CHAPTER 17

Risk Assessment in Pressure Ulcer Prevention

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Objectives

The reader will be challenged to:

- Envision the appropriate use of risk assessment tools in a program of prevention of pressure ulcers
- Analyze interventions to reduce the intensity and duration of pressure in both bedfast and chairfast patients
- Propose a plan for evaluating a program of prevention of pressure ulcers
- Conceptualize occupational therapys contribution to the prevention of pressure ulcers.

Additional Resources:
National Guideline Center AHRQ - Pressure ulcers: prevention and management of pressure ulcers.
https://guideline.gov/summaries/summary/48026/pressure-ulcers-prevention-and-management-of-pressure-ulcers?q=pressure+ulcers

European Pressure Ulcer Advisory Panel/ National Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Advisory Panel - Treatment of pressure ulcers. In: Prevention and treatment of pressure ulcers: clinical practice guideline.
https://guideline.gov/summaries/summary/48866/treatment-of-pressure-ulcers-in-prevention-and-treatment-of-pressure-ulcers-clinical-practice-guideline?q=surgery+pressure+ulcers

Introduction

In recent years, a consensus has developed that the incidence of pressure ulcers in a facility or agency is an important indicator of quality of care. Unfortunately, as nurses and other healthcare professionals adjust to the increasing acuity of patients being cared for in every setting, they are suffering a sort of sensory overload. As more problems compete for their attention and less time is available to analyze the implications of all the data they collect, certain basic assessments and interventions are sometimes overlooked.

Pressure ulcer risk assessment and prevention seems to have been among these overlooked problems.[1,2] There is also evidence that a program of prevention guided by risk assessment can simultaneously reduce the institutional incidence of pressure ulcers by as much as 60% while reducing the costs of prevention.[3] ***One way to assure optimal risk assessment and effective prevention is through collaboration with multiple disciplines.*** The 2 disciplines most often involved in risk assessment and prevention are nursing and occupational therapy, but this collaboration has been minimally addressed in the literature. While nurses are primarily responsible for risk assessment, occupational therapists offer unique skills in the identification of special risks related to seating surfaces, instruction in pressure relief, and prescription of positioning devices and wheelchair seating. This chapter will pay significant attention to the contributions of both nursing and occupational therapy to effective prevention.

Braden BJ, Blanchard S. Risk assessment in pressure ulcer prevention. In: Krasner DL, van Rijswijk L, eds. *Chronic Wound Care: The Essentials e-Book*. Malvern, PA: HMP; 2018:225–242.

Table 1. A clinician's guide to research terminology	
Validity	Synonymous with accuracy; does the tool accurately identify those who are risk for pressure ulcers and those who are not?
Predictive validity	To what extent does the tool accurately identify those who will or will not develop pressure ulcers?
Reliability	Synonymous with consistency; to what extent does the tool consistently produce the same score in identical situations?
Interrater reliability	To what extent do different raters consistently assign the same score to the same patient?
Sensitivity	The percentage of people who develop a pressure ulcer that were previously identified by the tool as being at risk
Specificity	The percentage of people who do not develop a pressure ulcer and were previously identified as not being at risk

Table information adapted. Courtesy of Luther Kloth, PT, MS, FAPTA, CWS, FACCWS.

Norton Scale									
Physical Condition		**Mental Status**		**Activity**		**Mobility**		**Incontinence**	
4	Good	4	Alert	4	Ambulant	4	Full	4	Not controlled
3	Fair	3	Apathetic	3	Walks with help	3	Slightly limited	3	Occas. controlled
2	Poor	2	Confused	2	Chairbound	2	Very limited	2	Usually urinary
1	Very Bad	1	Stuporous	1	Bedfast	1	Immobile	1	Double

Figure 1. The Norton Scale.

Choosing a Risk Assessment Tool

Risk assessment is not confined to the problem of pressure ulcers. Risk assessment is part of the prevention of many diseases. Risk assessment tools are analogous to screening tests, which are used to detect incipient disease in persons who are asymptomatic. An assortment of screening tools has been used or proposed to determine whether patients are at risk for pressure ulcer development. These tools vary from simple (rating scales, serum albumin, serum transferrin) to complex (thermography, laser Doppler flowmetry, ultrasound).

The US Preventive Services Task Force recommends certain criteria in qualitatively evaluating the appropriateness of screening tests.[4] The first criterion is related to the effectiveness of the treatment for the condition predicted: Does the treatment do more good than harm? Is it more effective in asymptomatic patients than it is in symptomatic patients? Is there good evidence of that effectiveness? The second criterion relates to the burden of suffering, should the disease be contracted, in terms of mortality, morbidity, discomfort, dissatisfaction, or destitution. The third criterion relates to quality of the test in terms of reliability, validity, acceptability, safety, simplicity, and cost (Table 1). It is clear that risk assessment for pressure ulcer prevention is appropriate, given the first 2 criteria. The third criterion as it relates to risk for pressure ulcer development will require further exploration.

In looking at the various screening tools available, the paper and pencil rating scales possess the best balance of characteristics (eg, reliability, validity, acceptability, safety, simplicity, and cost). Indices such as serum albumin or serum transferrin, while somewhat lower in patients who develop pressure ulcers, are not valid predictors of pressure ulcer development.[5] The more complex tools, such as laser Doppler flowmetry and ultrasound, have higher costs, lack simplicity and practicality of use, and are less accurate as pre-

The Braden Scale for Predicting Pressure Sore Risk.

Patient's Name _____ Evaluator's Name_____ Date of Assessment

SENSORY PERCEPTION ability to respond meaningfully to pressure-related discomfort	**1. Completely Limited** Unresponsive (does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation. OR limited ability to feel pain over most of body	**2. Very Limited** Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness OR has a sensory impairment which limits the ability to feel pain or discomfort over ½ of body.	**3. Slightly Limited** Responds to verbal commands, but cannot always communicate discomfort or the need to be turned. OR has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities.	**4. No Impairment** Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort..				
MOISTURE degree to which skin is exposed to moisture	**1. Constantly Moist** Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	**2. Very Moist** Skin is often, but not always moist. Linen must be changed at least once a shift.	**3. Occasionally Moist:** Skin is occasionally moist, requiring an extra linen change approximately once a day.	**4. Rarely Moist** Skin is usually dry, linen only requires changing at routine intervals.				
ACTIVITY degree of physical activity	**1. Bedfast** Confined to bed.	**2. Chairfast** Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	**3. Walks Occasionally** Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of each shift in bed or chair	**4. Walks Frequently** Walks outside room at least twice a day and inside room at least once every two hours during waking hours				
MOBILITY ability to change and control body position	**1. Completely Immobile** Does not make even slight changes in body or extremity position without assistance	**2. Very Limited** Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	**3. Slightly Limited** Makes frequent though slight changes in body or extremity position independently.	**4. No Limitation** Makes major and frequent changes in position without assistance.				
NUTRITION usual food intake pattern	**1. Very Poor** Never east a complete meal. Rarely eats more than ⅓ of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement OR is NPO and/or maintained on clear liquids or IV's for more than 5 days.	**2. Probably Inadequate** Rarely eats a complete meal and generally eats only about ½ of any food offered. Protein intake includes only 3 servings of meat or dairy products per day. Occasionally will take a dietary supplement. OR receives less than optimum amount of liquid diet or tube feeding	**3. Adequate** Eats over half of most meals. Eats a total of 4 servings of protein (meat, dairy products per day. Occasionally will refuse a meal, but will usually take a supplement when offered OR is on a tube feeding or TPN regimen which probably meets most of nutritional needs	**4. Excellent** Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.				
FRICTION & SHEAR	**1. Problem** Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures or agitation leads to almost constant friction	**2. Potential Problem** Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.	**3. No Apparent Problem** Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair.					
					Total Score			

