemic fall prevention model, incorporating the physical environment, the care process and technology: a systematic review. J Adv Nurs. 2011;67(12):2501-2524.	Systematic Review	n/a	n/a	n/a	n/a	Using the multi-systemic fall prevention model, hospitals should promote a practical strategy benefitting from the collective effects of the physical environment, the care process, and culture and technology to prevent falls and fall-related injuries.	IIA
288	Church S, Robinson TN, Angles EM, Tran ZV, Wallace JL. Postoperative falls in the acute hospital setting: characteristics, risk factors, and outcomes in males. Am J Surg. 2011;201(2):197-202.	Nonexperimental	154 inpatient surgical procedure patients who fell	n/a	n/a	Characteristic of patient falls (eg, time, location, etiology, injury pattern)	One or more postoperative falls occurred in 1.6% of surgical inpatients leading to significant morbidity. Recognition of fall risk factors may help in designing postoperative fall prevention programs by identification of patients at the highest risk for post-op falls.	IIIB

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289	Mohanty S, Rosenthal RA, Russell MM, Neuman MD, Ko CY, Esnaola NF. Optimal perioperative management of the geriatric patient: a best practices guideline from the American College of Surgeons NSQIP and the American Geriatrics Society. J Am Coll Surg. 2016;222(5):930-947.	Guideline	n/a	n/a	n/a	n/a	Guidance provided for a fall risk assessment, risk factors and fall precautions.	IVB
290	Penprase B, Johnson C. Optimizing the perioperative nursing role for the older adult surgical patient. OR Nurse. 2014;8(4):26-33.	Expert Opinion	n/a	n/a	n/a	n/a	Older adult surgical patients should be assessed as individuals and the plan of care directed toward specific outcomes,	VB
291	Stansby G, Avital L, Jones K, Marsden G; Guideline Development Group. Prevention and management of pressure ulcers in primary and secondary care: summary of NICE guidance. BMJ. 2014;348:g2592.	Guideline	n/a	n/a	n/a	n/a	The guideline provides detailed algorithms on identifying who is at risk; and prevention of pressure ulcers in at risk and high risk adults, neonates, infants, children and young people.	IVA
292	Doerflinger DM. Older adult surgical patients: presentation and challenges. AORN J. 2009;90(2):223-240; quiz 241-244.	Expert Opinion	n/a	n/a	n/a	n/a	During patient transfer, the older adult may require more time to move from the OR stretcher to the OR bed. The periop RN should assess the patient's function, posture, gait and degree of mobility and immobility and incorporate in the transfer plan.	VA
293	Fletcher HC. Preventing skin injury in the OR. OR Nurse. 2014;8(3):28-34.	Expert Opinion	n/a	n/a	n/a	n/a	The authors review intraoperative patient positions.	VC
294	Boynton T, Kelly L, Perez A. Implementing a mobility assessment tool for nurses. Am Nurse Today. 2014;9(9):13-16.	Organizational Experience	n/a	n/a	n/a	n/a	The Banner Mobility Assessment Tool is part of a program to increase staff awareness, education, and training for patient assessments, prevention of patient falls and staff injuries and achievement of better patient outcomes.	VA
295	Assessment: Timed Up & Go (TUG). Centers for Disease Control and Prevention. <a href="https://www.cdc.gov/steady/pdf/TUG_Test-print.pdf">https://www.cdc.gov/steady/pdf/TUG_Test-print.pdf</a> . Accessed May 10, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	The tool assesses patient mobility.	VA
296	Humphrey JA, Johnson SL, Patel S, Malik M, Willis-Owen CA, Bendall S. Patients' preferred mode of travel to the orthopaedic theatre. World J Orthop. 2015;6(3):360-362.	Qualitative	40 female and 30 male elective orthopedic surgery patients	n/a	n/a	Preferred mode of transportation to the OR	The majority of orthopedic patient preferred to walk to the OR thereby enhancing independence, maintaining dignity, and improving efficiency of the process.	IIIC
297	Keegan-Doody M. Walk or be driven? A study on walking patients to the operating theatre. Can Oper Room Nurs J. 2007;25(2):30-38.	Qualitative	Surgical patients # not available)	n/a	n/a	Patient preference for walking to OR versus riding on a stretcher	Giving patients a choice as to their mode of transportation to the OR can reduce preoperative stress. Assistive personnel were more available to assist with patient positioning and PACU transfers.	IIIC
298	Nagraj S, Clark CI, Talbot J, Walker S. Which patients would prefer to walk to theatre? Ann R Coll Surg Engl. 2006;88(2):172-173.	Qualitative	171 patients	n/a	n/a	Preference to walk to the operating room.	Walking enhances patient autonomy and may reduce delays in patient transfers to the OR.	IIIB
299	2011 ANA Health and Safety Survey. American Nurses Association. <a href="https://www.nursingworld.org/practice-policy/work-environment/health-safety/health-safety-survey/">https://www.nursingworld.org/practice-policy/work-environment/health-safety/health-safety-survey/</a> . Accessed May 10, 2018.	Expert Opinion	n/a	n/a	n/a	n/a	This study documented nurses' exposure to workplace hazards in the current healthcare environment. A total of 4614 RNs completed the survey.	VA



