Resources: Ergonomic/Musculoskeletal Hazards in Patient Handling

- Forceful Exertions
- Sustained and/or Awkward Postures
- Repetition
- Gripping
- Contact Stresses or Pressures
- High Risk Patient Handling Tasks

Forceful Exertions

Force is the amount of effort required to lift/lower, carry, push/pull, or grip/pinch. It is a product of the mass and acceleration of an object (F=ma). Therefore, more force will be required to move a patient:

- the more a patient weighs
- the greater amount of assistance the patient requires to move
- the faster and less controlled or smoothly one attempts to move the patient

Unlike handling many other types of loads (e.g., boxes), patients are bulky, have no handles, cannot always be held close to the body and can be unpredictable. To account for some of these additional hazards when handling patients, Waters (2007) recommended that the maximum safe lifting limit should be lower than for manual materials handling. Using the evidence-based Revised NIOSH Lifting Equation for manual materials handling tasks (1994), Waters (2007) indicated that caregivers should not lift more than approximately 35 lbs of a patient's weight under ideal conditions, including:

- The patient can follow directions and is not combative
- The amount of weight the caregiver handles can be estimated
- The lifting is smooth and slow
- The "geometry" of the lift does not change – the body and hand positions in relation to the object being lifted and the amount of weight to be lifted are not subject to change

This weight limit has been accepted as the industry standard in the development of safe patient handling guidelines, but would be lower for many patient handling tasks which present less than ideal lifting conditions such as:

- Lifting with extended arms
- Lifting near floor height
- Lifting when sitting or kneeling
- Lifting with the trunk twisted or the load off to the side of the body
- Lifting with one hand or in a restricted space
- Lifting during a shift lasting longer than 8 hours

Links:

When is it Safe to Manually Lift a Patient?

Awkward Postures

The neutral posture or zone is a region of little or no resistance to movement in the middle of a joint's range of motion. The joints or body segments are not bent or twisted significantly in any direction and the natural curves of the spine are maintained so that the least amount of energy is required to maintain it. This position places the least amount of stress/strain on soft tissues and the muscles are in their strongest position to develop the maximum amount of force most efficiently.

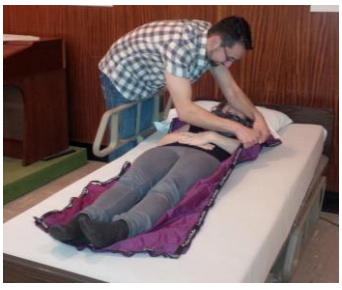
An awkward posture is one that deviates significantly from the neutral position or zone (i.e., extreme joint ranges). The muscles, tendons, nerves and bones are stretched, shortened, and/or compressed and are not in an optimal position for force development. An awkward posture requires more muscular force to maintain, produces excessive and unnecessary effort, reduces strength and can limit certain movements. For example, when the arm is kept close to the body, the forces placed upon it are reduced, especially when the elbow is flexed at about 90º. As soon as the arms are brought forward and away from the chest wall, just the weight of the arms alone places additional load onto the low back and shoulder. Therefore, when exerting a force, the muscles must handle the weight of the patient being moved AND the weight of the body.

The risk of MSI increases the more awkward a posture is, if it is sustained or repetitive, or when combined with a forceful exertion.

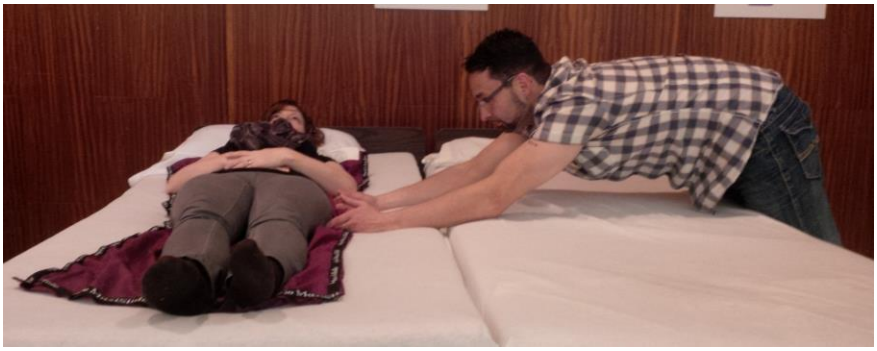
Links:
Awkward Postures in Patient Handling

The physical environment where patient care is taking place may contribute to awkward postures. Improper layout of work areas, space limitations (small rooms, lots of equipment) and certain patient handling tasks can make workers use unnatural and stressful body positions. For example:

- leaning over a low bed or bedrail


- reaching across a bed/stretcher during a lateral transfer



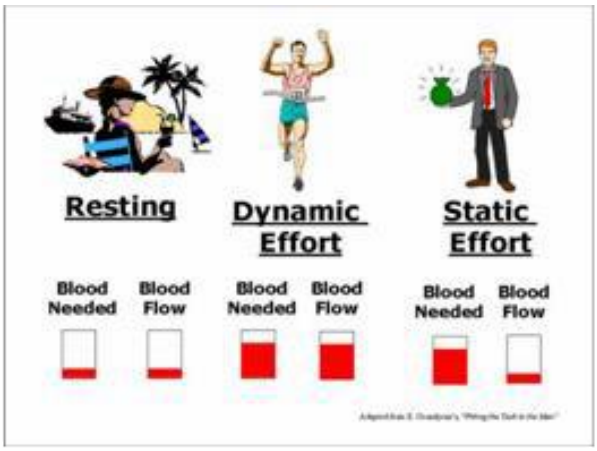
- twisting when assisting a patient up to a sitting position

