

AORN Guidance Statement: Safe Patient Handling and Movement in the Perioperative Setting

Editor's note: Ergonomic Tool #3 and related text in this guidance statement were updated in September 2011 to reflect the revised Ergonomic Tool #3 published in the AORN Journal (May 2011, Vol 93, No 5, page 591).

Description of the Problem

Perioperative registered nurses and the perioperative team are routinely faced with a wide array of occupational hazards in the perioperative setting that place them at risk for work-related musculoskeletal disorders.¹⁻³ Musculoskeletal disorders are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, or spinal discs associated with actions such as overexertion, repetitive motion, and bodily reaction.^{4,5} The US Department of Labor does not include injuries caused by slips, trips, falls, motor vehicle accidents, or similar accidents in their definition of musculoskeletal disorders.⁴ Musculoskeletal disorders are one of the most frequently occurring and costly types of occupational issues affecting nurses.^{2,6,7} More than a third (ie, 36%) of the musculoskeletal injuries that nurses reported requiring time away from work were back injuries.⁸ Among the nurses working in the private sector, nearly 9,000 had back injuries.^{8,9} One study revealed that 12% of nurses planning to leave the profession indicated that back injuries were either a primary or contributing factor to their decision.¹⁰ While back injuries are one of the most common occupational injuries in the health care industry, injuries of the shoulder and neck were more likely to prevent nurses from performing their work than low back pain.¹⁰⁻¹³ The US Department of Health and Human Services report on nursing identified concern for personal safety in the health care environment as the reason given by 18.3% of nurses for leaving the profession.¹⁴

When the worker's physical ability, task, workplace environment, and workplace culture are not compatible, there is an increased risk of a musculoskeletal disorder.^{1,2,15} The connection between physical risk factors and musculoskeletal disorders is greater when exposures are intense and prolonged and when several occupational risk factors are present at the same time.¹⁶ Examples of physical stressors encountered in health care include

- forceful tasks,
- repetitive motion,
- awkward posture,
- static posture,
- moving or lifting patients and equipment,
- carrying heavy instruments and equipment, and
- overexertion.^{1-3,11,12,14,17-26}

The perioperative setting poses unique challenges related to the provision of patient care and completion of procedure-related tasks. This highly technical environment is equipment intensive and necessitates the lifting and moving of heavy supplies and equipment during the perioperative team member's work period. Many of the patients having surgical or other invasive procedures are completely or partially dependent on the caregivers due to the effects of general or regional anesthesia or sedation. Patients who are unconscious cannot move, sense discomfort, or feel pain, and they must be protected from injury. This may require the perioperative team to manually lift the patient or the patient's extremities several times during a procedure. The following are among the high-risk tasks specific to perioperative nurses identified that will be addressed in the following discussion of ergonomic tools:

- transferring patients on and off OR beds,²
- repositioning patients in the OR bed,²
- lifting and holding the patient's extremities,²
- standing for long periods of time,²
- holding retractors for long periods of time,²
- lifting and moving equipment,² and
- sustaining awkward positions.

Transferring, lifting, and handling patients has been identified as the most frequent precipitating trigger of back and shoulder problems in nurses.^{2,27} Certain patient handling tasks (eg, patient transfers) have been identified as high risk for musculoskeletal injuries to health care workers.²⁷ Lifting and moving patients is a frequent activity in the perioperative setting; for example, caregivers transfer patients to and from transport carts (eg, stretchers) and the OR bed many times during a typical work shift.

Health care providers often reposition patients once they are on the OR bed to provide appropriate exposure of the surgical site. This high-risk activity requires team members to physically lift and maneuver the patient or a patient's extremity while simultaneously placing a positioning device. The patient's weight may not be evenly distributed; the extremity's mass may be bulky and asymmetric, and it may be difficult to hold the extremity close to the health care provider's body during positioning maneuvers.²⁸ Additionally, concern for the patient's airway, maintaining his or her body alignment, and supporting the extremities may make it difficult for team members to position themselves in an ergonomically safe position, thus exacerbating physical demands.