Figure 2. The Braden Scale for Predicting Pressure Sore Risk.
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dictors than the paper and pencil rating scales. Two rating scales have been recommended by the Agency for Healthcare Research and Quality (AHRQ) panel in its *Pressure Ulcer Prevention Guidelines*.[6] The Norton Scale[7] (Figure 1) and the Braden Scale[8] (Figure 2) were judged to have undergone sufficient testing to justify their use in making clinical judgments.

The parameters examined to establish the validity of this type of screening tool are sensitivity (ability to identify true positives while minimizing false negatives) and specificity (ability to identify true negatives while minimizing false positives). The Norton Scale has been reported to have good sensitivity but low to moderate specificity at a score of 14.[9,10] The Braden Scale [8,11–13] has demonstrated good sensitivity and specificity in a variety of settings at cutoff scores that range from 16 to 18. The Braden Scale has also been demonstrated to have excellent interrater reliability when used by registered nurses, but a much lower level of reliability when used by licensed practical nurses or nursing assistants.[11,12]

These risk assessment tools measure broad categories of factors that most commonly put patients at risk and that can be committed to interval ratings (eg, 1–4). Other factors enter into pressure ulcer risk, however. Some of the risk factors that have been found to predict who develops pressure ulcers and who does not are advanced age, low diastolic blood pressure, elevated body temperature, and inadequate current intake of protein.[5] Other factors are also thought to contribute to risk but have not been adequately studied include smoking, vasoactive drugs, and elevated cortisol levels due to exogenous or endogenous corticosteroids.[14]

In addition, specific patient populations may

Table 2. AOTA practice framework

Occupational Therapy Practice Framework	Braden Scale Score
Sensory perception (ability to perceive sensation, pain, pressure via mechanoreceptors) Motor and sensory function of dermatomes and myotomes.	Sensory perception: ability to respond to meaningful pressure related
Bowel and bladder (continence and hygiene following toileting)	Moisture: degree to which skin is exposed to moisture
Basic Activities of Daily Living (grooming, self-feeding, dressing from a upright or seated position) Functional Independence Measure Modified Falls Efficacy Scale Canadian Occupational Performance Measure	Activity: degree of physical activity
Bed mobility Wheelchair mobility Functional mobility Mobility-related ADLs (access to essential areas, transfers to bed, bath tub, commode, or car)	Mobility: ability to change and control body position
Eating: mastication and bolus formation Swallowing: 4 stages of swallowing Self-Feeding: plate to mouth pattern	Nutrition: usual food intake pattern
Pressure Relief (push-ups, lateral weight shifts, or forward raises) Range of motion, strength to perform pressure relief and transitional movements	Friction and shear: level of assistance required to move

have unique characteristics that are not measured by existing risk assessment tools. For example, spinal cord rehabilitation units have a population that is fairly homogeneous with respect to sensory perception, mobility and activity, thus limiting the predictive capacity of those subscale scores. Other predictors may have to be considered, and specialized tools may prove more useful.[15,16]

Pressure Mapping as a Specialized Tool

Occupational therapists may utilize the Braden or Norton Scale to predict pressures ulcer risk and pressure mapping to determine and prioritize the site of the risk. According to Harrison and Loukras, "Pressure is defined as Pressure = Force/Area. Therefore, an effective method of reducing pressure is to increase the area of contact, resulting in pressure reduction. Load distribution can be achieved by providing support distally on the anterior thigh and laterally across the buttocks and by accommodating the bony prominences of the anatomical seating surface."[17] Pressure mapping is a pressure sensor system that utilizes computer aided design/computer aided manufacturing (CAD/CAM) to identify a patient's pressure distribution when seated. An advantage of pressure mapping is that a graph or chart provides a representation of pressure areas. A disadvantage is that movement causes the pressure distribution to change.[18,19] Stinson et al[20] recorded 2 sets of pressure maps of 15 occupational therapists with experience in pressure mapping and 50 occupational therapy students with no practical experience in pressure mapping. Subjects ranked both sets of maps in terms of best to poorest distribution of pressure. Pressure maps, average interface pressure (mmHg) and maximum interface pressure (mmHg) were rank-ordered. Results suggest that pressure map interface pressure was a reliable method in identifying pressure risks. There was significant agreement ($P < 0.001$) between groups of operators and reliability extended over the range of seating surfaces. Thus, pressure mapping is a reliable assessment for interpreting interface pressure in seating and may be used to guide treatment intervention.

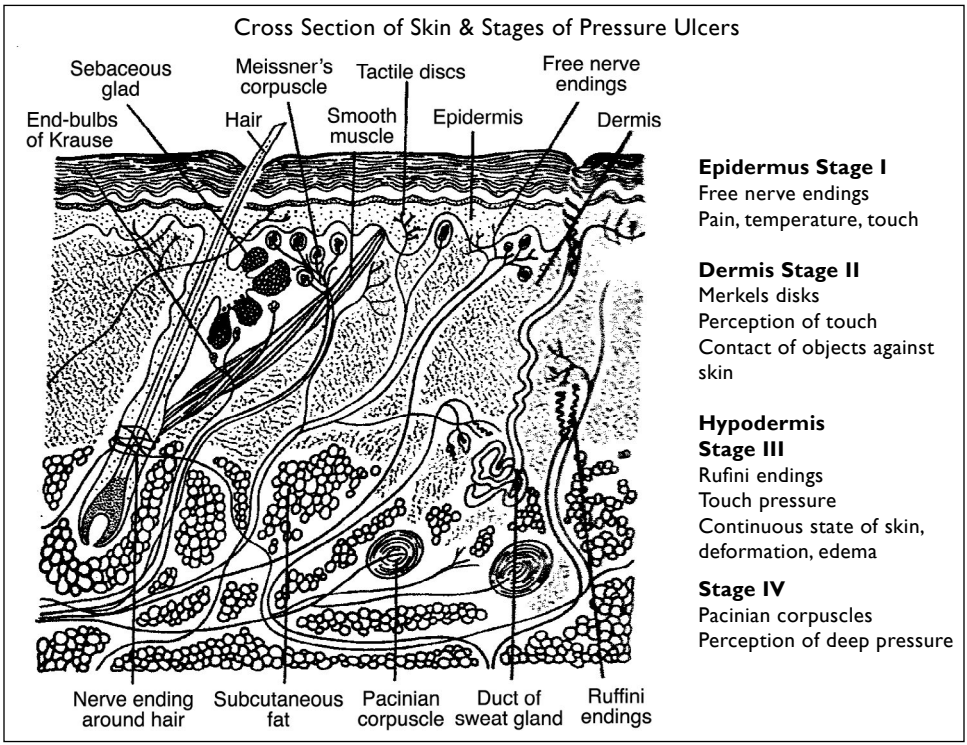


Figure 3. Layers of the skin and sensory perceptual structures associated associated with each pressure ulcer stage.

