

# THE NATIONAL QUALITY FORUM

## *Draft Environmental Scan for National Voluntary Consensus Standards for Developing a Framework for Measuring Quality for Prevention and Management of Pressure Ulcers*

As part of the tasks associated with the project, *National Voluntary Consensus Standards for Developing a Framework for Measuring Quality for Prevention and Management of Pressure Ulcers*, NQF staff performed an environmental scan of the currently available literature and published guidelines. Following the primary literature search, NQF staff requested additional literature, guidelines and other resources from the Steering Committee to fill the gaps found in the literature search and supplement the environmental scan.

In the topic areas of 'pressure-ulcer free time', 'staging across the continuum' and 'harmonization of measure specifications across settings of care' no information could be located thus far. However, the Steering Committee will address the area of harmonization of measure specifications across settings of care in the framework currently underway. Also, additional information will be added as the contract progresses and information becomes available.

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## BACKGROUND

Pressure ulcers are a complex clinical problem with a variety of causes. They are an adverse outcome of admission to a healthcare facility and are one of the five most common causes of harm to patients. In addition, pressure ulcers are key clinical indicators of the standard and effectiveness of care. Even though they are largely preventable and major technical advances have been made in preventing them, pressure ulcers still occur at unacceptable rates within healthcare facilities.<sup>1</sup>

Pressure ulcers are both high- cost and high- volume adverse events. In 2006, there were 322,946 reported cases of Medicare patients with a pressure ulcer as a secondary diagnosis—each case had an average charge of \$40,381 for an annual total cost of \$13 billion.<sup>2</sup>

Quality measurement organizations have worked to reduce the prevalence of pressure ulcers in nursing homes, home health, and nursing-sensitive hospital measurement. To date, NQF has endorsed six measures addressing pressure ulcers. The measures use a variety of definitions, specifications, staging, and timeframes such that the results are not comparable among settings of care or for a single patient that moves to different care settings. To understand the impact of pressure ulcers across populations, quality measures addressing prevention, incidence, and prevalence of pressure ulcers must be harmonized and aligned. This will require collaboration among measure developers and other interested stakeholders.

## ENVIRONMENTAL SCAN

NQF staff performed an environmental scan to address the following areas:

- Prevention and healing of pressure ulcers;
- Measuring incidence and prevalence of pressure ulcers and the pros and cons of both;
- Multiple levels of analysis, including providers, systems, communities and geographical areas;
- Accountability as the patient moves across settings of care, i.e., present on admission;
- Measuring and staging of pressure ulcers, including temporarily “unstageable” and scoring systems;
- Multiple lesions and deep tissue injury in evolution; and

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<sup>1</sup> Elliot R, McKinley S, Fox V, Quality improvement program to reduce the prevalence of pressure ulcers in an intensive care unit, *Am J Crit Care*, 2008.17(4):338-334.

<sup>2</sup> Association of periOperative Registered Nurses, *Skin Integrity*. Available at [www.skinintegrity.com/pdf/WhyItMatters.pdf](http://www.skinintegrity.com/pdf/WhyItMatters.pdf).

- Harmonization of measure specifications across settings of care

In addition to an extensive search of the published literature, as part of the initial phase of the pressure ulcer framework and environmental scan, the Steering Committee was asked to identify various aspects of evidence, measurement, and care regarding pressure ulcers in all settings. The Steering Committee was also provided with the initial literature and asked to provide additional literature to fill the gaps in the environmental scan. The additional resources provided by the Steering Committee were incorporated into the environmental scan.

While many of the general areas identified crossover, the literature search revealed a substantial amount of literature surrounding prevention and healing, measuring incidence and prevalence and multiple level of analysis while the literature addressing accountability across settings, measuring and staging including temporarily “unstageable”, deep tissue injury and scoring systems is limited to date.

Members of the Steering Committee also provided literature regarding pressure ulcers in the pediatric population which is a relatively new area of research because pressure ulcers are presumed rare in children. However, a new focus in pressure ulcer research aims to determine whether pressure ulcers are, indeed, relatively uncommon in the pediatric population and takes into account the unique physiologic and psychosocial needs of children.<sup>3</sup> The Steering Committee also provided additional literature on the subject of pressure ulcers and nutritional status and measuring wound size. See Appendix A

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<sup>3</sup> Dixon, M. and Ratliff, C.R. Pediatric Pressure Ulcer Prevalence-One Hospital’s Experience, *Ostomy/Wound Management*, 2005. 51(6): 44-50

## EXISTING GUIDELINES

Below is a summary of existing guidelines found in the National Guideline Clearinghouse:

**Treatment of Pressure Ulcers: AHCPR Clinical Practice Guideline # 15:** The recommended treatment program focuses on (1) assessment of the patient and pressure ulcer, (2) tissue load management, (3) ulcer care, (4) management of bacterial colonization and infection, (5) operative repair in selected patients with Stage III and IV pressure ulcers, and (6) education and quality improvement.

Accurate, ongoing assessment of the ulcer is essential. Of equal importance are the assessment and management of the individual's overall health, including physical, psychosocial, and nutritional status. Pain should be assessed and managed. Management of tissue loads (i.e., pressure, friction, and shear), through vigilant use of positioning techniques and appropriately selected support surfaces, is critical.

Ulcer care includes (1) debridement of necrotic tissue and debris, (2) wound cleansing using saline and avoiding antiseptics, and (3) application of dressings that maintain a clean, moist environment while keeping the surrounding skin dry. Education and quality improvement are integral to an effective pressure ulcer treatment program.

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Bergstrom N, Bennett MA, Carlson CE, et al. Treatment of Pressure Ulcers. Clinical Practice Guideline, No. 15. Rockville, MD: U.S. Department of Health and Human Services. Public Health Service, Agency for Health Care Policy and Research. AHCPR Publication No. 95-0652. December 1994.

**Pressure Ulcers in Adults: Treatment and Prevention: AHCPR Clinical Practice Guideline # 3:** This guideline makes specific recommendations to identify at-risk adults and to define early interventions for prevention of pressure ulcers. The guideline may also be used to treat Stage I pressure ulcers (nonblanchable erythema of intact skin). These guideline recommendations are not intended as the basis for care of infants and children, nor do they apply to individuals with existing Stage II or greater pressure ulcers or to individuals who are fully mobile.

Most pressure ulcers can be prevented and those Stage I pressure ulcers that do appear need not worsen under most circumstances. However, even the most

vigilant nursing care may not prevent the development and worsening of ulcers in some very high-risk individuals. In those cases, intensive therapy must be aimed at reducing risk factors (such as improving nutritional status), at preventive measures (such as frequent turning, and the use of mattress overlays), and at treatment.

Recommendations target four overall goals: (1) identifying at-risk individuals who need prevention and the specific factors placing them at risk, (2) maintaining and improving tissue tolerance to pressure in order to prevent injury, (3) protecting against the adverse effects of external mechanical forces (pressure, friction, and shear), and (4) reducing the incidence of pressure ulcers through educational programs.

Interventions include early detection maneuvers such as risk factor identification by assessing mobility, nutritional factors, continence, and level of consciousness. Treatments evaluated included those broadly conceptualized as pressure reduction and relief and strategies to maintain tissue tolerance.

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Panel for the Prediction and Prevention of Pressure Ulcers in Adults. Pressure Ulcers in Adults: Prediction and Prevention. Clinical Practice Guideline, Number 3. AHCPR Publication No. 92-0047. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, U.S. 5Department of Health and Human Services. May 1992.