- bringing elbows up and out to the side when manually repositioning

Sustained Postures

When the body is moving, the muscles alternate between tension (shortening) and relaxation (lengthening), maintaining the flow of blood ("dynamic effort"). Conversely, when there is a lack of body movement, the muscles are in a constant state of tension or relaxation and continual muscle contraction ("static effort"). There is reduced blood flow to the working muscle as blood vessels are compressed and not being pumped through the muscle. This mismatch between blood flow

needed and actual blood flow can lead to muscular fatigue and decreased efficiency much sooner than dynamic work. This increases the risk for injury. For example, holding a patient's leg (e.g., during wound care or in the OR) or standing for long periods can lead to muscular fatigue and pain.



Repetition (frequency of movements)

Repetition entails performing the same motion or series of motions over and over again using the same muscle groups with little variation or chance of recovery time. As with sustained postures, the muscles begin to fatigue and the amount of force a person can exert and the capacity to do work will decrease. The task needs to be stopped for a period of time in order for the body to recover. The length of time needed for recovery depends on the task as well as the individual's physical conditioning. If the break is too short, the body will not have recovered fully and the capacity to do work decreases more quickly. Repetition can have a cumulative effect over time and result in repetitive strain injury (RSI), similar to a single incident of excessive force.

Determining the level of risk can be challenging as more research is required to be able to predict the capacity of a person to perform specific tasks repeatedly. Furthermore, there is no accepted universal definition of repetitive or any standards that regulate acceptable frequency rates. Some definitions have included (E.K. Gillin & Associates Inc., date unknown):

- a cycle time of less than 30 seconds, i.e., task is repeated every 30 seconds or less
- more than 50% of the time is spent performing the same task/activity
- the same (or similar movement) is performed for 1 hour (uninterrupted)
- more than 200 times/hour
- finger movements >200 times/min

What is clearly evident is that ***frequency*** should never be considered in isolation when evaluating repetitive tasks. ***Duration*** and ***intensity*** (e.g., forces) of a task will also significantly affect physical demands and overall risk level. Likewise, when combined with other risk factors such as awkward postures, the risk of MSI significantly increases.

In general, many patient handling activities may not be considered repetitive when considered in isolation. However, the cumulative effect of handling many patients or performing the same task over the course of a shift may be repetitive and increase the risk of MSI (e.g., repositioning and transferring dependent client with high care needs, performing numerous bath assists consecutively, etc.).

Gripping

The type of grip used when handling patients will affect the force that can be generated and risk of MSI. A power (cylindrical) grip, which uses the entire hand to produce force, provides the maximum gripping force that can be generated by the hand and requires the least amount of effort. A pinch (precision) grip, which only involves the fingertips (i.e., between thumb and finger(s)), can produce ~25% of the force of a power grip.

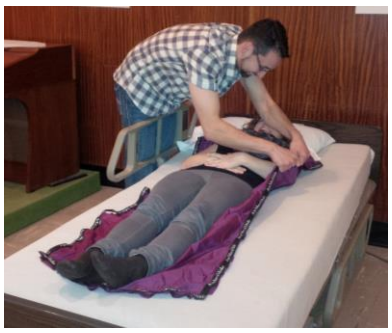
Because the human body does not possess any handles, it is difficult to find areas that would enable the use of a good grip, at least not without potentially injuring the patient.

Pinch Grip

Power Grip

Contact Stresses or Pressures and Repeated Impacts

Contact stress occurs when a hard or sharp object comes in contact with the skin such as kneeling on hard ground, leaning against a bed rail or stretcher, resting forearms or wrists on the edge of a surface (e.g., computer work), or when ridges and hard edges on equipment dig into your hands. Force is concentrated on a small area of the body, which can pinch or compress the underlying nerves and tissues and restrict normal blood flow to that area. The sides of the fingers, palms, wrists and forearms, elbows and knees are most susceptible because the nerves, tendons and blood vessels are close to the skin and underlying bones in those areas.



High Risk Patient Handling Tasks

The following traditional patient handling techniques have been shown to exceed the recommended force limits. They are considered to be high risk of injury, regardless of the weight of the patient. These techniques are not recommended and should be eliminated wherever possible.

1. Pivot transfer

   During a pivot transfer, the HCW stands in front of the patient to assist the patient to stand (or semi-squat) and turn 90-180°. The patient does not assist by taking steps once in a standing position. This transfer requires a high level of skill to perform correctly. It places greater reliance on the patient to understand what they have to do, i.e., achieve and maintain a weight-bearing stance and cooperate with the HCW at critical moments in the transfer. Even with training, there is still a tendency to lift the patient straight up to a standing position rather than assisting the patient to shift their weight forward (i.e., normal pattern of movement). The HCW must also perform the weight shift at a distance away from the base of the spine (awkward posture). Finally, if the patient fails to weight bear, this places a sudden force on the lower back of the worker.