Using Risk Assessment in Prevention Programs

At-risk patients should be identified on admission to healthcare facilities and home care services. The activity subscales of either the Norton Scale or the Braden Scale can be used to determine whether patients require a full assessment for pressure ulcer risk. Following the admission assessment, reassessment should take place 48 hours later and at periodic intervals depending on the rapidity with which the condition changes as well as whenever a major change occurs in the condition.

Special vigilance is required during acute illness and during the first 2 weeks following admission to long-term care, as these are times of high risk for pressure ulcer development. In one prospective study of nursing home residents, investigators followed new admissions for 3 months and found that 80% of those who developed a pressure ulcer did so within 2 weeks of admission and 96% did so within 3 weeks of admission.[5] ***Thus, an appropriate schedule for reassessment of pressure ulcer risk in nursing homes might be every week for 4 weeks followed by routine quarterly assessments.***

In hospital settings, reassessments are often performed daily in intensive care units (ICUs) and every other day in general medical-surgical units. If this schedule is burdensome, it may be sufficient to assess on admission and 48 hours later. In home care, screening should probably be done with every registered nurse visit as the frequency of these visits is generally predicated on the severity of illness or the lability of the condition of the patient.

Clinicians should keep in mind that the risk assessment tools are intended to supplement their judgment but not replace it. Additional factors should be considered when patients are assessed for risk of pressure ulcer development. Nurses and other practitioners should also keep in mind that patients who are rapidly improving (eg, young

Table 3. Protocols by level of risk

Mild Risk (15–18)*

- Turning schedule
- Maximal remobilization
- Protect heels
- Manage moisture, nutrition, friction, and shear
- Pressure reduction support surface if bed- or chair-bound

*If other major risk factors are present, advance to next level of risk

Moderate Risk (13–14)*

Turning schedule with 30° rule
+
All interventions for mild risk

High Risk (10–12)*

- Frequency of turning and facilitate 30-degree lateral turns with foam wedges
- Supplement turning with small shifts

+
All interventions for mild risk

Very High Risk (>_ 9)

- Consider static air overlay if adequate monitoring possible
- Consider use of low-air-loss bed if patient has additional risk factors ameliorated by low-air-loss beds OR uncontrolled pain OR severe pain exacerbated by turning

+
All interventions for mild risk

*low-air-loss beds do not substitute for turning schedules

persons recovering from surgery) are probably at low risk, although their scores at the time may indicate otherwise. Likewise, persons whose level of function and health is declining may be at higher risk than their scores would indicate.

Occupational Therapists and Risk Assessment

Occupational therapy practitioners providing services in the ICU, acute care, rehabilitation, long-term care, and home health may utilize the Braden Scale score or the Norton Scale score provided by the nursing staff as a first step when determining the cause of pressure ulcer risks. In recent times, more occupational therapy practitioners are using the Braden Scale as a primary assessment tool to aid in predicting pressure ulcer risks. There are several reasons why the Braden Scale score is utilized in occupational therapy practice. First, occupational therapy practice is guided by the American Occupational Therapy Association's Practice Framework (PFW).[21] The PFW guides practice intervention and identifies specific areas that need to be addressed prior to treatment intervention. The Braden Scale score mirrors the PFW and is comprised of specific occupational therapy performance areas, skills, and patient factors. Performance areas include activities of daily living (ADLs) and performance skills address strength and range of motion (ROM) necessary to achieve mobility and perform self-pressure relief (Table 2). Patient factors include cognitive and neuromusculoskeletal structures that may affect attention span and sensory receptors, which are responsible for the perception of pain and pressure that directly impact skin integrity during seating and positioning. Figure 3 represents a cross section of skin and mechanoreceptors that may be compromised depending on the stage of pressure ulcer (Stages I–IV). Second, occupational therapists need to follow guidelines for reimbursement laid out by the Centers for Medicare and Medicaid Services (CMS) in the Advanced Determination of Medicare Coverage for Durable Medical Equipment (mobility, seating, positioning). Claims reviewers recommend the use of evidence-based assessment tools, such as the Braden Scale and pressure mapping,[22] to aid in making a determination regarding occupational therapists' recommended pressure relieving devices (eg, as wheelchair bases, seat backs, and cushions). Third, reviewers also require an International Classification of Diseases, Ninth Revision, Clinical Modifications (ICD-9-CM) code that represents the medical necessity for providing intervention; occupational therapy practitioners may utilize the PFW and the Braden Scale score to select appropriate primary and secondary ICD-9-CM codes. For example, a patient diagnosed with chronic obstructive pulmonary disorder (COPD) or congestive heart failure (CHF) would have a primary diagnosis code of 496, an occupational therapy treatment diagnosis of lower extremity edema of 457.1, a compromised sensation code of 780, and a Braden Scale score of "high risk" (10–12).[23] Because patients with COPD or CHF are often immobilized

Table 4. Turning schedules

These turning schedules may be used to organize care on nursing units with large numbers of patients who are at risk for pressure ulcers. Patients on a team or unit can be assigned to 1 of 3 schedules in a balanced manner, eg, if 6 patients are at risk, 2 would be assigned to each of the 3 schedules. These schedules may have to be adjusted to each day, depending on other components of the patient's schedule.