**Guideline for Prevention and Management of Pressure Ulcers: Wound, Ostomy and Continence Nurses Society (WOCN) Clinical Practice Guideline # 2.** Wound, Ostomy, and Continence Nurses Society (WOCN). Guideline for prevention and management of pressure ulcers. Glenview (IL): Wound, Ostomy, and Continence Nurses Society (WOCN); 2003. 52 p. (WOCN clinical practice guideline; no. 2). [141 references]

**International Guidelines on Pressure Ulcer Prevention** – To be announced and discussed at the Feb, 2009 NPUAP Conference. Can be viewed at <http://www.pressureulcerguidelines.org/therapy/>

**Scope Document 3.0**  
**Pressure Ulcer Prevention**

# **A European Pressure Ulcer Advisory Panel & National Pressure Ulcer Advisory Panel Collaboration to Produce a Clinical Practice Guideline**

## **1. Short title**

Pressure ulcer prevention

## **2. Background**

Clinical practice guidelines are systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances ([www.nice.org.uk](http://www.nice.org.uk), 2005). Guidelines have become increasingly used in response to concerns regarding wide variations in health care as well as the suspicion that much of this care is of sub-optimal quality. An appropriately developed guideline can serve as an authoritative statement about best practice for providers and patients, an important educational tool, and as a benchmark for use in assessing care. The pressure ulcer prevention guideline developed by the European Pressure Ulcer Advisory Panel in 1998 is now outdated in terms of its content and fails to take account of significant advances in the guideline development process that have been reported in the past few years ([www.agreecollaboration.org](http://www.agreecollaboration.org)). In a similar fashion the US AHCPR clinical guideline on pressure ulcer prevention is also outdated with no revision since 1992. This scope document sets out the limits of the revision required of the EPUAP and NPUAP guidelines on pressure ulcer prevention.

## **3. Clinical need for the guideline**

Pressure ulcers (also known as pressure sores, bed sores, pressure damage, pressure injuries and decubitus ulcers) are areas of localized damage to the skin and underlying tissue caused by pressure, shear or friction or a combination of these. They generally occur over the bony prominences of the body of those who are very ill, while the neurologically compromised or immobile are particularly vulnerable.

Prevention of pressure ulcers is an important goal for healthcare professionals and there is a growing body of knowledge to support the use of a range of prevention strategies.

## **4. The guideline**

The guideline development process will broadly follow the methods devised by the UK National Institute for Clinical Excellence for guideline development with some modification in relation to the international context. Full details of the process can be found in Appendix 1.

This document is the scope. It defines exactly what this guideline will (and will not) examine, and what the guideline developers will consider

The areas that will be addressed by the guideline are described in the following sections.

## **4.1. Population**

### **4.1.1 Groups that will be covered**

The guideline recommendations will apply to all patients and vulnerable people of all age groups.

### **4.1.2 Topics that will not be covered**

The guideline will not include recommendations on the classification and treatment of existing pressure ulcers as this will be the subject of a separate guideline. Other wound types will not be included in this guideline

## **4.2. Healthcare setting**

The guideline is intended for the use of health care professionals who are involved in the care of patients and vulnerable people that are at risk of developing pressure ulcers, whether they are in hospital, long term care, assisted living (supported accommodation) at home or any other care setting, and regardless of their diagnosis or health care needs. It will also help to guide patients and carers on the range of prevention strategies that are available.

## **4.3. Clinical management**

The guideline will cover all aspects of pressure ulcer risk assessment and prevention and include:

- a). Reviewing the current definitions of a pressure ulcer
- b). Risk assessment including nutrition.
- c). Skin inspection
- d) Skin care
- e). The use of positioning and repositioning of patients
- f). The guideline will include evidence that supports the use and information on the use of support surfaces including beds, mattresses, overlays (including those for operating tables and trolleys), cushions and other pressure redistributing aids. Devices that will be considered include:
  - Air fluidized beds
  - Alternating air mattresses, overlays and seating such as cushions
  - Bead-filled overlays and seating such as cushions
  - Foam: block, cubed, layers of different densities – mattresses, overlays and cushions
  - Gel mattresses, overlays and seating such as cushions
  - Fibre-filled overlays and cushions
  - Low air loss beds and mattresses
  - Static air-filled mattresses, overlays and cushions
  - Turning beds



Pressure redistributing aids will include genuine and synthetic sheepskins, limb protectors, doughnut shaped devices and water-filled cushions.

f). Other types of protective devices used for pressure ulcer prevention

g). The contribution of education and training for health care professionals, unqualified support workers such as health care assistants, patients and carers on the prevention of pressure ulcers.

#### **4.4. Audit support within guideline**

Criteria for undertaking audits related to guideline implementation will be included in the guideline. They will be linked to the EPUAP position statement on prevalence and incidence measurement.

**National Collaborating Centre for Nursing and Supportive Care (NCCNSC). (2003). The use of pressure-relieving devices (beds, mattresses and overlays) for the prevention of pressure ulcers in primary and secondary care. Guidelines commissioned by the National Institute for Clinical Excellence. <http://www.nice.org.uk/nicemedia/pdf/cg007fullguideline.pdf>.**

##### **Summary of guideline recommendations**

1. Decisions about which pressure-relieving device to use should be based on cost considerations and an overall assessment of the individual. Holistic assessment should include all of the following points, and should not be based solely on scores from risk assessment scales:

- identified levels of risk
- skin assessment
- comfort
- general health state
- lifestyle and abilities
- critical care needs
- acceptability of the proposed pressure-relieving equipment to the patient and/or carer

##### **THE USE OF PRESSURE-RELIEVING DEVICES FOR PREVENTION OF PRESSURE ULCERS**

1. Principles of practice and summary of guideline recommendations

2. All individuals assessed as being vulnerable to pressure ulcers should, as a minimum provision, be placed on a high-specification foam mattress with pressure-relieving properties.

3. Although there is no research evidence that high-tech pressure-relieving mattresses and overlays are more effective than high-specification – low-tech – foam mattresses and overlays, professional consensus recommends that

consideration should be given to the use of alternating pressure or other high-tech pressure relieving systems:

- as a first-line preventative strategy for people at elevated risk, as identified by holistic assessment
- when the individual's previous history of pressure ulcer prevention and/or clinical condition indicates that they are best cared for on a high-tech device
- when a low-tech device has failed.

4. All individuals undergoing surgery and assessed as being vulnerable to pressure ulcers should, as a minimum provision, be placed on either a high specification foam theatre mattress or other pressure relieving surface.

5. The provision of pressure-relieving devices needs a 24- hour approach. It should include consideration of all surfaces used by the patient.

6. Support surface and positioning needs should be assessed and reviewed regularly and determined by the results of skin inspection, patient comfort, ability and general state. Thus repositioning should occur when individuals are on pressure-relieving devices.

7. The management of a patient in a sitting position is also important. Even with appropriate pressure relief, it may be necessary to restrict sitting time to less than two hours until the condition of an individual with an elevated risk changes.

8. A pressure ulcer reduction strategy should incorporate a co-coordinated approach to the acquisition, allocation and management of pressure-relieving equipment. The time elapsing between assessment and use of the device should be specified in this strategy.

9. All health care professionals should be educated about:

- pressure ulcer risk assessment and prevention
- selection, use and maintenance of pressure relieving devices
- patient education and information-giving.

10. Individuals vulnerable to or at elevated risk of developing pressure ulcers, and their carers, should be informed verbally and in writing about:

- the prevention of pressure ulcers using pressure relieving strategies
- the use and maintenance of pressure-relieving devices
- where they can seek further advice and assistance.

**National Institute for Clinical Excellence (NICE). (2001 [Reviewed 2005]).  
Pressure Ulcer Risk Assessment and Prevention.** Available at:

[http://www.nice.org.uk/nicemedia/pdf/clinicalguidelinepressuresoreguidance\\_nice.pdf](http://www.nice.org.uk/nicemedia/pdf/clinicalguidelinepressuresoreguidance_nice.pdf).

#### Summary of guidelines

- 2.1 Identifying individuals 'at risk'
- 2.2 Use of risk assessment scales
- 2.3 Risk factors
- 2.4 Skin inspection
- 2.5 Pressure relieving devices
- 2.6. Use of aids
- 2.7 Positioning
- 2.8 Seating
- 2.9. Education and training

#### **Paralyzed Veterans of America Pressure Ulcer Prevention and Treatment Following Spinal Cord Injury.** Available at

[http://www.guideline.gov/summary/summary.aspx?ss=15&doc\\_id=2589&nbr=1815](http://www.guideline.gov/summary/summary.aspx?ss=15&doc_id=2589&nbr=1815)

#### Summary of guidelines

##### **Prevention**

##### **Risk Factors, Risk Assessment, and Risk Assessment Tools**

1. Conduct comprehensive, systematic, and consistent assessment of pressure ulcer risk factors in individuals with spinal cord injury.