2. Manual lift/hold/carry (e.g., cradle/basket lift, fore/aft lift, three-person lift, belt lift from floor)

3. "Hook and toss" or drag lift (i.e., using a patient's arm as a handle)

   A common practice is to use a patient's armpit as a handle and pull through the arm. This poses a significant risk of injury to the patient (e.g., shoulder pain and dislocation) and should be eliminated.

4. Drawsheets or incontinence pads (aka "soaker pads") for repositioning

   Incontinence pads were designed to absorb bodily fluids such as urine and wound drainage to keep beds and linens dry and protect patients' skin. They are not intended or suitable for repositioning patients – the excessive force required and improper placement under the patient does not make them conducive to repositioning patients.

Links:

[Soaker Pads Are Not For Repositioning]

[WRHA Help Reduce Soaker Pad Use]

5. Lifting and/or Holding Patient Limbs

The average weight of a patient's leg, arm, and head can be estimated as a percentage of total body weight where each complete lower extremity (i.e., foot, thigh, calf) weighs 15.7% of a person's total body weight, each complete upper extremity (i.e., upper arm, forearm, hand) weighs 5.1% of total body weight, and the head/neck weighs 8.4% of total body weight. Therefore, the lower limb of a patient weighing >220 lbs. would exceed the recommended maximum lift limit of 35 lbs. under ideal lift conditions. When considering less than ideal situations (e.g. where the limb is often lifted and/or held at full arm's length), strength capabilities and shoulder to grip length of US women, Water's et al. (2009) calculated the maximum recommended load for a one-handed lift to be 11.1 lbs. and two-handed lift 22.2 lbs. Furthermore, because muscle strength capabilities decrease as a function of time, maximum loads for holding body parts have been proposed for one-, two-, and three-minute durations.

TABLE 1. LIFTING AND HOLDING LEGS OR ARMS IN AN ORTHOPAEDIC SETTING

Patient Weight, lb (kg)	Body Part	Body Part Weight, lb (kg)	Lift		Hold		
			1 hand	2 hands	2 hands <1 min	2 hands <2 min	2 hands <3 min
<40 (<18)	Leg	<6.3 (3)					
	Arm	<2.0 (1)					
40–90	Leg	<14.1 (6)					
(18–41)	Arm	<4.6 (2)					
90–140	Leg	<22.0 (10)					
(41–64)	Arm	<7.1 (3)					
140–190	Leg	<29.8 (14)					
(64–86)	Arm	<9.7 (4)					
190–240	Leg	<37. (17)					
(86–109)	Arm	<12.2 (6)					
240–290	Leg	<45.5 (21)					
(109–132)	Arm	<14.8 (7)					
290–340	Leg	<53.4 (24)					
(132–155)	Arm	<17.3 (8)					
340–390	Leg	<61.2 (28)					
(155–177)	Arm	<19.9 (9)					
390–440	Leg	<69.1 (31)					
(177–200)	Arm	<22.2 (10)					
>440 (>200)	Leg	>69.1 (31)					
	Arm	>22.2 (10)					

***Note.* These are guidelines for the average weight of the leg and arm and are based upon the patient's weight. The maximum weight for a 1-handed lift is 11.1 lb. and for a 2-handed lift, 22.2 lb. No shading**: Okay to lift and hold; use clinical judgment and do not hold longer than noted. **Gray shading**: Do not lift alone; use assistive device or more than one caregiver.

Examples from Table 1: It is safe to manually lift the leg of a patient weighing 120 lb with two hands to place the leg in a sling, but it should not be manually held for more than a few seconds. Similarly, it is safe to manually lift the arm of a patient weighing 185 lb with two hands, but the arm should not be held in place longer than 1 min. In addition, it is safe to lift the arm of a patient weighing up to 440 lb with two hands, but the arm should not be held manually for more than a few seconds.

Links:

[Lifting and Holding Limbs]

6. Simultaneously swinging the legs and trunk of a patient

   During this transfer method from lying to sitting, the HCW swings the patient's trunk and lower limbs together to sit the patient on the edge of the bed. This often results in awkward postures (e.g., trunk rotation) and excessive force, especially if done in a hurry or without asking the patient to assist where they can.

References

Waters, T.R. (2007). When is it safe to manually lift a patient? The Revised NIOSH Lifting Equation provides support for recommended weight limits. *The American Journal of Nursing*, 107(8): 53-58.

Waters, TR, Sedlak, CA, Howe, CM, Gonzalez, CM, Doheny, MO, Patterson, M, Nelson, A. (2009). Recommended weight limits for lifting and holding limbs in the orthopaedic practice setting. *Orthopaedic Nursing*, 28(2 Suppl): S28-32.

E.K. Gillin & Associates Inc. (date unknown). *Ergonomics Certification-Phase I Introduction.* Ontario: E.K. Gillin & Associates