Direction of Turn	Schedule 1	Schedule 2	Schedule 3
1. Back (breakfast and bath)	7:00–9:00	7:30–9:30	8:00–10:00
2. Right side	9:00–11:00	9:30–11:30	10:00–12:00
3. Back (lunch)	11:00–1:00	11:30–1:30	12:00–2:00
4. Right side	1:00–3:00	1:30–3:30	2:00–4:00
5. Left side	3:00–5:00	3:30–5:30	4:00–6:00
6. Back (dinner)	5:00–7:00	5:30–7:30	6:00–8:00
7. Left side	7:00–9:00	7:30–9:30	8:00–10:00
8. Right side	9:00–11:00	9:30–11:30	10:00–12:00
9. Left side	11:00–1:00	11:00–1:30	12:00–2:00
10. Back	1:00–3:00	1:30–3:30	2:00–4:00
11. Right side	3:00–5:00	3:30–5:30	4:00–6:00
12. Left side	5:00–7:00	5:30–7:30	6:00–8:00

secondary to compromised physical conditioning, they may develop edema in the same areas where pressure ulcers develop.[24] Pitting edema develops in dorsal, sacral, and peripheral extremities that are in a dependent position. Edema increases capillary pressure and inhibits transport of nutrients to the cells. "The presence of interstitial fluid increases the distance from the capillary to the cell. The rate of diffusion of nutrients is reduced by the reciprocal of the square root of that distance; this is calculated as field theory. Thus local edema doubles the capillary-to-cell distance and decreases the supply of nutrients."[24] Finally, when occupational therapists couple the Braden Scale score with a comprehensive seating assessment, pressure mapping, or the use of a pressure sensor, the practitioner is able to prescribe appropriate wheelchair bases, cushions, and back supports.

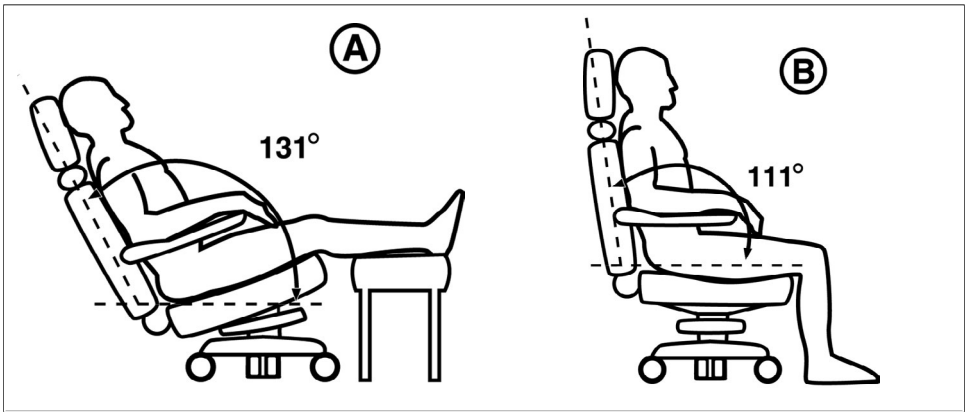
Preventive Protocols Based on Level of Risk

Preventive interventions should become more frequent and/or intense as risk increases. Braden and Bergstrom[8] have made specific recommendations based on level of risk (Table 3). There is evidence that this approach leads to more effective and less expensive care.[3,25,26] This likely occurs because appropriate assessment of risk allows the clinician to limit interventions to those persons who are at risk, to reserve intensive and costly interventions to those who are most in need, and to identify and address specific problems or factors that contribute to that level of risk.

Reducing the Exposure to Pressure

Turning schedules. Close attention should be paid to an individualized turning schedule. Sample turning schedules that account for periods when the patient must be on his or her back, such as during meals and morning care, can be seen in Table 4. These schedules can be further altered to meet individual patient needs. Repositioning should be done with assistance and with attention to good body mechanics, such as using pillows and pads to protect bony prominences.

To protect the heels when the patient is supine, pillows should be used to support the entire length of the legs, ending at the ankles and suspending the heels above the mattress. The heels must be checked frequently to ensure that, as the pillows compress, they remain free of pressure. If use of the pillows is not effective in protecting the heels, consult physical therapy or occupational therapy to construct devices that adequately protect the heels from excessive pressure. Pressure-



Figures 4a and 4b. Chair positioning. Adated from Defloor T, Grypdonck MH. Sitting posture and prevention of pressure ulcers. *Appl Nurs Res. 1999;12(3):136–142.*

relieving ankle-foot orthoses are often used to prevent pressure on the heels.

At higher levels of risk or for emaciated patients, turning schedules should include either increased frequency of turns or assisted frequent, small shifts in body weight. Lateral turns should not exceed 30 degrees[27] and, if at all possible, the head of the bed should not be elevated beyond 30 degrees. Foam wedges are helpful in lateral positioning and can be used to increase the frequency of repositioning by pulling it out slightly every 30 minutes to 1 hour. If narcotics or sedatives are being used, extra attention should be paid to turning during those times of heavy sedation. A turning schedule linked to meal time may be posted at the head of the patient's bed to facilitate interdisciplinary and inter-shift communication.

When patients can tolerate the prone position (ie, lying horizontally with the face down) it should be added to the turning schedule, as it allows the most common sites of pressure ulcer formation (eg, sacrum, trochanters, heels) to be totally relieved of pressure while also preventing flexion contractures of the hips. Careful padding and positioning are required if the prone position is employed. Prone positioning is contraindicated in patients who have a gastrointestinal tube or nasogastric tube due to the high probability of regurgitation and aspiration. In addition, partial or full paralysis of the diaphragm or trunk may impede adequate respiration in the prone position.

Attention must also be paid to effective chair positioning, as very high interface pressure and shearing forces can develop with poor posture or seating surfaces. Defloor and Grypdonck[28] found that a chair position with the back tilted slightly backward, with the leg supported on a rest and the heel extending over the end of the rest, resulted in the lowest interface pressures at the sacrum and ischial tuberosities (Figure 4a). If this position cannot be achieved with the available seating, an upright posture with feet resting on the floor in a chair equipped with arm rests should be used (Figure 4b).

Wheelchair Positioning

There are many different types of and brands of wheelchairs that may be used to aide in pressure relief, positioning and mobility. Common areas of pressure loading secondary to wheelchair seating include the scapula and spine, elbow and forearm, knee and calf (politeal fossa), buttocks, and heel and foot. Pressure, friction and shearing must be considered when selecting a wheelchair. The frame, back, and seat comprise the seating system. Seating systems are attached to a wheeled base for mobility. Goals of seating and positioning include evenly distributing pressure over a large surface, preventing friction and shear, and providing a stable support surface.

Pressure ulcers tend to develop when the amount of pressure that can be tolerated reduces blood flow to capillary beds to between 30 and 100 mmHg. The amount of pressure exerted on the patient's buttocks, sacrum or other anatomical structures

by the seating system must be determined prior to prescribing the final wheelchair seat and back. Braden Scale scores, pressure mapping, and pressure monitoring aid in determining the best wheelchair seat and cushion for pressure relief.

A majority of wheelchairs prescribed for consumers will be manual, tilt in space, or recline. The type of wheelchair prescribed depends on the physical (strength, ROM, sensation) and cognitive ability (cause and effect, memory, problem solving, and level of self-care participation) of the patient.