##### **Prevention Strategies**

2. Implement pressure ulcer prevention strategies as part of the comprehensive management of acute spinal cord injury and review all aspects of risk when determining prevention strategies.
3. Conduct daily comprehensive visual and tactile skin inspections, with particular attention to the areas most vulnerable to pressure ulcer development, including, but not limited to:
  - Ischii
  - Sacrum/coccyx
  - Trochanters
  - Heels
4. Turn or reposition individuals with spinal cord injury initially every 2 hours in the acute and rehabilitation phases if the medical condition allows.
5. Evaluate the individual and his/her support environment for optimal maintenance of skin integrity.

6. Provide an individually prescribed wheelchair and pressure-reducing seating system.
7. Implement an ongoing exercise regimen for the medically stable spinal cord injured individual to promote maintenance of skin integrity, increase strength of paretic and nonparalyzed muscles, improve cardiovascular endurance, and prevent fatigue and deconditioning.
8. Provide individuals with spinal cord injury, their families, significant others, and health-care professionals with specific information on effective strategies for the prevention and treatment of pressure ulcers.

### **Nutrition**

9. Assess nutritional status of all spinal cord injured individuals on admission and as needed, based on medical status, including:
  - Dietary intake
  - Anthropometric measurements
  - Biochemical parameters (prealbumin, total protein, albumin, hemoglobin, hematocrit, transferrin, and total lymphocyte count)
10. Provide adequate nutritional intake to meet the individual's needs, especially:
  - Calories (or Energy)
  - Protein
  - Micronutrients (zinc, vitamin C, vitamin A, and vitamin E)
  - Fluids
11. Implement aggressive nutritional support measures if dietary intake is inadequate or if an individual is nutritionally compromised.

### **Assessment Following Onset of a Pressure Ulcer**

#### **Assessment of the Individual With a Pressure Ulcer**

12. Perform an initial comprehensive assessment of the individual with a pressure ulcer, to include:
  - Complete history
  - Physical examination and laboratory tests
  - Psychological health, behavior, cognitive status, and social and financial resources
  - Availability and utilization of personal care assistance
  - Positioning, posture, and related equipment

#### **Assessment of the Pressure Ulcer**

13. Describe in detail an existing pressure ulcer. Include the following parameters:
  - Anatomical location and general appearance
  - Size (length width, depth, and wound area)
  - Stage

- Exudate/odor
- Necrosis
- Undermining
- Sinus tracts
- Infection
- Healing (granulation and epithelialization)
- Wound margins/surrounding tissue

## **Treatment**

### **Nonsurgical**

#### *Cleansing*

14. Cleanse pressure ulcers at each dressing change.

#### *Debridement*

15. Debride devitalized tissue from pressure ulcers using a method appropriate to the ulcer's status and the individual's condition and goals.

#### *Dressings*

16. Use dressings that will keep the ulcer bed continuously moist and the surrounding intact skin dry.

#### *Electrical Stimulation*

17. Use electrical stimulation to promote closure of stage III or IV pressure ulcers combined with standard wound care interventions.

#### *Reassessment*

18. Monitor and assess the pressure ulcer on a consistent, ongoing basis to determine the adequacy of the plan of care.
19. Modify the treatment plan if the ulcer shows no evidence of healing within 2 to 4 weeks.

### **Surgical**

20. Refer appropriate individuals with complex, deep stage III pressure ulcers (i.e., undermining, tracts) or stage IV pressure ulcers for surgical evaluation. When surgery is indicated, include the following tenets of surgical treatment:
  - Excising of ulcer, surrounding scar, bursa, soft tissue calcification, and underlying necrotic or infected bone
  - Filling dead space, enhancing vascularity of the healing wound, and distributing pressure off the bone

- Resurfacing with a large regional pedicle flap, with suture line away from the area of the direct pressure, and one that does not encroach on adjacent flap territories
- Preserving options for future potential breakdowns

### **Pre-operative Care**

21. Assess, treat and optimize the following factors preoperatively:
  - Local wound infection
  - Nutritional status
  - Bowel regulation
  - Severe spasm and contractures
  - Co-morbid conditions
  - Previous ulcer surgery
  - Smoking
  - Osteomyelitis
  - Urinary tract infection
  - Heterotopic ossification

### **Post-operative Care**

22. Be cognizant of postoperative care procedures.

### **Complications of Pressure Ulcers**

#### **Non-surgical**

23. Identify the pressure of tissue and/or bone infection
24. Identify the potential complications of immobility associated with pressure ulcer management and implement preventive and therapeutic measures for:
  - Nutritional deficiencies and dehydration
  - Decreased range of motion
  - Deconditioning (cardiopulmonary, cardiovascular, and musculoskeletal)
25. Manage hypergranulation tissue that may impede ulcer healing.
26. Identify the potential psychosocial impacts of pressure ulcers and immobility and provide referral for therapeutic interventions based upon the individual's characteristics and circumstances. Refer to appropriate resources for problem resolution, including:
  - Vocational rehabilitation services
  - Peer counseling and support groups
  - Formal psychotherapy and/or family therapy

#### **Surgical**

27. Identify potential complications of surgical intervention, including:
  - Wound dehiscence/wound separation

- Delayed infection and abscess
- Hematoma and seroma

## **Support Surfaces and Positioning for Managing Tissue Loads**

### **Bed Positioning**

28. Use bed-positioning devices and techniques to prevent and treat pressure ulcers. Use devices and techniques that are compatible with the bed type and the individual's health status.
  - Avoid positioning individuals directly on a pressure ulcer.
  - Avoid positioning individuals directly on the trochanter
  - Use cushions and positioning aids to relieve pressure on pressure ulcers or vulnerable skin areas by elevating them away from the support surface.
  - Avoid close cutouts or donut-type cushions
  - Prevent contact between bony prominences.
  - Limit the amount of time the head of the bed is elevated
  - Develop, display, and use an individualized positioning regimen and repositioning schedule.

### **Bed Support Surfaces**

29. Use pressure-reducing bed support surfaces for individuals who are at risk for or who have pressure ulcers.

### **Wheelchair Positioning**

30. Prescribe wheelchairs and seating systems according to individualized anthropometric, ergonomic, and functional principles.
31. Evaluate the individual's postural alignment, weight distribution, balance, stability, and pressure reduction capabilities to establish a proper sitting schedule.

### **Wheelchair Support Surfaces**

32. Use appropriate wheelchair cushions with all individuals with spinal cord injury.

## 1.0 Prevention and Healing

### HOSPITAL/ACUTE CARE:

**Baumgarten, B. et al. Extrinsic risk factors for pressure ulcers early in the hospital stay: a nested case-control study. *Journal of Gerontology: Medical Sciences*. 2008; 63A(4), 408-413.**

Little is known about the impact of extrinsic factors on pressure ulcer risk. The objective of this study was to determine whether risk of pressure ulcers early in the hospital stay is associated with extrinsic factors such as longer emergency department (ED) stays, night or weekend admission, potentially immobilizing procedures and medications, and admission to an intensive care unit (ICU). A nested case-control study was performed in two teaching hospitals in Philadelphia, Pennsylvania. Participants were medical patients age  $\geq 65$  years admitted through the ED. Cases ( $n = 195$ ) had  $\geq 1$  possibly or definitely hospital-acquired pressure ulcers. Three controls per case were sampled randomly from among noncases at the same hospital in the same month ( $n = 597$ ). Pressure ulcer status was determined by a research nurse on the third day of hospitalization. Pressure ulcers were classified as preexisting, possibly hospital-acquired, or definitely hospital-acquired. Information on extrinsic factors was obtained by chart review. The odds of pressure ulcers were twice as high for those with an ICU stay as for those without (adjusted odds ratio [aOR] 2.0, 95% confidence interval [CI], 1.2-3.5). The aOR was 0.6 (95% CI, 0.3-0.9) for use of any potentially immobilizing medications during the early inpatient period. Many of the procedures experienced by patients in the ED and early in the inpatient stay do not confer excess pressure ulcer risk. Having an ICU stay is associated with a doubling of risk. This finding emphasizes the importance of developing and evaluating interventions to prevent pressure ulcers among patients in the ICU.