Several unique aspects of high-risk patient handling tasks associated with prepping a patient's limb have been identified.²⁹ Preparing an extremity for surgery generally requires it to be elevated to allow complete circumferential skin preparation. The limb can be suspended by a person holding the limb or by

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placing the limb in a holding device. In some instances, the limb may be held manually during the entire skin prep while a second person performs the skin prep. The person performing the skin prep may also hold the limb if the limb is small or if only the distal portion needs to be prepped. To maintain asepsis, the person lifting the extremity is forced to hold the limb extended away from his or her body. The size of the limb, length of prep time, posture necessary to hold the extremity, and the physical capability of the person holding the limb all contribute to the ability of the caregiver to safely suspend the limb for the required prep. The following questions should be considered when determining how to safely raise and hold a limb.

- Does the limb need to be raised for the entire surgical skin prep?
- Does the limb need to be lifted by scrubbed or unscrubbed personnel?
- Is the person holding the limb strong enough to perform the task?
- Is there an alternative practice that can be adopted?
- Is there equipment that could be used to support the task?
- Is it possible to hold a heavy limb safely without risk of injury to the nurse or the patient?²⁹

Perioperative registered nurses are prone to pain and fatigue from static posture during surgical procedures. The entire perioperative team spends a significant

amount of time on their feet during the course of a shift; however, sterile perioperative team members may be required to stand for much longer periods of time. The sterile team members must maintain the integrity of the sterile field, which precludes them from changing levels. They should not alternate between sitting in a chair that is lower than the sterile field and a standing position. Acute and chronic back, leg, and foot pain are frequent complaints resulting from standing in one place for long periods of time. The following factors should be considered during surgical or other invasive procedures. Are the sterile members of the team

- at the appropriate height for the level of the OR bed?
- adopting awkward positions to work effectively?
- positioned in close proximity to the patient to perform required tasks?
- stretching and relaxing muscles regularly?²⁹

Perioperative nurses and other perioperative personnel are frequently required to push or pull heavy equipment (eg, OR beds, portable microscopes, video carts). This equipment is very expensive and often must be shared between several individual operating rooms. Unoccupied OR beds are very heavy and difficult to move. Moving an occupied OR bed is not recommended because the risk of injury increases for both the worker and the patient.

Perioperative personnel and central processing personnel are frequently required to carry sets of surgical

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instruments. Instrument set weights vary and may weigh as much as 40 pounds. Instrument trays are wrapped with impervious nonwoven material or contained in a ridged container system. Both packaging methods can present lifting and carrying problems. Wrapped instrument sets that are too heavy may pose an additional problem because they have no handles and are awkward to carry. Rigid container systems often have handles that make carrying easier, but the weight of the container itself adds to the total weight of a full tray. In an effort to keep costs down and conserve storage space, instrument trays may be inappropriately prepared and too heavy to lift or carry safely. Instrument sets that are flash sterilized require staff members to aseptically remove the hot trays from the sterilizer. The weight of these trays and the height of the person removing them from the sterilizer in relation to the height of the sterilizer chamber contribute to the degree of risk to that individual.

The consequences of musculoskeletal disorders are severe. Employees who experience pain and fatigue are less productive and attentive, more prone to make mistakes, more susceptible to further injury, and may be more likely to affect the health and safety of others. Nurses suffering from disabling back injuries or the fear of getting injured have contributed to the number of nurses leaving the profession, thus increasing the nursing shortage. Workplaces with high incidences of musculoskeletal disorders report increases in lost or modified workdays, higher staff member turnover, increased costs, and adverse patient outcomes.^{14,29,30}

Description of the Process

The 2005–2006 Workplace Safety Task Force was charged by AORN President Sharon McNamara, RN, MS, CNOR, to prepare a guidance document for ergonomically healthy workplaces. In addition, the task force was charged with forming a collaborative arrangement with the National Institute for Occupational Safety and Health (NIOSH) and the American Nurses Association (ANA) to work together to discuss, design, and advance the agenda of healthy work sites for perioperative professionals, to include ergonomic safety. This document was developed by AORN with the assistance of a panel of experts from the Patient Safety Center of Inquiry, Tampa, Fla; the James A. Haley Veterans Administration Medical Center (VMAC); the NIOSH Division of Applied Research and Technology Human Factors and Ergonomics Research Team; and ANA.