Manual (mobility-based) wheelchairs may be self-propelled with the upper and lower extremities or by an assistant. Various wheelchair seats and backs may be added to manual bases for pressure relief to bony prominences. A standard or manual wheelchair does not have a tilt or recline feature, so there is increased loading on the ischial tuberosities. When the vinyl or nylon seat and back upholstery become stretched out secondary to wear, the back and seat may become slung, adding to the hammock effect of seating. Hammocking of the wheelchair seat and back increases musculoskeletal deformities, including posterior pelvic tilt (sacral sitting), anterior pelvic tilt, scoliosis, obliquity, and a combination of deformities referred to as windswept. A key factor in reducing pressure ulcers associated with manual wheelchair sitting is to have the patient move off the area. Patients who have adequate upper extremity strength and ROM are encouraged to perform self-pressure relief. Pressure relief to the ischial tuberosities, greater trochanters, sacrum, buttocks, popliteal area, and upper extremities may be achieved through performing push-ups, lateral weight shifts from sided to side, and forward raises.

Remobilization of the immobile. When a patient is found to have deficits in activity or mobility, the nurse should always be alert to the patient's potential to become remobilized. During an episode of illness, it is easy for an elderly person to be less active than is optimal and to enter into a spiral of deconditioning and decline. This leads to a myriad of complications beyond increased pressure ulcer risk. A physical therapy consultation may be helpful in determining the degree to which remobilization is possible and beginning the process of remobilization. The physical therapist, the occupational therapist, the nurse, and, if possible, the patient should collaborate in developing a plan that is clear about the responsibilities that each one holds in the process of remobilization.

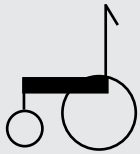
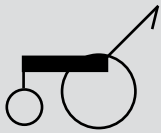
In cases for which the return to full mobility is not possible, the patient can be taught to make small shifts in body position. This includes things such as moving the legs and shifting weight from one buttock to another. If the person is wheelchair-bound, he or she needs to be taught to perform a variation of the push-ups. To perform this push-up, lock the wheelchair or brakes, make sure the armrests are locked to the wheelchair, grasp the armrest with respective right and left hands, and push down of the armrest. This will result in the buttocks being lifted or pushed up from the wheelchair seat. Wheelchair push-ups should be performed every 15 minutes throughout the time spent in the wheelchair.[24,29]

Performing lateral weight shifts requires good balance and strength. The patient places his or her elbows on the left or right side of the wheelchair armrests and turns to the left or right side and shifts the weight off the buttocks of the respective side. The hips and buttocks should be lifted at least 1 inch off the chair (seat) surface; the patient should lean far enough to the side to allow a hand to guide under the buttock or thigh. Lateral weight shifts should be performed every 15 minutes throughout the time spent in the wheelchair.[24,29]

Forward weight shifts or raises may also be performed from a manual wheelchair. The patient with good balance removes his or her feet from the wheelchair footrests and places them onto the floor. The trunk is positioned in forward flexion and the elbows rest on the distal thighs or knees until the buttocks are lifted off the wheelchair seat. A duration of every 15 minutes throughout the time spent in the wheelchair is congruent with pressure relief time recommended for push ups and lateral weight shifts. Forward raises should be performed by patients who have adequate balance, strength, ROM, and knowledge of cause and effect.

The elbow or wrist may also be hooked around the wheelchair push-handle allowing, the patient to lean to the opposite side or forward. Patients who cannot perform wheelchair push-ups or forward raises because of balance or other safety reasons should perform lateral weight shifts in bed using a bed rail.

Table 5. Pros and cons of manual recline and tilt wheelchair positioning systems

Type of Seating system	Pros	Cons
Manual or Standard Wheelchair 	• Self-propelled • Use upper- and lower-extremity for propulsion • Self-pressure relief • User positioned in upright-position	• Force of gravity increases falling forward or to the side • Hammocking of wheelchair seat and back • Increased associated musculoskeletal deformities
Recline System 	• Distributes pressure • Easier intermittent catheterization • Transfers easier with back of wheelchair reclined	• Increased pressure over sacral area • Molded system increases shear forces • Disrupted postural alignment increases shear forces • Limited knee or hip ROM pulled out of position
Tilt System 	• Comfort • Increased sitting tolerance • Minimal shear forces	• Constant hip flexion limits bladder emptying • Prolonged hip and knee flexion increases potential for contracture • Interferes with use of lap tray

Adapted from Lange[30] and Perr.[62]

Because patients using manual wheelchairs are expected to participate in pressure relief using one or more of the aforementioned types of pressure relief either manually or aided by an assistant, clinicians may want to increase the possibility of adherence by designing a weight shift schedule. Providing a reminder such as an auditory cue (eg, an alarmed wrist watch) or a vibratory cue (eg, a vibrating PDA) placed in an area of normal sensation may also be an effective reminder to perform pressure relief.

Weight shifts may also be achieved by using a tilt-in-space or recline feature of a wheelchair. A 45-degree tilt allows adequate pressure relief. Tilt and recline wheelchairs or seating systems may also aid in pressure relief, seating stability, comfort, and rest (Table 5). Some seating systems combine tilt and recline features.[30]

Recline systems open the seat to back angle, which allows the patient to lie down and back and return to an upright position. Shearing and friction are often associated with wheelchair repositioning. When a reclining back of a wheelchair is raised or lowered, the patient's skin tends to adhere to the surface of the wheelchair seat or back. Friction may occur when the skin slides over skin during repositioning of the wheelchair or when performing transfers. Recent gains in seating technology include low- or no-shear backs for reclining wheelchairs.

"Tilt-in-space systems allow the patient to drop back without changing anatomical angles (bending at the hips and knees)."[30] Tilt systems are used for patients who have increased tone, orthopedic limitations (contractures), or forward head postures, which compromise speech, swallowing, or eye gaze.

Use of special support surfaces. Support surfaces include overlays (mattress or wheelchair seating), mattress replacements, or specialty beds. Mattress overlays and mattress replacements may be classified as either static (eg, foam, gels) or dynamic (eg, alternating pressure surfaces). Specialty beds are classified as either low-air-loss or air-fluidized. The comparative effectiveness of these surfaces is difficult to evaluate, but findings converge on these areas: a) almost any surface tested reduced interface pressure below those seen with

a standard hospital mattress;[31–33] b) foam overlays that were 2–3 inches thick did not compare favorably to other pressure-reduction surfaces,[34] including thicker foam surfaces;[35] c) foam mattresses with flat surfaces are more effective than those with convoluted foam surfaces;[36] d) static air overlays, if properly maintained, are some of the most effective overlays at reducing interface pressure, performing nearly as well or equally well as specialty beds;[37–39] e) air-fluidized beds and low-air-loss beds result in substantial pressure reduction and appear to be beneficial in healing pressure ulcers, though results are not always dramatic,[40–43] and f) rotating beds show no apparent benefit over standard hospital or ICU beds.[44,45] Two excellent integrated reviews of existing research related to efficacy of various pressure reduction surfaces by Whittemore[46] and Reddy et al[47] are suggested for those requiring more detailed information.