**Baumgarten, M., Margolis, D.J., Localio, A.R., Kagan, S.H., Lowe, R.A., Kinoshian, B., Holmes, J.H., Abbuhl, S.B., Kavesh, W., & Ruffin, A. Pressure Ulcers Among Elderly Patients Early in the Hospital Stay. *Journal of Gerontology: Medical Sciences*. 2006; 61A(7); 749-755.**

Pressure ulcers among elderly hospital patients diminish quality of life and increase the cost of hospital care. Evidence suggests that pressure ulcers can arise after only a few hours of immobility. The goals of this study were to estimate the incidence of hospital-acquired pressure ulcers in the first 2 days of the hospital stay and to identify patient characteristics associated with higher incidence. A prospective cohort study was performed between 1998 and 2001. A total of 3233 patients 65 years old or older admitted through the



Emergency Department to the inpatient Medical Service at two study hospitals were examined by a research nurse on the third day of hospitalization. Pressure ulcers were ascertained using standard criteria and were classified as either preexisting, possibly hospital-acquired, or definitely hospital-acquired. There were 201 patients with one or more possibly or definitely hospital-acquired pressure ulcers for a cumulative incidence of 6.2% (95% confidence interval, 5.4%-7.1%). Most of the pressure ulcers were stage 2, and the majority were in the sacral area or on the heels. In multivariable analysis, pressure ulcer incidence was significantly associated with increasing age, male gender, dry skin, urinary and fecal incontinence, difficulty turning in bed, nursing home residence prior to admission, recent hospitalization, and poor nutritional status. A small but significant proportion of elderly emergently admitted hospital patients acquire pressure ulcers soon after their admission. New models of care may be required to ensure that preventive interventions are provided very early in the elderly person's hospital stay.

**Clarke, H.F., Bradley, C., Whytock, S., Handfield, S., van der Wal, R., & Gundry, S. Pressure ulcers: Implementation of evidence-based nursing practice. *Journal of Advanced Nursing*. 2005; 49(6), 578-590.**

AIMS: A 2-year project was carried out to evaluate the use of multi-component, computer-assisted strategies for implementing clinical practice guidelines. This paper describes the implementation of the project and lessons learned. The evaluation and outcomes of implementing clinical practice guidelines to prevent and treat pressure ulcers will be reported in a separate paper.

**BACKGROUND:** The prevalence and incidence rates of pressure ulcers, coupled with the cost of treatment, constitute a substantial burden for our health care system. It is estimated that treating a pressure ulcer can increase nursing time up to 50%, and that treatment costs per ulcer can range from US\$10,000 to \$86,000, with median costs of \$27,000. Although evidence-based guidelines for prevention and optimum treatment of pressure ulcers have been developed, there is little empirical evidence about the effectiveness of implementation strategies.

**METHOD:** The study was conducted across the continuum of care (primary, secondary and tertiary) in a Canadian urban Health Region involving seven health care organizations (acute, home and extended care). Trained surveyors (Registered Nurses) determined the prevalence and incidence of pressure ulcers among patients in these organizations. The use of a computerized decision-support system assisted staff to select optimal, evidence-based care strategies, record information and analyze individual and aggregate data.

**RESULTS:** Evaluation indicated an increase in knowledge relating to pressure ulcer prevention, treatment strategies, resources required, and the role of the interdisciplinary team. Lack of visible senior nurse leadership; time required to acquire computer skills and to implement new guidelines; and difficulties with the computer system were identified as barriers.

**CONCLUSIONS:** There is a need for a comprehensive, supported and sustained approach to implementation of evidence-based practice for pressure ulcer prevention and treatment, greater understanding of organization-specific barriers, and mechanisms for addressing the barriers.

**Clarke, M., Kadholm, H.M. The nursing prevention of pressure sores in hospital and community patients. *J Adv Nurs.* 1988 May; 13(3): 365-73.**

**Abstract:** The main purpose of the study was to evaluate the amount of time which was spent in giving preventive pressure area care in both a sample of hospital patients (n = 88) and a sample of community patients (n = 30). Bedfast or chairfast patients were studied from admission to the selected hospital wards or community nursing areas for a period of a maximum of 6 weeks or until they were discharged from care, developed pressure sores, died or became mobile. Data were collected by means of a diary sheet which was designed for use by nurses in the hospital and by nurses and relatives in the community. They were asked to record pressure area care as it was given on the diary sheets. The researcher also collected data about the patients' appetite, Norton score, age, sex and diagnosis. The outcome measure used was whether or not the patient developed a pressure sore, which was defined for this study as a break in the skin due to pressure. Some descriptive analysis of the data has been carried out. Results available so far show that a higher percentage of the hospital patients developed pressure sores (29%) than among the community patients studied (20%). The study appears to show that nursing care devoted to the prevention of pressure sores in terms of time and frequency is significantly related to outcome and thus to effectiveness.

**Courtney, B.A., Ruppman, J.B., & Cooper, H.M. Save our skin: Initiative cuts pressure ulcer incidence in half. *Nursing Management.* 2006; 37(4), 36-45.**

Six Sigma initiative cuts pressure ulcer incidence by more than half at an Illinois medical center.

**Cullum, N. Pressure ulcer prevention and treatment: A synopsis of the current evidence from research. *Crit Care Nurs Clin North Am.* 2001 Dec; 13(4): 547-54.**

Foam alternatives to the standard hospital foam mattress can reduce the incidence of pressure ulcers in people at risk. The relative merits of AP and CLP devices and of the different AP devices for pressure ulcer prevention are unclear. There is some evidence from one study to suggest that LAL beds may reduce the incidence of pressure ulcers compared with standard intensive care beds. There is insufficient evidence to make conclusions on the value of various CLP devices and sheepskins as pressure ulcer prevention strategies, although Australian Medical Sheepskin was an effective preventive strategy in a recent study. There is evidence from two trials that air-fluidized therapy may improve pressure ulcer healing rates. There is insufficient evidence to make conclusions on the value of other beds and mattresses as pressure ulcer treatments. There is insufficient evidence to recommend any particular wound dressing or debridement technique. Research about pressure ulcer prevention and treatment is generally conducted on a small scale and is of poor quality; few economic evaluations have been undertaken of pressure area care strategies. Only when a clinically relevant research agenda has been developed and appropriate research methods have been used in sufficiently large studies can evidence-based pressure ulcer prevention and treatment be a possibility. Until then, nurses and other health care professionals can only rely on what little research evidence exists together with their professional judgment to make decisions in this field.

**De Laat, E.H., Pickkers, P., Schoonhoven, L., Verbeek, A.L., Feuth, T., van Achterberg, T. Guideline implementation results in a decrease of pressure ulcer incidence in critically ill patients. *Crit Care Med.* 2007 Mar; 35(3): 815-20.**

**Objective:** To describe the short-term and long-term effects of a hospital-wide pressure ulcer prevention and treatment guideline on both the incidence and the time to the onset of pressure ulcers in critically ill patients.

**Design:** Prospective cohort study.

**Setting:** Adult intensive care department of a university medical center.

**Patients:** Critically ill patients (n = 399).

**Interventions:** A guideline for pressure ulcer care was implemented on all intensive care units. The attention of nurses for timely transfer to a specific pressure-reducing device was an important part of this guideline.

**Measurements and Main Results:** Patient characteristics, demographics, pressure ulcer risk profile at admission, daily pressure ulcer grading, and

type of mattress were determined to describe the short-term and long-term effects 3 and 12 months after the implementation. The incidence density of pressure ulcers grade II-IV decreased from 54 per 1000 patient days at baseline to 32 per 1000 days ( $p = .001$ ) 12 months after the implementation. The median pressure ulcer-free time increased from 12 days to 19 days (hazard rate ratio, 0.58;  $p = .02$ ). After adjustment for differences in risk factors in a Cox proportional hazard model, the number of preventive transfers to special mattresses was the strongest indicator for the decreased risk of pressure ulcers (hazard rate ratio, 0.22;  $p < .001$ ). The number needed to treat to prevent one pressure ulcer during the first 9 days was six.

**Conclusions:** The implementation of a guideline for pressure ulcer care resulted in a significant and sustained decrease in the development of grade II-IV pressure ulcers in critically ill patients. Timely transfer to a specific mattress (i.e., transfer before the occurrence of a pressure ulcer) was the main indicator for a decrease in pressure ulcer development.

**De Laat, E.H., Scholte op Reimer, W.J., van Achterberg, T. J Clin Nurs. Pressure Ulcers: diagnostics and interventions aimed at wound-related complaints: a review of literature. 2005 Apr; 14(4): 464-72.**

**Aims and objectives.:** To describe the current scientific evidence in the field of diagnostics and treatment of pain, malodour and exudate from pressure ulcers and to give recommendations for practice, based on these findings.