Members of the task force examined current research, literature, and patient care practices to evaluate and make recommendations to promote patient and caregiver safety when performing activities in a perioperative setting. While there are several high-risk tasks specific to perioperative nurses, the task force identified seven key activities as the starting point for developing recommendations. Some of these recommendations are based upon current technology that can be immediately implemented. Others, such as use of ceiling lifts in operating rooms, are in development or are projected patient handling innovations.

This group will continue to examine what is available and encourage manufacturers to develop new and innovative technologies to achieve the optimal safety of the patient and the caregiver. Development of this equipment is critical for successful implementation of these ergonomic tools.

The ergonomic tools developed for this guidance document are based on previous work by Audrey Nelson, PhD, RN, FAAN; experts within the Veterans Administration (VA); and nationally recognized researchers.²⁸ The ergonomic tools for safe patient handling and movement have been designed with the goal of eradicating job-related musculoskeletal disorders in perioperative nurses. The ergonomic tools and algorithms were developed based on professional consensus and evidence from research. Plans are underway for pilot tests in several facilities.

Ergonomic Tool #1: Lateral Transfer From Stretcher To and From the OR Bed

Transferring a patient to and from the OR bed is one of the first actions of the perioperative team. The AORN “Recommended practices for positioning the patient in the perioperative practice setting” recommends that the perioperative registered nurse perform a preoperative assessment for patient-specific positioning needs.³¹ Based on that assessment and using [Ergonomic Tool #1](#), the patient will be transferred to and from the OR bed in an ergonomically safe manner.

*Calculation of Design Goal

To accommodate the design goal of 75% of the US adult female working population, **maximum load for a one-handed lift** is calculated to be 11.1 lb (5.0 kg), assuming a worst-case scenario where the patient load may be handled at full arm's length. This is determined by calculating the strength capabilities for the 25th percentile US adult female maximum shoulder flexion moment (25th percentile strength = 31.2 Nm, based on mean of 40 Nm and standard deviation of 13 Nm, therefore 25th percentile = 31.2 Nm)³⁵ and the 75th percentile US adult female shoulder to grip length (75th percentile length = 630 mm, based on mean of 610 mm and standard deviation of 30 mm).³⁶ Therefore, maximum one-handed lift is calculated as 31.2 Nm divided by 0.63 m, which equals 49.5 N, or 11.1 lb.

Maximum load (for one person) for a two-handed lift (22.2 lb/10.1 kg) is calculated as twice that of a one-handed lift. According to Rohmert, muscle strength capabilities diminish as a function of time.³⁷ Therefore, maximum loads for two-handed holding of body parts are presented for one-, two-, and three-minute durations. After one minute, muscle endurance has decreased by 48%; by 65% after two minutes; and after three minutes of continuous holding, strength capability is only 29% of initial lifting strength.

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ERGONOMIC TOOL #1. LATERAL TRANSFER FROM STRETCHER TO AND FROM THE OR BED



- The number of personnel to safely transfer the patient should be adequate to maintain the patient's body alignment, support extremities, and maintain patient's airway.
- For lateral transfers, it is important to use a lateral transfer device that extends the length of the patient.
- Current technologies for supine-to-prone include the Jackson frame and the spine table.
- Destination surface should be slightly lower for all lateral patient moves.
- A separate algorithm for prone-to-jackknife is not included because this is assumed to be a function of the table.
- If the patient's condition will not tolerate a lateral transfer, consider the use of a mechanical lift with a supine sling.
- During any patient transfer task, if any caregiver is required to lift more than 35 lb of a patient's weight, assistive devices should be used for the transfer.
- While some facilities may attempt to perform a lateral transfer simultaneously with positioning the patient in a lateral position (ie, side-lying), this is not recommended until new technology is available.
- The assumption is that the patient will leave the operating room in the supine position.