If the patient is bed-bound, an overlay or replacement support surface to decrease interface pressure over bony prominences is recommended.[6] If the Braden Scale score is below 9 or the patient has intractable or severe pain exacerbated by turning, use of a low-air-loss bed may be indicated. ***It is important to remember that turning will still be necessary to prevent pressure ulcers and other complications of immobility. However, the nurse must be clear about the goal of care for these patients. When the patient is terminal and the goal of care is provision of comfort, a rigorous schedule of turning is not appropriate.***

Patients who are chair-bound also require special support surfaces, as the interface pressures that develop at the sacrum and ischial tuberosities when seated on a hard surface are much higher than those experienced in a supine position. Few studies have been published on chair seating surfaces, but a recent study comparing 4 surfaces (2 static air, 1 foam, and 1 water-cushion) found that the static air cushions provided the best pressure reduction.[28]

Wheelchair Support Surfaces

The type of wheelchair back and cushion will depend on the needs of the patient, prior history of pressure ulcers, awareness of sensation, and ability to perform pressure relief. Occupational therapists prescribe wheelchair cushions to prevent the risk of sitting acquired pressure ulcers (SAPUs). Periodic reassessments of the effectiveness of the base of support is performed for long-term tertiary prevention. An ideal cushion distributes pressure evenly over a large surface area, is lightweight, requires minimal maintenance, and provides even pressure distribution which facilitates circulation. Research consistently suggests that no one cushion is universally effective for all patients.[18,48–50]

Various strategies are used to select wheelchair cushions including an individual needs assessment, Braden or Norton scale scores, medical history and comprehensive review of systems (eg, neuromuscular skeletal, sensory, cognitive, vision), results of pressure mapping, physical conditioning (ability to perform self-pressure relief, activity tolerance, and energy expenditure) and how the wheelchair and seating surface will be used to accommodate lifestyle and occupational (functional) performance.

For able-bodied persons sitting is not static but dynamic, and posture is generally modified approximately every 15–20 minutes. For persons immobilized by disabling conditions, wheelchair cushions are prescribed to compensate for inadequate pressure relief, increase sitting tolerance, and allow maximum participation and performance of ADLs. Wheelchair cushions provide a firm base of support, minimize the hammocking effect or slung wheelchair seat, and promote postural alignment. Thus, associated deformities (eg, posterior pelvic tilt, obliquity, and scoliosis) are reduced.

All wheelchair users benefit from pressure relieving cushions. Medicare classifies wheelchair cushions into 4 basic types: a) a 1-inch cushion; b) a 2-inch cushion; c) a pressure-equalization cushion; and d) a custom-molded seat. To qualify for a 1- to 2-inch cushion, the wheelchair user must sit in the wheelchair at least 4 hours per day. Pressure equalization cushions are prescribed for patients meeting the following criteria: 1) the patient is unable to perform self-pressure relief; 2) skin is insensate under the ischial tuberosities; 3) abnormal tone increases buttock migration or sliding; 4) muscle atrophy impedes ability to shift weight; 5) age-related changes diminish strength of the skin and reduce circulation with increase risk of skin breakdown; 6) orthopedic deformities increase pressure over bony prominences; and 7) diabetes compromises circulation in the lower

Table 6. Comparison of wheelchair cushions

1 - Excellent	2 - Good	3 - Fair	4 - Poor	
Characteristics	**Foam**	**Fluid/Gel**	**Air**	**Custom**
Availability	1	1–2	1–2	4
Can be customized	2	2	2	1
Numerous choices	1	2	2	3
Comfort	2	2–3	1	1
Stable base of support	3	1	2–3	1
Low maintenance	1	3	3	1
Easy to clean	4	1	1	1
User friendly	1	3	3	1
Durable	4	2	2	1
Skin breakdown protection	3–4	1	1	1
Shear protection	3–4	1	1	3–4
Prevents heat buildup	3	4	1	3
Allows good air circulation	4	4	1	4
Lightweight	1	3–4	1	4
Cost	1	3	3	4

Adapted from Schmidt[63]

extremities while seated.[51]

The composition of wheelchair cushions has changed based on technology, evaluation of pressure between the cushion and the seating surface, type of wheelchair base, and the lifestyle of the consumer. Practitioners are more knowledgeable about wheelchair cushions and are using evidence-based practice to match the patient's risk factors for pressure ulcers to positioning needs and the most effective seating system based on occupation and lifestyle.[52] "New technologies are reintroducing the concept of offloading-translating pressure to muscular areas, such as gluteal and posterior thigh and eliminating pressure from the ischial tuberosities and coccyx."[48,30] When offloading is combined with computerized pressure mapping, the clinician gains a sound understanding of the magnitude of pressure resulting from the buttock and seat interface.

Cushions are selected based on their ability to provide pressure relief and prevent pressure ulcers. Other considerations include weight, height, contour, shape, size, stability versus emersion, composition of materials, cover material, maintenance, and cost.[48] Cushions also provide comfort through shock absorption and vibration reduction. Repetitive shock and vibration may result in pain in the back and pelvis, increased fatigue, and reduced sitting tolerance. Cushions may reduce friction and shear between the wheelchair and the buttocks and aid in minimizing the development of heat and moisture at the seat interface.[53]

Practitioners must also consider cushion density, stiffness, resilience, dampening, and envelopment. Interface pressure depends on the properties of stiffness, dampening, and enveloping. Stiffness is defined as the depth at which the patient sinks into the cushion. Dampening refers to the cushion's ability to soften and reduce the impact of tissue loading during activity. Enveloping is the cushion's ability to surround or contain the buttocks. Interface pressure mapping assists in the evaluation of envelopment.[50]

Cushions may be classified as linear and nonlinear. Linear systems (eg, foam) conform to the weight of the individual, and nonlinear cushions are custom-contoured or modular.[53] Cushions may be static (pressure-reducing) or dynamic (pressure-relieving). Static cushions are used when the risk of developing pressure ulcers is low to high, and dynamic cushions are used with high risk or existing pressure ulcers.[54]

Custom-contoured cushions maximize contact with the support surface, provide pressure relief, and accommodate fixed-orthopedic deformities, such as pelvic obliquity. Contoured cushions are constructed by pushing foam up underneath a planar surface, resulting in a pressure distribution that is shaped like the person. Vacuum molding creates a negative impression that is recorded digitally and utilizes pressure mapping to guide cushion fabrication. Contoured cushions provide a stable base of support and are durable. Patients may experience shear and heat build-up depending on the surface coating.