**Background:** Patients with pressure ulcers are confronted with symptoms of chronic wounds and impaired wound healing. Assessment and treatment of these symptoms have received very little attention.

**Design:** Systematic literature review.

**Methods:** Medline, CINAHL, and Cochrane, were searched for studies on pain, malodour and exudate in patients with pressure ulcers.

**Results:** The McGill Pain Questionnaire, the Visual Analogue Scale and the Faces Rating Scale are useful instruments to assess pressure ulcer related pain. Strong evidence was found to support a positive effect of (dia)morphine. Some evidence was found to support a positive effect of benzydamine gel and Eutectic Mixture of Local Anesthetic-cream. Wound malodour is subjectively assessed. In a laboratory study, it is proved that activated charcoal is capable of absorbing gas molecules causing malodour. At present, no studies are available on the odor-absorbing capacity of activated charcoal dressings in pressure ulcer patients. Exudate is a

symptom of impaired wound healing. The Pressure Sore Status Tool is a valid and reliable instrument for assessing the wound healing process. There is a possible indication that hydrocolloid positively influences healing time because the absorption of exudates is more effective.

**Conclusion:** Little sound research has been performed on wound-related complaints in patients with pressure ulcers. Nevertheless several recommendations could be made on the present state of the art.

**Relevance to clinical practice:** Regarding pressure ulcer related pain, this review supports the intervention of local pain relieve in patients with pressure ulcers. Regarding pressure ulcer related odor and exudates, this study identifies the gaps in evidence and research.

**De Laat, E.H., Schoonhoven, L., Pickkers, P., Verbeek, A.L., & Van Achterberg, T. Int. Implementation of a new policy results in a decrease of pressure ulcer frequency. *J Qual Health Care*. 2006 Apr; 18(2): 107-12.**

The main purpose of the study was to evaluate the amount of time which was spent in giving preventive pressure area care in both a sample of hospital patients (n = 88) and a sample of community patients (n = 30). Bedfast or chairfast patients were studied from admission to the selected hospital wards or community nursing areas for a period of a maximum of 6 weeks or until they were discharged from care, developed pressure sores, died or became mobile. Data were collected by means of a diary sheet which was designed for use by nurses in the hospital and by nurses and relatives in the community. They were asked to record pressure area care as it was given on the diary sheets. The researcher also collected data about the patients' appetite, Norton score, age, sex and diagnosis. The outcome measure used was whether or not the patient developed a pressure sore, which was defined for this study as a break in the skin due to pressure. Some descriptive analysis of the data has been carried out. Results available so far show that a higher percentage of the hospital patients developed pressure sores (29%) than among the community patients studied (20%). The study appears to show that nursing care devoted to the prevention of pressure sores in terms of time and frequency is significantly related to outcome and thus to effectiveness.

**Fogerty, M. D., Abumrad, N. N., Nanney, L., Arbogast, P. G., Poulouse, B., & Barbul, A. Risk factors for pressure ulcers in acute care hospitals: Correlational study. *Wound Repair and Regeneration*. 2008; 16(1), 11-18.**

Selection of patients for preventive measures to protect against pressure ulcers relies on clinical scales and provider judgment, which vary widely. Our objectives were to: (a) identify risk factors by clinical classification and

report demographic differences in pressure ulcer risk and (b) develop criteria for identification of high risk patients. Patients with pressure ulcer as a discharge diagnosis were identified from the 2003 Nationwide Inpatient Sample (NIS). The effect of discharge diagnosis was examined using the Agency for Healthcare Research and Quality Clinical Classification Software (CCS). Multiple regression analysis for survey data was used to assess risk factors. The 2003 NIS listed 94,758 with a discharge diagnosis of pressure ulcer, identified as International Classification of Disease-9 code 707.0–707.09, for an overall incidence of 143 per 10,000. Forty-five CCS discharge diagnoses were present in at least 5% of these patients and 28 of these CCS diagnoses had odds ratios > 2.0. African-American race and advanced age were identified as risk factors for pressure ulcer diagnosis. Disorders of skin integrity, organ system failure, and infection were found to be broad categories of risk factors as well. Using the NIS, risk factors for pressure ulcer including diagnoses and demographic factors have been identified.

**Gunes, O.Y., & Eser, I. Effectiveness of a honey dressing for healing pressure ulcers. *Journal of Wound, Ostomy & Continence Nursing*. 2007;34(2), 184-190.**

**OBJECTIVE:** To compare the effect of a honey dressing vs. an ethoxy-diaminoacridine plus nitrofurazone dressing in patients with pressure ulcers.

**DESIGN:** This 5-week randomized clinical trial evaluated the effect of a honey dressing on pressure ulcer healing.

**SETTING AND SUBJECTS:** Thirty-six patients with a total of 68 stage II or III pressure ulcers referred from a university hospital in Izmir were enrolled in the study. Twenty-six subjects completed the trial.

**INSTRUMENTS:** Ulcers were measured with acetate tracings and Pressure Ulcer Scale for Healing (PUSH) evaluations.

**METHODS:** Fifteen patients with 25 pressure ulcers were treated with honey dressings, and 11 patients with 25 pressure ulcers were treated with ethoxy-diaminoacridine plus nitrofurazone dressings. Wound healing was assessed weekly using the PUSH tool, version 3.0. The primary outcome measure was the change in PUSH tool scores in each group at 5 weeks.

**RESULTS:** The two groups were statistically similar with regard to baseline and wound characteristics. After 5 weeks of treatment, patients who were treated by honey dressing had significantly better PUSH tool scores than subjects treated with the ethoxy-diaminoacridine plus nitrofurazone dressing (6.55 +/- 2.14 vs. 12.62 +/- 2.15,  $P < .001$ ).

**CONCLUSION:** By week 5, PUSH tool scores showed that healing among subjects using a honey dressing was approximately 4 times the rate of healing in the comparison group. The use of a honey dressing is effective and practical.

**Gunningberg, L. Are patients with or at risk of pressure ulcers allocated appropriate preventions measures? *Int J Nurs Pract.* 2005 Apr; 11(2): 58-67.** The aims of the study were to investigate the risk for and prevalence of pressure ulcers in different medical care groups, to discover if patients at risk for or with pressure ulcers are allocated appropriate pressure ulcer preventions and to investigate which variables are associated with appropriate pressure ulcer preventions. A cross-sectional survey design was used and followed the methodology developed by the European Pressure Ulcer Advisory Panel. A total of 612 patients participated in the study. The prevalence of pressure ulcers was greatest in geriatric care, followed by intensive care, acute care and neurological care. The majority of patients at risk for or with pressure ulcers did not receive appropriate preventative measures, either while they were in bed or in a chair. Significant variables associated with appropriate preventions in bed were intensive care, geriatric care, a low Braden score, a low score in the subscale activity and a long hospital stay.

**Jones, K.R., Fennie, K., & Lenihan, A. *Adv Skin Wound Care: Evidence-based management of chronic wounds.* 2007 Nov; 20(11): 591-600.** **OBJECTIVE:** Identify the consistency of current chronic wound care practices with evidence-based recommendations for wound management.

**DESIGN:** A retrospective study based on 400 subject records (venous ulcers, 183; diabetic ulcers, 103; and pressure ulcers, 114). Study records were located at hospitals, wound care centers and clinics, home health agencies, and nursing homes in 4 diverse geographic locations.

**METHODS:** Chronic wound assessment and evidence-based treatment practices were identified by extensive review of the literature, professional Web sites, and the Agency for Healthcare Research and Quality National Guideline Clearinghouse. Actual delivery of wound care practices was obtained from retrospective chart reviews and a structured data abstraction protocol. Collected data were then compared with recommended practices for consistency, adherence variations, and wound healing across data collection sites.

**RESULTS:** Significant variations occurred in adherence to evidence-based recommendations across sites of care delivery, with selection and application of appropriate dressings showing the greatest need for improvement.

**CONCLUSIONS:** Current chronic wound care practices are inconsistent with evidence-based recommendations for wound management. Further studies are needed to determine the best method for translating this information to multiple settings.

**Lyder, C.H., Preston, J., Grady, J., Scinto, J., Allman, R., Bergstrom et al. Quality of care for hospitalized Medicare patients at risk for pressure ulcers. *Archives of Internal Medicine*. 2001; 161, 1549-1554.**

**Background:** No state peer review organization has attempted to identify processes of care related to pressure ulcer prediction and prevention in US hospitals.