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Supine to Prone Transfer

Assuming that one caregiver or anesthesia care provider supports the patient's head and neck during supine to prone transfers, the patient's remaining body mass equals 91.6% of his or her total body mass.³² Using the approach for lifting and holding, a maximum two-handed load to achieve 75% US adult female design goal equals 22.2 lb (10.1 kg).^{*} Typically one of the four caregivers moving a patient is the anesthesia care provider who maintains the airway and supports the patient's head. Two caregivers plus the anesthesia care provider can safely transfer a patient weighing up to 48.5 lb (22.0 kg) from supine to prone position. Three caregivers, plus an anesthesia care provider, can safely transfer a patient weighing up to 72.7 lb (33.0 kg). If the patient's weight is greater than 73 lb, it is necessary to use assistive technology and a minimum of three to four caregivers. Although this has been identified as a gap in technology, a mechanical device is preferable for this task and should be developed.

Supine to Supine Transfer

The desirable approach for lateral transfer of a patient involves use of a lateral transfer device (eg, friction-reducing sheets, slider board, and air-assisted transfer device). If only a draw sheet is used without a lateral transfer device, the care provider exerts a pull force up to 72.6% of the patient's weight.³³ Assuming that one caregiver or anesthesia care provider supports the patient's head and neck to maintain the airway during lateral transfers, the remaining mass of the patient's body equals 91.6% of his or her total body mass.³² Research indicates that for a pulling distance of 6.9 ft (2.1 m) or less, where the pull point (ie, starting point for the hands) is between the caregiver's waist and nipple line, and the task is performed no more frequently than once every 30 minutes, the maximum initial force required equals 57 lb (26 kg) and the maximum sustained force needed equals 35 lb (16 kg).³⁴ Therefore, each caregiver can safely contribute a pull force required to transfer up to 48 lb (35 lb/0.726 as referenced above). For one caregiver, plus the anesthesia care provider, maximum patient weight equals 52.6 lb (48 lb/0.916 as referenced above). Two caregivers plus the anesthesia care provider can safely transfer a patient up to 104.8 lb ($[48 \times 2]/0.916$ as referenced above). Three caregivers plus the anesthesia care provider can safely transfer a patient up to 157.2 lb ($[48 \times 3]/0.916$ as referenced above). If the patient is > 157 lb, use an appropriate mechanical lifting device—ie, mechanical lift with supine sling, mechanical lateral transfer device, or air-assisted lateral transfer device—and a minimum of three to four caregivers.

Ergonomic Tool #2: Positioning and Repositioning the Patient on the OR Bed Into and From the Supine Position

The AORN "Recommended practices for positioning the patient in the perioperative practice setting" require that "the perioperative nurse should actively participate in monitoring patient body alignment and tissue integrity based on sound physiologic principles." It further states, "an inadequate number of personnel and equipment can result in patient injury."³¹ [Ergonomic Tool #2](#) provides evidence-based guidelines to assist the perioperative registered nurse and other team members to position and reposition the patient on the OR bed in a safe manner for the patient and the team.

Moving the Patient Into and Out of a Semi-Fowler Position

The mass of a patient's body from the waist up, including the head, neck, and upper extremities, equals 68.6% of the patient's total body weight.³² Added to this is the estimated weight of the equipment (20 lb/9.1 kg). To accommodate at least 75% of the US adult female working population, the maximum load for a two-handed lift is 22.2 lb (10.1 kg). This is determined based on 25th percentile US adult female shoulder strength capabilities³⁵ and 75th percentile US adult female arm length.³⁶ Therefore, three caregivers together could lift up to 66.6 lb (10.3 kg), which equates to a 68-lb (30.1 kg) patient.[†] Mechanical devices and a minimum of three caregivers are preferable if the patient weighs more than 68 lb. An example of an appropriate mechanical device is the automatic semi-Fowler positioning feature of an electric OR bed. Further research to address gaps in technology is recommended.