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300	Durand MJ, Vézina N, Loisel P, Baril R, Richard MC, Diallo B. Workplace interventions for workers with musculoskeletal disabilities: a descriptive review of content. <i>J Occup Rehabil.</i> 2007;17(1):123-136.	Systematic Review	n/a	n/a	n/a	n/a	Workplace interventions often represent a secondary aspect of rehabilitation program and the descriptions of the programs are vague. There is confusion in the terms (ie, modified work, work modifications, accommodations) used and whether these changes are permanent or temporary. The rehabilitation objective should be described including the disability stage (eg, acute, subacute, chronic) and work status ( eg, absent, full-time, part-time).	IIIA
301	Fochsen G, Josephson M, Hagberg M, Toomingas A, Lagerstrom M. Predictors of leaving nursing care: a longitudinal study among Swedish nursing personnel. <i>Occup Environ Med.</i> 2006;63(3):198-201	Qualitative	1095 Swedish nurses	n/a	n/a	Predictors for leaving nursing with special reference to physical working conditions and musculoskeletal problems	Nursing personnel reporting MSDs of the neck, shoulder or knees and those with limited use of transfer devices were more likely to leave nursing.	IIIB
302	Matt SB, Fleming SE, Maheady DC. Creating disability inclusive work environments for our aging nursing workforce. <i>J Nurs Adm.</i> 2015;45(6):325-330.	Expert Opinion	n/a	n/a	n/a	n/a	Health care organizations should accept the reality that aging and disability are part of life for their nurses. Employers should provide reasonable accommodations to retain their aging nurses' talent, ability, and experience.	VA
303	Vieira ER, Kumar S. Safety analysis of patient transfers and handling tasks. <i>Qual Saf Health Care.</i> 2009;18(5):380-384.	Nonexperimental	Thirty-six volunteer female nurses	n/a	n/a	Lumbar range of motion, compression and shear forces at L5/S1, ligament strain, and percentage of population without sufficient torso strength to perform 14 phases of 9 nursing tasks	Nursing tasks impose high biomechanical demands on the lumbar spine. Excessive lumbar flexion and forces are critical aspects of manual transfers requiring most of the nurses' capabilities.	IIIB
304	Hill KS. Improving quality and patient safety by retaining nursing expertise. <i>Online J Issues Nurs.</i> 2010;15(3):1.	Literature Review	n/a	n/a	n/a	n/a	The aging workforce and predicted retirement of massive numbers of experienced nurses will have a negative impact on quality patient care unless this anticipated loss of knowledge and expertise is lessened with actions that promote retention of seasoned nurses. One way to increase retention of nurses is making ergonomic accommodations.	VA
305	Moscato U, Trinca D, Rega ML, et al. Musculoskeletal injuries among operating room nurses: results from a multicenter survey in Rome, Italy. <i>J Public Health.</i> 2010;18(5):453-459.	Qualitative	185 operating room nurses	n/a	n/a	Prevalence of low back pain and risk factors for musculoskeletal injuries in the OR	It is important to promote new programs of prevention based on professional training and physical activity among nurses and to improve the organization of work shifts in the hospital.	IIIB
306	Warming S, Ebbelhøj NE, Wiese N, Larsen LH, Duckert J, Tønnesen H. Little effect of transfer technique instruction and physical fitness training in reducing low back pain among nurses: a cluster randomised intervention study. <i>Ergonomics.</i> 2008;51(10):1530-1548.	RCT	181 nurses	Transfer technique instruction with and without physical fitness training	Control-usual routine. Transfer technique instruction with and without physical fitness training	low back pain, disability and sick leave due to low back pain, knowledge of transfer technique, change of work routine due to low back pain	Implementing transfer technique alone or in combination with physical fitness training when compared to a control group show any statistical differences among self-reported low back pain, pain level, disability and sick leave at 12 month follow up. The transfer technique with physical fitness did significantly improve low back pain disability indicating that physical fitness training could reduce the consequences of low back pain.	IB