**Objective:** To profile and evaluate the processes of care for Medicare patients hospitalized at risk for pressure ulcer development by means of the Medicare Quality Indicator System pressure ulcer prediction and prevention module.

**Methods:** A multicenter retrospective cohort study with medical record abstraction was used to obtain a total of 2425 patients aged 65 years and older discharged from acute care hospitals after treatment for pneumonia, cerebrovascular disease, or congestive heart failure. Six processes of care for prevention of pressure ulcers were evaluated: use of daily skin assessment; use of a pressure-reducing device; documentation of being at risk; repositioning for a minimum of 2 hours; nutritional consultation initiated for patients with nutritional risk factors; and staging of pressure ulcer. The associations between processes of care and incidence of pressure ulcer were determined with Kaplan-Meier survival analyses.

**Results:** National estimates of compliance with process of care were as follows: use of daily skin assessment, 94%; use of pressure-reducing device, 7.5%; documentation of being at risk, 22.6%; repositioning for a minimum of 2 hours, 66.2%; nutritional consultation, 34.3%; stage 1 pressure ulcer staged, 20.2%; and stage 2 or greater ulcer staged, 30.9%.

**Conclusion:** These results suggest that US hospitals and physicians have numerous opportunities to improve care related to pressure ulcer prediction and prevention.



**Reddy, M., Gill, S. S., & Rochon, P. A. Preventing pressure ulcers: a systematic review. *JAMA*. 2006; 296(8), 974-84.**

Context: Pressure ulcers are common in a variety of patient settings and are associated with adverse health outcomes and high treatment costs.

Objective: To systematically review the evidence examining interventions to prevent pressure ulcers.

Data Sources and Study Selection: MEDLINE, EMBASE, and CINAHL (from inception through June 2006) and Cochrane databases (through issue 1, 2006) were searched to identify relevant randomized controlled trials (RCTs). UMI Proquest Digital Dissertations, ISI Web of Science, and Cambridge Scientific Abstracts were also searched. All searches used the terms *pressure ulcer*, *pressure sore*, *decubitus*, *bedsore*, *prevention*, *prophylactic*, *reduction*, *randomized*, and *clinical trials*. Bibliographies of identified articles were further reviewed.

Data Synthesis: Fifty-nine RCTs were selected. Interventions assessed in these studies were grouped into 3 categories, i.e., those addressing impairments in mobility, nutrition, or skin health. Methodological quality for the RCTs was variable and generally suboptimal. Effective strategies that addressed impaired mobility included the use of support surfaces, mattress overlays on operating tables, and specialized foam and specialized sheepskin overlays. While repositioning is a mainstay in most pressure ulcer prevention protocols, there is insufficient evidence to recommend specific turning regimens for patients with impaired mobility. In patients with nutritional impairments, dietary supplements may be beneficial. The incremental benefit of specific topical agents over simple moisturizers for patients with impaired skin health is unclear.

Conclusions: Given current evidence, using support surfaces, repositioning the patient, optimizing nutritional status, and moisturizing sacral skin are appropriate strategies to prevent pressure ulcers. Although a number of RCTs have evaluated preventive strategies for pressure ulcers, many of them had important methodological limitations. There is a need for well-designed RCTs that follow standard criteria for reporting nonpharmacological interventions and that provide data on cost-effectiveness for these interventions.

**POST-ACUTE/NH/LTC:**

**Bates-Jensen, B.M., Alessi, C.A., Al-Samarrai, N.R., & Schnelle, J.F. The effects of an exercise and incontinence intervention on skin health**

**outcomes in nursing home residents. *Journal of the American Geriatrics Society*. 2003; 51(3), 348-355.**

**OBJECTIVES:** To examine skin health outcomes of an exercise and incontinence intervention.

**DESIGN:** Randomized controlled trial with blinded assessments of outcomes at three points over 8 months.

**SETTING:** Four nursing homes (NHs).

**PARTICIPANTS:** One hundred ninety incontinent NH residents.

**INTERVENTION:** In the intervention group, research staff provided exercise and incontinence care every 2 hours from 8:00 a.m. to 4:30 p.m. (total of four daily care episodes) 5 days a week for 32 weeks. The control group received usual care from NH staff.

**MEASUREMENTS:** Perineal skin wetness and skin health outcomes (primarily blanchable erythema and pressure ulcers) as measured by direct assessments by research staff, urinary and fecal incontinence frequency, and percentage of behavioral observations with resident engaged in standing or walking.

**RESULTS:** Intervention subjects were significantly better in urinary and fecal incontinence, physical activity, and skin wetness outcome measures than the control group. However, despite these improvements, differences in skin health measures were limited to the back distal perineal area, which included the sacral and trochanter regions. There was no difference between groups in the incidence rate of pressure ulcers as measured by research staff, even though those residents who improved the most on fecal incontinence showed improvement in pressure ulcers in one area.

**CONCLUSION:** A multifaceted intervention improved four risk factors related to skin health but did not translate into significant improvements in most measures of skin health. Even if they had adequate staffing resources, NHs might not be able to improve skin health quality indicators significantly if they attempt to implement preventive interventions on all residents who are judged at risk because of their incontinence status.

**Bates-Jensen, B.M., McCreath, H.E., Kono, A., Apeles, N.C.R., & Alessi, C. Subepidermal moisture predicts erythema and Stage I pressure ulcers in nursing home residents: A pilot study. *Journal of the American Geriatrics Society*. 2007; 55(8), 1199-1205.**

**OBJECTIVES:** To examine the relationship between a measure of subepidermal moisture (SEM) and visual skin assessment (VSA) of erythema and Stage 1 pressure ulcers (PUs) performed a week later in nursing home (NH) residents.

**DESIGN:** Descriptive, cohort study.

**SETTING:** Two NHs.

**PARTICIPANTS:** Thirty-five residents.

**METHODS:** Concurrent VSAs and SEM readings were obtained at the sacrum, right and left trochanters, buttocks, and ischial tuberosities weekly for 52 weeks. SEM was measured using a handheld dermal phase meter, with higher readings indicating greater SEM (range 0-999 dermal phase units [DPUs]). VSA was rated as normal, erythema/Stage 1 PU, or Stage 2+PU. SEM was modeled as a predictor of VSA of erythema and PUs 1 week later (controlling for clustering), with concurrent moisture, Braden Scale PU risk status, anatomic site, and ethnicity as covariates.

**RESULTS:** Participants had a mean age of 84.7, 83% were female, and 80% were non-Hispanic white. SEM measures were lowest for normal skin (97+/-122 DPU), higher for erythema/Stage 1 PUs (192+/-188 DPU), and highest for Stage 2+PUs (569+/-320 DPU) across all sites (all  $P < .001$ ). SEM was responsive to changes in VSA, and higher SEM predicted greater likelihood of erythema/Stage 1 PU the next week (odds ratio=1.26 for every 100-DPU increase in SEM,  $P = .04$ ).

**CONCLUSION:** SEM measures are associated with concurrent erythema and PUs and future (1 week later) development of erythema/Stage 1 PUs. SEM may assist in predicting early PU damage, allowing for earlier intervention to prevent skin damage.

**Bergquist, S. The quality of pressure ulcer prediction and prevention in home health care. *Applied Nursing Research*. 2005; 18,148-154.**

The purpose of this study was to assess the quality of pressure ulcer prediction and prevention in home health care. Randomly selected Medicare-certified home care agencies in four Midwestern states were surveyed. The overall response rate was 44% ( $n = 128$ ). Approximately half (57.8%) of the responding agencies assessed all patients for pressure ulcer risk upon admission; another 4.7% assessed only chair or bed-bound patients. Clinical nursing judgment was the most commonly (72%) used method for assessing risk; only 21% of the agencies used a validated tool such as the Braden Scale

or the Norton Scale to identify those at risk. Approximately one third of the reporting agencies had prediction and/or prevention policies. Only 18.0% of home health care agencies identified recommended interventions in a pressure ulcer prevention protocol. Findings suggest opportunities for improvement in pressure ulcer prediction and prevention practice in home health care.