Positioning the Patient Into and From the Lateral Position

Positioning or repositioning a patient into or out of a lateral position involves push/pull forces rather than lifting forces. Assuming that one caregiver or anesthesia care provider supports the patient's head and neck during lateral positioning, the patient's remaining body mass equals 91.6% of total body mass.³² Based on the Liberty Mutual tables (see [Table 3](#) under [Ergonomic Tool #7](#)) for a pulling distance of 6.9 ft (2.1 m) or less, with a pull point (ie, starting position of the hands) between the caregiver's waist height and nipple line, performed no more frequently than once every 30 minutes, maximum initial force equals 57 lb (26 kg), and maximum sustained force equals 35 lb (16 kg).³⁴ Therefore, two caregivers, plus an anesthesia care provider maintaining the

[†]Maximum patient weight = (Maximum 2-handed lift (22 lb) x 3 caregivers) – equipment weight (20 lb) = 68 lb (68 lb) Percentage of patient weight above the waist (0.686)

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ERGONOMIC TOOL #2. POSITIONING/REPOSITIONING THE PATIENT ON THE OR BED INTO AND FROM THE SUPINE POSITION



- (1) Mechanical devices are preferable for this task, but their practicality has not yet been tested. There are special slings and straps that can be used with mechanical devices. For example, turning straps can be used to turn a patient to and from lateral or supine, or limb support slings can be used to lift the legs to and from lithotomy. More research is needed.
- (2) Use the automatic semi-Fowler positioning feature of an electric table if available.
- (3) One of these caregivers could be the anesthesia provider to hold the head and maintain the airway.

- During any patient handling task, if any caregiver is required to lift more than 35 lb of a patient's weight, an assistive device should be used.
- The number of personnel to safely position the patient should always be adequate to maintain the patient's body alignment.
- A separate algorithm for prone-to-jackknife is not included because this is assumed to be a function of the table.

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ERGONOMIC TOOL #3. LIFTING AND HOLDING LEGS, ARMS, AND HEAD FOR PREPPING								
Patient weight lb (kg)	Body part	Body part weight		Lift 1-hand	Lift 2-hand	Hold 2-hand ≤ 1 min	Hold 2-hand ≤ 2 min	Hold 2-hand ≤ 3 min
≤ 40 lb (≤ 18 kg)	Leg	< 6 lb	< 3 kg					
	Arm	< 2 lb	< 1 kg					
	Head	< 3 lb	< 1 kg					
40-90 lb (18-41 kg)	Leg	< 14 lb	< 6 kg					
	Arm	< 5 lb	< 2 kg					
	Head	< 8 lb	< 4 kg					
90-140 lb (41-64 kg)	Leg	< 22 lb	< 10 kg					
	Arm	< 7 lb	< 3 kg					
	Head	< 12 lb	< 6 kg					
140-190 lb (64-86 kg)	Leg	< 30 lb	< 14 kg					
	Arm	< 10 lb	< 4 kg					
	Head	< 16 lb	< 7 kg					
190-240 lb (86-109 kg)	Leg	< 38 lb	< 17 kg					
	Arm	< 12 lb	< 6 kg					
	Head	< 20 lb	< 9 kg					
240-290 lb (109-132 kg)	Leg	< 46 lb	< 21 kg					
	Arm	< 15 lb	< 7 kg					
	Head	< 24 lb	< 11 kg					
290-340 lb (132-155 kg)	Leg	< 53 lb	< 24 kg					
	Arm	< 17 lb	< 8 kg					
	Head	< 29 lb	< 13 kg					
340-390 lb (155-177 kg)	Leg	< 61 lb	< 28 kg					
	Arm	< 20 lb	< 9 kg					
	Head	< 33 lb	< 15 kg					
390-440 lb (177-200 kg)	Leg	< 69 lb	< 31 kg					
	Arm	< 22 lb	< 10 kg					
	Head	< 37 lb	< 17 kg					
> 440 lb (> 200 kg)	Leg	> 69 lb	> 31 kg					
	Arm	> 22 lb	> 10 kg					
	Head	> 37 lb	> 17 kg					