The most commonly prescribed cushions are gel, air, flotation, or a combination of different shapes and materials. For example, "floam" is a newer technology that is lighter than gel; viscosity is stable with temperature changes, and the cushion is durable up to 3–5 years with proper care. Some cushions are constructed of thermoplastic material in which the cells resemble a honeycomb; the perforated walls of the cushion add ventilation and provide pressure relief and are easily laundered.[55]

Foam cushions are lightweight, have varying degrees of density (firm or soft), and may be open- or closed-cell. Foam used for pressure relief may be layered with varying levels of density (pound weight), which helps to maintain shape. Foam is temperature-sensitive, so it is important to use foam that is resistant to temperature changes. Foam cushions less than 6–7 cm deep tend to bottom out more quickly than those that are 10–11 cm deep. Advantages in selecting foam include its numerous choices, its low cost, its light weight, its degree of comfort, and its low maintenance. Foam is not easy to clean, and it provides fair pressure relief.[48,54]

Cushions that utilize air are lightweight. They require regular maintenance and consistent monitoring, and they are easily punctured. Air cushions are based on flotation technology and provide excellent pressure relief. Pressure reduction and positioning occur when the body is immersed into the surrounding air sacs depending on the profile of the cushion (eg, high or low or wedged), stability or base of support may be compromised. Air minimizes heat build-up and moisture. Lower interface pressures are achieved with nonstretch cushion cover materials; cushion cover materials may limit immersion based on the degree of stretch.[48,54]

Gel cushions are heavier than air and foam and are temperature sensitive. Polymer gels reduce shear as the material moves with the skin; therefore, immersion is limited and aids in cooling the skin. Polymer gels may be used in combination with foam-based cushions. Fluid gels promote immersion and reduce shear because bony prominences move within the fluid. Bottoming out may occur as a result of repetitive immersion.[48,54] Table 6 illustrates the comparison of properties between foam, gel, air, and custom cushions.

Wheelchair seat backs may also cause pressure ulcers over the vertebral spine (eg, the apex of kyphosis) and spine of the scapula. Assessments used to determine pressure ulcer risk associated with seat cushions may also be used for seat backs. Seat backs may be constructed of gel or foam, and they may be modular or contoured. For patients experiencing lateral flexion of the trunk, padded lateral supports may be used to reduce pressure to the ribs. Correcting scoliosis may require three points of interface contact between the lower ribs, shoulder, and hip and may result in pressure ulcers. Practitioners attempting to correct fixed deformities of the spine may need to consider using a tilt-in-space wheelchair base.

Managing moisture. Exposure of the skin to excessive moisture from any source can weaken the outer layers and increase the opportunity for skin injury. Incontinence is a common cause of skin maceration and breakdown. A variety of interventions aimed at reducing or eliminating incontinent episodes is available to clinicians, including use of bladder training, prompted voiding, or other behavioral methods.[56,57] After each incontinent episode, the nurse should use a very mild soap to cleanse the skin, rinse thoroughly, and pat the skin dry before applying a commercial moisture barrier. Absorbent underpads or briefs should be used, checked frequently, and changed as needed. The use of thin, plastic-backed underpads should be avoided, as these keep the mattress dry while the patient sits in a pool of urine or liquid stool.

Diarrhea is very caustic to the skin and can lead quickly to skin breakdown. An attempt should be made to determine the cause of the diarrhea and eliminate that cause. Such diarrhea may be related to hyperosmolar tube feedings or

Table 7. Formulas for program evaluation		
Prevalence	=	# with pressure ulcers # surveyed during study
Nosocomial rate	=	# with ulcers during study - # with ulcers on admission # of patients surveyed during study
Severity Index	=	([length + width]/2) x stage
Severity Index for Hospital	=	total severity index for all pressure ulcers total # with pressure ulcers

impaction. If intervention to stop the diarrhea does not bring quick results, a fecal incontinence pouch should be used while further attempts at control are made.

Perspiration can be problematic when it is constant, trapped between skin folds, or held close to the skin through contact with nonbreathable support surfaces. Absorbent materials should be used beneath the patient and next to the patient's skin. Use of absorbent powders is generally not advisable, as the powder may collect in skin folds and become a source of injury. If perspiration is the result of a nonbreathing support surface, an alternative surface should be sought.

Friction and shear. Friction and shear are very harmful to the skin and make it particularly susceptible to the effects of pressure. Dinsdale[58] used swine to investigate the effects of friction. He found that, in the absence of friction, a pressure of 290 mmHg was required to produce ulceration while a pressure of only 45 mmHg would produce ulceration in skin pretreated with friction.

Several interventions may be used to prevent or ameliorate exposure of the skin to friction and shear. The use of a trapeze or turning sheet may be used to assist movement in bed. Ankle and heel protectors, while doing nothing to relieve pressure, may be very helpful in protecting these areas from friction. In some instances, hydrocolloid dressings may be used over a particular prominence that is being exposed to friction.

Shearing can occur in the sacral area when the head of the bed is elevated or the patient slumps in a chair. ***For those who are bedfast, maintaining the elevation of the head of the bed at or below 30 degrees will prevent shearing as well as excess pressure at the sacrum. This may not be possible at all times, but the duration of higher elevations should be minimized in persons at higher levels of risk.*** When slumping in a chair is problematic, a recliner or special chair that allows for slight backward recline with elevated legs should be considered.

Nutritional repletion. Both long-term and short-term problems with nutrition make patients more prone to pressure ulcer development. It appears that an even slightly lower than optimal dietary intake of protein is an especially strong risk factor.[5] It is possible that immediate nutritional repletion, particularly for protein intake, may provide some protection. If the patient has good liver and renal function, it may be helpful to increase protein intake beyond 100% of the Food and Drug Administration (FDA)'s recommended daily allowances (RDA) and increase general caloric intake so as to spare the protein from being used for energy. Although there is no direct evidence that vitamin deficiencies increase the risk for developing pressure ulcers, it is known that vitamins A and C and zinc are important in building new tissue and healing injured tissue. Nutritional supplementation with these vitamins and minerals may be helpful.

When there are problems with nutrition, a consultation with a registered dietitian should be considered. This is particularly important when the patient is being fed enterally to ensure adequacy of the feeding for the individual patient's needs. If the patient develops diarrhea, a change to a feeding with a lower osmolality, higher fiber content, and/or lower volume may be sufficient to treat the diarrhea. Bacterial contamination from the feeding equipment should be considered as a potential contributing factor. Occasionally, antidiarrheal medication may be necessary.

Evaluating a Program of Prevention

Developing an evaluation plan for a program of prevention is important for a variety of reasons.