**Fader, M., Clarke-O'Neill, S., Cook, D., Dean, G., Brooks, R., Cottenden, A., & Malone-Lee, J. Management of night-time urinary incontinence in residential settings for older people: An investigation into the effects of different pad changing regimes on skin health. *Journal of Clinical Nursing*. 2003; 12(3), 374-386.**

Abstract: Absorbent pads are the main method of managing urinary incontinence in residential settings for older people. Improvements in technology have resulted in highly absorbent products which may be worn all night, but the effects of prolonged pad wearing on aged skin are unknown. The aim of this study was to examine the effects of two different pad changing regimes on skin health. A cross-over design was used. Subjects from residential settings were randomly allocated to one of two pad changing regimes: a frequent pad changing regime or a less frequent pad changing regime. Each regime lasted 4 weeks and was followed by the alternative regime. Skin measurements were taken twice during each regime using the Diastron Erythema meter, a visual grading scale, the Servomed evaporimeter, and pH meter. The primary outcome variable was the Diastron Erythema meter index. Eighty-one subjects completed the study. No significant differences were found in the severity of erythema, or skin pH, between regimes. Measurements of trans-epidermal water loss were significantly higher in the less frequent pad changing regime indicating that skin was 'wetter' ( $P = 0.01$ ; 95% CI: 2.89-21.39). Five subjects developed grade 2 pressure ulcers (abrasions) during the less frequent pad changing regime, but none in the frequent pad changing regime; this result was not significant ( $P = 0.1$ ; 95% CI: 0-1.09). No evidence was found that a less frequent pad changing regime has an effect on skin erythema or pH. There is evidence that skin is wetter which may make it more vulnerable to friction and abrasion. The statistically non-significant finding of greater incidence of grade 2 pressure ulcers is a cause for concern and merits further investigation because of the clinical significance of loss of skin integrity.

**Graumlich, J.F., Blough, L.S., McLaughlin, R.G., Milbrandt, J.C., Calderon, C.L., Agha, S.A. & Scheibel, L.W. Healing pressure ulcers with collagen or hydrocolloid: A randomized, controlled trial. *Journal of the American Geriatrics Society*. 2003; 51(2), 147-154.**

**OBJECTIVES:** To compare the effects of topical collagen and hydrocolloid on pressure ulcer healing.

**DESIGN:** Randomized (allocation concealed), single-blind (outcome assessors), controlled trial with 8-week follow-up.

**SETTING:** Eleven nursing homes in central Illinois. **PARTICIPANTS:** Sixty-five patient-residents with Stage II or III pressure ulcers: median age 83.1, median Braden score 12, 63% female, 80% Stage II ulcers, and 20% Stage III ulcers. Exclusion criteria included cellulitis and osteomyelitis.

**INTERVENTION:** Thirty-five patients were allocated to topical collagen daily, 30 to topical hydrocolloid twice weekly.

**MEASUREMENTS:** The primary outcome was complete healing within 8 weeks. Secondary outcomes were time to heal, ulcer area healed per day, linear healing of wound edge, and cost of therapy.

**RESULTS:** Analysis by intention to treat revealed similar complete ulcer healing within 8 weeks in collagen (51%) and hydrocolloid (50%) recipients (difference 1%, 95% confidence interval (CI) = 26-29%). Mean healing time was similar: collagen healed in 5 weeks (95% CI = 4-6), hydrocolloid healed in 6 weeks (95% CI = 5-7). Mean area healed per day was 6 mm<sup>2</sup>/d in both treatment groups. Mean linear healing of the wound edge was 3 mm in both groups. In multivariate analysis, baseline ulcer depth was the only independent predictor of complete ulcer healing within 8 weeks (odds ratio = 0.56, 95% CI = 0.38-0.81). Cost analysis favored hydrocolloid.

**CONCLUSIONS:** There were no significant differences in healing outcome between collagen and hydrocolloid. Collagen was more expensive and offered no major benefits to patients otherwise eligible for hydrocolloid treatment.

**Hunter, S., Anderson, J., Hanson, D., Thompson, P., Langemo, D., & Klug, M.G. Clinical trial of a prevention and treatment protocol for skin breakdown in two nursing homes. *Journal of Wound, Ostomy and Continence Nursing.* 2003; 30(5), 250-258.**

Objective: Our objective was to assess the effectiveness of skin care protocols, including a body wash and skin protectant, on skin breakdown in 2 nursing homes.

Design: This was a quasi-experimental pretest/posttest design study.

Setting and subjects: Adult residents (n = 136) of 2 skilled nursing homes consented to participate in this study. Seventy percent were women; the sample average age of 82 years.

Instruments: A researcher-designed data recording form documented resident demographics, incidence and type of skin breakdown or pressure ulcer, presence of urinary or fecal incontinence, and assessment of the effectiveness of body wash and skin protectant.

Methods: Baseline data on prevalence of pressure ulcers and skin protocol were collected weekly for a 3-month period followed by a week-long educational program by the researchers about skin care and the body wash and skin protectant. During the 3-month trial with the body wash and skin protectant incorporated into routine care, research assistants recorded resident data weekly and researchers again assessed prevalence and incidence of pressure ulcers and skin breakdown weekly.

Results: Incorporation of a body wash and skin protectant into a skin care prevention and early intervention protocol in 2 nursing homes documented a decrease in skin breakdowns from 68 pre-intervention to 40 post intervention; the decrease in agency B was statistically significant. There was a statistically significant decrease in stage I and II pressure ulcer incidence overall (pre-intervention = 19.9%, post intervention = 8.1%). Nurses evaluated the body wash and skin protectant as effective for 98% of the time used.

Conclusion: Implementation of a protocol for skin care along with staff education, including the prophylactic use of a body wash and skin protectant, reduced the incidence of skin breakdown, including pressure ulcers and perineal dermatitis, in 2 long-term care facilities. (J WOCN 2003;30:250-8.)

**Hollisaz, M.T., Khedmat, H., & Yari, F. A randomized clinical trial comparing hydrocolloid, phenytoin and simple dressings for the treatment of pressure ulcers. *BMC Dermatology*. 2004; 4(18), 1-9.**

Background: Pressure sores are important and common complications of spinal cord injury. Many preventive and therapeutic approaches have been tried and new trials are evolving. One relatively recent method is application of a hydrocolloid dressing (HD). In this study we compared the therapeutic effects of HD on pressure ulcer healing with two other topical applications, phenytoin cream (PC) and simple dressing (SD).

**Methods:** Ninety-one stage I and stage II pressure ulcers of 83 paraplegic male victims of the Iran-Iraq war were randomly allocated to three treatment groups. Mean age and weight of the participants were  $36.64 \pm 6.04$  years and  $61.12 \pm 5.08$  kg, respectively. All the patients were managed in long term care units or in their homes for 8 weeks by a team of general practitioners and nurses, and the ulcer status was recorded as "Complete healing", "Partial healing", "Without improvement" and "Worsening".

**Results:** Complete healing of ulcers, regardless of location and stage, was better in the HD group than the PC [23/31(74.19%) vs. 12/30(40%); difference: 34.19%, 95% CI = 10.85–57.52, (P < 0.01)] or the SD [23/31(74.19%) vs. 8/30(26.66%); difference: 47.53%, 95% CI = 25.45–69.61, (P < 0.005)] groups. Complete healing of stage I ulcers in the HD group [11/13(85%)] was better than in the SD [5/11(45%); difference: 40%, 95% CI = 4.7–75.22, (P < 0.05)] or PC [2/9 (22%); difference: 63%, 95% CI = 29.69–96.3, (P < 0.005)] groups. Complete healing of stage II ulcer in the HD group [12/18 (67%)] was better than in the SD group [3/19(16%); difference: 51%, 95% CI = 23.73–78.26, (P < 0.005)], but not significantly different from the PC group [10/21 (48%); difference: 19%, 95% CI = -11.47–49.47, (P > 0.05)]. We performed a second analysis considering only one ulcer per patient (i.e. 83 ulcers in 83 patients). This "per patient" analysis showed that complete ulcer healing in the HD group was better than in the PC [20/28(71.4%) vs. 11/28 (39.3%); difference: 32.1%, 95% CI = 7.4–56.7, (P < 0.01)] or SD [20/28(71.4%) vs. 8/27 (29.6%); difference: 41.8%, 95% CI = 17.7–65.8, (P < 0.005)] groups.

**Conclusion:** We deduced that HD is the most effective method investigated for treating stage I and II pressure ulcers in young paraplegic men.