No shading: OK to lift and hold; use clinical judgment and do not hold longer than noted.
Heavy shading: Do not lift alone; use assistive device or more than one caregiver.

patient's airway, can safely position a patient weighing up to 76 lb (34.5 kg) (35 lb x 2 care providers/0.916 as referenced above). Three caregivers plus an anesthesia care provider can safely position a patient weighing up to 115 lb (52.2 kg) (35 lb x 3 care providers/0.916 as referenced above). If the patient's weight exceeds 115 lb, lateral positioning devices are needed. Further research is needed to enhance technology to address this task.

Positioning the Patient Into and From the Lithotomy Position

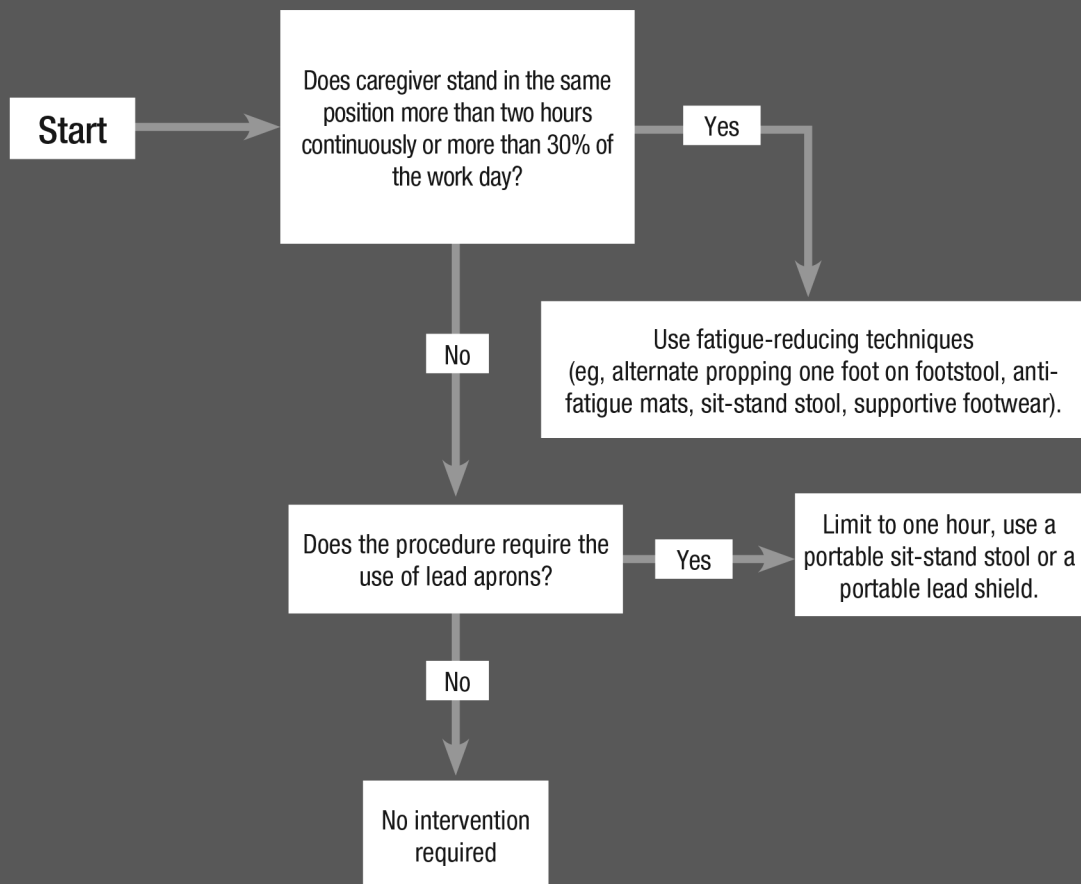
When lifting and holding body parts, the maximum load for a two-handed lift is 22.2 lb (10.1 kg). Each

complete lower patient extremity, including thigh, calf, and foot, weighs 15.7% of the patient's total body mass. Therefore, one caregiver can safely perform this task if the patient weighs 141 lb (64.1 kg) or less because each leg is estimated to be less than 22.2 lb.³³