Table 8. Stratification of data by pressure ulcer stage and level of risk

		Total Pts.	PU-	PU+	Stage 1	Stage 2	Stage 3	Stage 4
Not at risk	#	700	700	0				
Low Risk	#	170	110	60	45	15	0	0
	%		65%	35%	26%	9%		
Mod. Risk	#	75	35	40	20	20	0	0
	%		47%	53%	27%	27%		
High Risk	#	35	5	30	5	21	4	0
	%		14%	86%	14%	60%	12%	
Very High Risk	#	20	0	20	5	7	4	4
	%			100%	25%	35%	20%	20%

Note: All percentages represent percents of the total number of patients at that level of risk.

One important but seldom recognized reason is that the act of periodically evaluating progress and giving feedback to nursing staff has been shown to enhance the effectiveness of the overall program. For example, one Midwestern tertiary care hospital, using a continuous quality improvement strategy that allowed for this periodic feedback, cut the nosocomial rate of pressure ulcers from 18.7% to 6.4% over 3 years.[3]

Baseline data are important to the accurate measurement of the impact of the program of prevention. While many clinical facilities/agencies have sophisticated management information systems that enable them to determine how many pressure ulcers had been documented by the nursing staff in a previous time period, a point-prevalence study is a better method for obtaining an accurate baseline. This is because prior to implementation of a formal program of prevention, the nursing staff may not be attentive to certain pressure ulcers, particularly partial-thickness lesions. This inattentiveness leads to under-documentation and, therefore, underestimation of the problem. A point-prevalence study will provide more accurate information.

The purpose of a point-prevalence study is to determine the percentage of patients with pressure ulcers in the facility or agency at 1 point in time (usually 1 day). Conducting such a study requires a team of nurses who have been trained to stage and measure pressure ulcers. All nursing units participating in the program of prevention should be part of the point-prevalence study. If possible, each patient currently in the facility should be examined for the presence or absence of pressure ulcers on that day. If the facility is too large to inspect the skin of all patients, a large random sample should be selected for study.

If a patient is found to have one or more pressure ulcers, an estimate of wound severity should be recorded. Scores on formal wound assessment tools, such as the PUSH (Pressure Ulcer Scale for Healing) or the PSST (Pressure Sore Status Tool), may be used.[59,60] If these are not available or are too time-consuming for purposes of a point-prevalence study, the stage, size (length and width), and location of each should be recorded on the data collection sheet. From these data, a severity index may be calculated for each ulcer and for the facility (Table 7). The nurse should also note whether any of the admissions assessments indicated the presence of any ulcers, as this information will allow one to estimate the percent of nosocomial ulcers found.

A chart review should be conducted at the same time as the point-prevalence study. The chart review usually consists of calculating the percentage of times the risk assessment score is charted on admission notes and noting evidence of implementation of preventive interventions on the care plan and in the charting. The results of both should be reported to nursing staff on various units. In most facilities, the association between the point-prevalence study and the chart review will be obvious; nursing units having the lowest prevalence, noso-

comial rate, and severity index are usually the units on which the staff is most diligent in performing risk assessment and implementing preventive measures. Units that have high nosocomial rates and low compliance with protocols are usually targeted for additional education or assistance in strengthening their care procedures.

The baseline point-prevalence study should be conducted as close to the time of start-up as possible. This means the study should be conducted a few weeks before the facility-wide educational programs are initiated. After the staff has been educated, the point-prevalence study should be conducted at specific intervals, such as every 6 months.

Because the case mix in a facility or hospital may change based on season and other factors, it is advisable to stratify nosocomial data by level of risk and severity. The most straightforward method for doing this involves using the levels of risk by Braden Scale score (Table 8) and the stages of pressure ulcers. This type of table should be prepared at the conclusion of each point-prevalence study and used to examine trends. The desirable outcomes are that both nosocomial rates and severity would decrease at each level of risk.

Self-Assessment Questions

1. Patients should be assessed for pressure ulcer risk at which of the following intervals?
   A. An admission assessment is sufficient
   B. An admission assessment and a repeat assessment in 24 hours
   C. An admission assessment and a repeat assessment in 48 hours and every other day thereafter
   D. An admission assessment and a repeat assessment in 48 hours and at intervals based on severity and lability of the patient's illness

2. Which of the following methods for collecting baseline prevalence and nosocomial data

Take-Home Messages for Practice

- While not all pressure ulcers are preventable, many are. The cost and human suffering associated with treatment of pressure ulcers is tremendous and, for the most part, unnecessary. Prevention of pressure ulcers requires a systematic approach that begins with risk assessment and ends with appropriate preventive measures being delivered in a timely manner to those who are in need. Primary, secondary, and tertiary prevention of pressure ulcers may be achieved through the interprofessional collaboration of nursing, occupational therapy, and physical therapy. Prevention regimes should focus on a plan that includes increasing physical activity, which increases oxygen and nutrients to the tissues. Increased strength may contribute to better weight shifts and reduced comorbidities. Skin that is too dry is fragile, moisture leads to maceration, and heat increases metabolic rate, resulting in increased oxygen demand and will potentiate the possibility of ischemia. Skin over the ischia, sacrum/coccyx, trochanters, heels, ankles, knees, spine, scapula, and elbows should be inspected twice a day.
- A long-handled skin assessment mirror may be used by persons with spinal cord injuries (eg, paraplegia and C6-C8 tetraplegics); higher-level spinal cord injured persons require caregiver assistance for skin inspection. Malnourished persons are typically underweight and may develop ischemia over bony prominences. In contrast, obesity may limit participation in weight shifts and increase friction and shear during transfers[61]. Remember that appropriate wheelchair seat bases, cushions, and backs aid in reducing pressure, providing alignment and a stable base of support, and increased activity tolerance and participation in occupational performance (ie, functional activity). Push-ups and lateral and forward weight-shift routines are also effective ways to prevent pressure ulcers. A careful reading of this chapter should supply the clinician with the necessary information to initiate a formal, research-based program of prevention in his or her facility.

was recommended in this chapter as a way to evaluate outcomes of a pressure ulcer prevention program?

A. A 1-year retrospective review of hospital research prior to implementation
B. Continuous prospective data collection during the first 6-month period following training of nursing staff and/or the implementation of a program of prevention
C. Point-prevalence by direct observation and estimates of nosocomial rates obtained prior to training or implementation of a program of prevention
D. Point-prevalence by direct observation and estimates of nosocomial rates obtained by the American Occupational Therapy Association during the first 6-month period following implementation of a program of prevention

3. Tilt-in-space wheelchair bases are effective in preventing pressure sores. The tilt-in-space system may be used for all of the following conditions EXCEPT:

A. Orthopedic limitations (contractures)
B. Hypertonicity
C. Dysphagia
D. Bladder emptying

4. Wheelchair seat cushions offer a stable base of support, prevent spinal deformities, and support pressure relief. Which of the following spinal deformities may be associated with wheelchair seat hammocking?

A. Posterior pelvic tilt
B. Scoliosis
C. Obliquity
D. Kyphosis
E. All of the above

Answers: 1-D, 2-C, 3-D, 4-E

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