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307	Menzel NN, Lilley S, Robinson EM. Interventions to reduce back pain in rehabilitation hospital nursing staff. Rehabil Nurs. 2006;31(4):138-147.	RCT	31 RNs with history of back pain of at least 1 week's duration in the past year	Ergonomic assessment of facility equipment needs, availability of selected equipment, training in the operation and application of equipment for both groups and cognitive behavior therapy for the intervention group	No cognitive behavior therapy / cognitive behavior therapy	Stress, back pain, disability, and pain coping skills	Nursing staff at rehabilitation hospitals are exposed to more frequent patient-handling activities due to the high dependency levels of the patient population. Preventative approaches are needed to protect the rehabilitation staff.	IB
308	Jaromi M, Nemeth A, Kranicz J, Laczko T, Betlehem J. Treatment and ergonomics training of work-related lower back pain and body posture problems for nurses. J Clin Nurs. 2012;21(11-12):1776-1784.	RCT	124 nurses with low back pain	Ergonomics training and education called Back School 1x week for 6 weeks	Control group received passive physiotherapy 1x week for 6 weeks	Pain intensity and body posture (ie, angle of thoracic kyphosis, lumbar lordosis) at 6 and 12 months	There was a significant reduction in pain intensity and improvements in body posture with usage of active physical therapy methods (Back School) in nurses experiencing chronic low back pain.	IB
309	Rasmussen CD, Holtermann A, Bay H, Sjøgaard K, Birk Jørgensen M. A multifaceted workplace intervention for low back pain in nurses' aides: a pragmatic stepped wedge cluster randomised controlled trial. Pain. 2015;156(9):1786-1794.	RCT	594 nurses' aides	Participatory ergonomics, physical training, cognitive behavior training, maintenance, knowledge sharing	Randomization to four successive time periods three months apart	low back pain, absence from work, work ability, occupational lifting and carrying, muscle strength, fear avoidance beliefs, and management support	Multifaceted interventions (eg, participatory ergonomics, physical training, cognitive behavior training) may be relevant for improving low back pain in a working population.	IB
310	Rasmussen CD, Holtermann A, Mortensen OS, Sjøgaard K, Jørgensen MB. Prevention of low back pain and its consequences among nurses' aides in elderly care: a stepped-wedge multifaceted cluster-randomized controlled trial. BMC Public Health. 2013;13:108.	RCT	594 nurses' aides	Participatory ergonomics, physical training, cognitive behavior training, maintenance, knowledge sharing	Randomization to four successive time periods three months apart	low back pain, absence from work, work ability, occupational lifting and carrying, muscle strength, fear avoidance beliefs, and management support	The proposed research design will potentially provide knowledge for prevention and reducing low back pain in nurses' aides.	IB
311	Morgan A, Chow S. The economic impact of implementing an ergonomic plan. Nurs Econ. 2007;25(3):150-156.	Organizational Experience	2000 bed community hospital	n/a	n/a	n/a	Reasons for implementing an ergonomic program include 1) right thing to do for the health and safety of workers; 2) reduction of injuries with use of safe patient handling equipment; 3) maximizes the use of the workforce with a program to return injured workers to duty; 4) increase recruitment and retention; and 5) lower workman compensation costs increasing fiscal health of the organization.	VB

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312	Standards of perioperative nursing. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2015:693-732.	Guideline	n/a	n/a	n/a	n/a	The standards of perioperative nursing provide a mechanism to delineate the responsibilities of RNs engaged in practice in the perioperative setting. These standards serve as the basis for quality monitoring and evaluation systems; databases; regulatory systems; the development and evaluation of nursing service delivery systems and organizational structures; certification activities; job descriptions and performance appraisals; agency policies, procedures, and protocols; and educational offerings. The standards of perioperative nursing are generic and apply to all RNs engaged in perioperative practice, regardless of clinical setting, practice setting, or educational preparation.	IVC
313	Schoenfisch AL, Lipscomb HJ, Pompeii LA, Myers DJ, Dement JM. Musculoskeletal injuries among hospital patient care staff before and after implementation of patient lift and transfer equipment. Scand J Work Environ Health. 2013;39(1):27-36.	Nonexperimental	11545 medical center and a community hospital patient care staff	n/a	n/a	musculoskeletal injuries, injury cause, days away from work, restricted work days	The observational study used administrative data from an ongoing surveillance system to describe injury experienced among patient care staff at a medical center and a community hospital over a 13 year period. The policy shifted to gradually introduce patient lift and transfer equipment. After introduction of the new policy and equipment patient handling injuries declined at the community hospital, and days away associated with patient handling injuries declined at both facilities.	IIIB