Caregivers attempting to lift the patient's legs using two hands can each safely lift one leg for patients weighing less than 141 lb. Patients weighing more than 141 lb require assistive technology or four caregivers (ie, two to lift each leg). A mechanical device such as support slings can be used to lift the legs to and from the lithotomy position. Further research is needed to enhance availability of technology to address this task.

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ERGONOMIC TOOL #4. PROLONGED STANDING

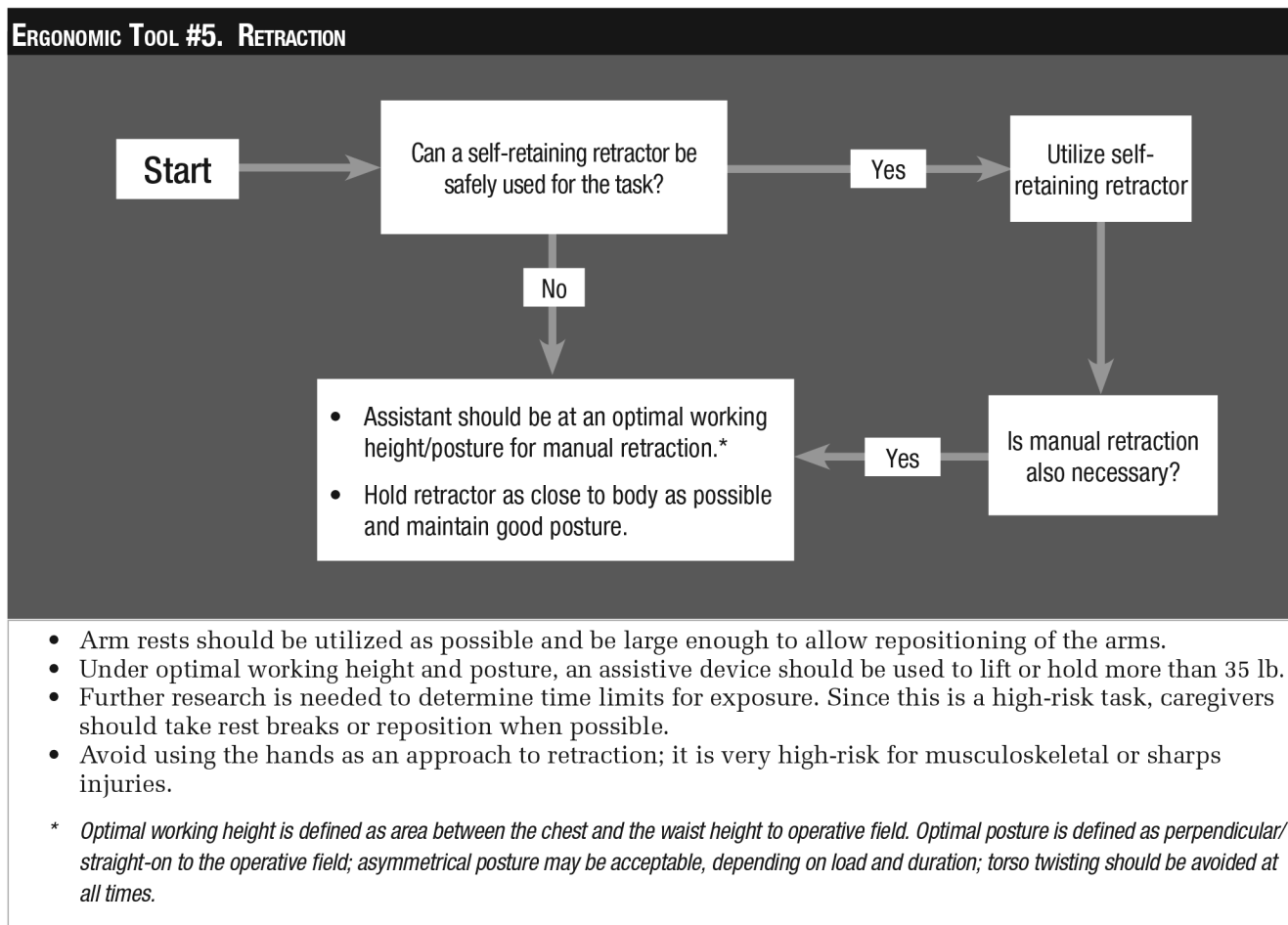


General recommendations

- Caregiver should wear supportive footwear that has the following properties:
 - does not change the shape of the foot;
 - has enough space to move toes;
 - shock-absorbing, cushioned insoles;
 - closed toe; and
 - height of heel in proportion to the shoe.
- Caregivers may benefit from wearing support stockings/socks.
- Anti-fatigue mats should be on the floors.
- Anti-fatigue mats should be placed on standing stools.
- The sit-stand chair should be set to the correct height before setting the sterile field so caregivers will not be changing levels during the procedure.*
- Be aware of infection control issues for nondisposable and anti-fatigue matting.
- Accommodations for pregnancy were considered, but the two-hour limit on prolonged standing covers this condition.
- Scrubbed staff should not work with the neck flexed more than 30 degrees or rotated for more than one minute uninterrupted.
- Two-piece, lightweight lead aprons are recommended.
- During the sit-to-stand break, staff should look straight ahead for a short while.

* "Recommended practices for maintaining a sterile field," in Standards, Recommended Practices, and Guidelines (Denver, Colo: AORN, Inc, 2007) 665-672.

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Ergonomic Tool #3: Lifting and Holding Legs, Arms, and Head for Prepping in a Perioperative Setting

Introduction

AORN's "Recommended practices for skin preparation of patients" states that "when indicated, the surgical site and surrounding area should be prepared with an antiseptic agent. The prepared area of skin and the drape fenestration should be large enough to accommodate extension of the incision, the need for additional incisions, and all potential drain sites."³⁸ To accomplish this task, a member of the perioperative team may need to hold the extremity so that the appropriate body part is prepared in the required manner.

[Ergonomic Tool #3](#) shows the calculations for average weight for an adult patient's leg, arm, and head as a function of whole body mass, ranging from slim to morbidly obese body type. Weights are presented both in US (lb) and metric (kg) units. Maximum lift and hold loads were calculated based on 75th percentile shoulder flexion strength and endurance capabilities for US adult females, where the maximum weight for a one-handed lift is 11.1 lb and a two-handed lift, 22.2 lb.

The shaded areas of the table indicate whether it would be acceptable for one caregiver to lift the listed

body parts or hold the respective body parts for 0, 1, 2, or 3 minutes with one or two hands. Respecting these limits will minimize risk of muscle fatigue and the potential for musculoskeletal disorders. Perioperative registered nurses must use clinical judgment to assess the need for additional staff member assistance or assistive devices to lift and/or hold one of these body parts for a particular period of time.

Rationale and Calculations for Ergonomic Tool #3

Note: These are guidelines for the average weight of the leg, arm, and head based upon the patient's weight. Nurses should use their clinical judgment to assess the need for additional staff member assistance or assistive devices to lift and/or hold one of these body parts for a particular period of time. The maximum weight for a one-handed lift is 11.1 lb and for a two-handed lift, 22.2 lb.

Patient weight is divided into 10 categories, ranging from very light (≤ 40 lb) to very heavy (> 440 lb). Normalized weight for each leg, each arm, and the patient's head is calculated as a percentage of total body weight, where each complete lower extremity represents 15.7% of total body mass, each upper extremity (ie, upper arm, forearm, hand) represents 5.1% of total body mass, and the combination of head