**Lyder, C.H., Shannon, R., Emleo-Frazier, O., McGehee, D., & White, C. A Comprehensive Program to Prevent Pressure Ulcers in Long-Term Care: Exploring Costs and Outcomes. *Ostomy Wound Management*. 2002; 48, 52-62.**

Pressure ulcers continue to be prevalent and costly for long-term care facilities. A recent document published by the National Pressure Ulcer Advisory Panel revealed a pressure ulcer incidence rate of 2.2% to 23.9% in long-term care.<sup>1</sup> Although the cost of pressure ulcer prevention remains elusive, costs associated with their treatment have been conservatively estimated to range from \$500 to \$50,000 per ulcer,<sup>2</sup> with more severe wounds being significantly more expensive to manage than less severe ulcers.<sup>3</sup> These costs do not account for the pain and suffering commonly associated with these ulcers. Presently, approximately 1.5 to 3 million adults suffer with pressure ulcers.<sup>4</sup> Given the high incidence rates, the need to address pressure ulcer prevention has become paramount. Most recently, the U.S. Centers for

Medicare and Medicaid Services (formerly the Health Care Financing Administration) included pressure ulcers as one of three sentinel events for long-term care<sup>5</sup>; therefore, the formation of a pressure ulcer or subsequent deterioration of a pressure ulcer can lead to significant monetary penalties (maximum \$10,000/day) in long-term care.

Pressure ulcers have become so common in long-term care that federal regulations now articulate pressure ulcer standards or guidelines of care and prevention. In May 1992, the Agency for Health Care Research and Quality (formerly the Agency for Health Care Policy and Research) released Clinical Practice Guidelines<sup>6</sup> for the prevention of pressure ulcers. These guidelines provide the healthcare community with current practice parameters based on expert opinion and synthesis of scientific evidence. The Joint Commission for Accreditation of Health Care Organizations (JCAHO) recommends use of the AHRQ clinical practice guidelines. Moreover, the Centers for Medicare and Medicaid Services are using the guidelines to create policy and reimbursement criteria and to direct the federal and state survey process of long-term care facilities.

The AHRQ guidelines for pressure ulcer prevention are meant to be living documents -- that is, providers should implement these guidelines in a cost-effective manner that offers intelligent wound care based on available evidence. How best to implement the standards in long-term care continues to be a challenge, even for discerning administrators and health professionals attempting to maximize resource utilization and balance quality pressure ulcer care. Thus, the purpose of this study was to examine the effectiveness of comprehensive protocols of care (SOLUTIONS®, ConvaTec, a Bristol-Myers Squibb Company, Princeton, NJ) focused on risk factors identified by the Braden Scale to prevent pressure ulcers in two long-term care facilities.

**Lyder, C., van Rijswijk, L. Pressure ulcer prevention and care: Preventing and managing pressure ulcers in long-term care: An overview of the revised federal regulation. *Ostomy Wound Management*. 2005 April; Suppl, 2-6.**

Although the Centers for Medicare and Medicaid Service's Federal Regulation as it relates to pressure ulcer prevention and care in long-term care facilities has not changed, the Guidance to Surveyors (F-314) has been expanded significantly. In addition to more clearly defining commonly used terms, the new guidance document emphasizes the use of pressure ulcer risk assessment and prevention strategies, pain assessment and treatment, and monitoring the care outcomes. The Centers for Medicare and Medicaid



Service has clearly raised the bar on pressure ulcer care. Based on currently available evidence, the guidance document is clear in its intent to encourage all long-term care facilities to adopt evidence-based pressure ulcer protocols of care. This transition, and the development and implementation of this guidance document, may present considerable challenges to some long-term care facilities. However, the lack of ambiguity in the F-314 document and its consistency with currently available evidence may be helpful to staff and improve outcomes of care.

### **HOME HEALTH:**

**Bergquist, S. Pressure ulcer prediction in home health care: Implications for use with OASIS. *Advances in Skin and Wound Care*. 2003; 132-139.**

**OBJECTIVE:** To determine whether admission data routinely collected on the Outcome and Assessment Information Set (OASIS) might be used to identify the older adult at risk for pressure ulcer development in home health care.

**DESIGN:** Secondary analysis of data from a retrospective cohort study

**SETTING AND SUBJECTS:** The sample included 1711 nonhospice patients 60 years or older and free of pressure ulcers who were admitted to the intermittent skilled nursing division of a large Midwestern home health care agency between January 1995 and March 1996.

**MAIN OUTCOME MEASURES:** Data on potential risk factors were extracted from admission information. Those identical to items on the admission OASIS assessment were included in the study. Patient records were followed forward chronologically to either pressure ulcer development or absence.

**MAIN RESULTS:** Cox regression analysis showed that limitation in activity to bed, dependence in dressing, urinary incontinence, and needing assistance with transferring predicted Stage I pressure ulcer development ( $P < \text{ or } = .001$ ). Bowel/bladder incontinence, oxygen use, a current fracture, and dependence in dressing predicted Stage II and greater pressure ulcer development ( $P > .001$ ). Predictors of Stage I plus Stage II and greater pressure ulcers included those predictors from each of the individual models, including limitation in activity to bed, dependence in dressing, a current fracture, oxygen use, needing assistance with transferring, and urinary incontinence ( $P < \text{ or } = .001$ ).

**CONCLUSION:** These findings suggest that the admission OASIS assessment may provide a method for identifying elderly patients who are at risk for developing Stage I and Stage II pressure ulcers in home health care.

**Chaves, Lidice M.; Grypdonck, Mieke H. F.; Defloor, Tom, Pressure Ulcer Prevention in Homecare: Do Dutch Homecare Agencies Have an Evidence-Based Pressure Ulcer Protocol? *Journal of Wound, Ostomy & Continence Nursing*. 2006 May/June; 33(3):273-280.**

**OBJECTIVE:** The purpose of this study was to gain insight into the availability and quality of protocols for pressure ulcer prevention in homecare agencies in the Netherlands.

**DESIGN:** A descriptive study was completed.

**SETTING AND SUBJECTS:** Forty-one homecare agencies in the Netherlands that provide nursing care were queried.

**INSTRUMENTS:** Three instruments were used to collect data: (1) a structured questionnaire containing 46 closed and open-ended questions, (2) a checklist used by experts to analyze the protocols for conformity to guidelines, and (3) a tool used to generate a numerical score for each protocol based on the experts' reviews.

**METHODS:** A questionnaire was mailed to all homecare agencies in the Netherlands that provided nursing care. The quality of each protocol was judged and scored by 3 pressure ulcer prevention experts. The scores were analyzed using descriptive statistics.

**RESULTS:** A pressure ulcer protocol was available in 78% of the agencies. Seventy-five percent had at least 1 wound care nurse who spent an average of 10 hours per week on pressure ulcer prevention. In 20% of the agencies, no introduction or instruction was given to the nurses when the protocol was implemented. In 25% of the agencies, nurses did not participate in the revision of the protocol. At the end of 2003, only 13% of the agencies had executed 1 or more revisions of their protocol since 2002, when the last Dutch pressure ulcer guideline was introduced. The 26 pressure ulcer prevention protocols had a mean score of 47 points out of a maximum of 100 points (range 9 to 82; SD, 18).

**CONCLUSIONS:** Although the use of protocols is considered an important adjunct in the prevention of pressure ulcers, 22% of the participating agencies did not have a pressure ulcer prevention protocol and 25% did not have wound care nurses, indicating a need for further promotion of standardized pressure ulcer prevention strategies. In addition, the available protocols were frequently of low quality or outdated, reflecting a need for increased attention to current and accurate tools to guide nursing practice.

**Lee, S.K., Posthauer, M.E., Dorner, B., Redovian, V., & Maloney, M.J. Pressure Ulcer healing with a concentrated, fortified, collagen protein hydrolysate supplement: A randomized controlled trial. *Advances in Skin & Wound Care*. 2006; 19(2), 92-96.**

**OBJECTIVE:** To compare Pressure Ulcer Scale for Healing (PUSH) scores at 8 weeks in long-term-care residents with pressure ulcers who were given standard care plus a concentrated, fortified, collagen protein hydrolysate supplement vs. residents who were given standard care plus placebo.

**DESIGN:** Randomized, prospective, controlled, multicenter trial at 23 long-term-care facilities in 4 states.

**SUBJECTS:** A total of 89 residents with Stage II, III, or IV pressure ulcers were entered into the trial; 71 residents completed the study.

**INTERVENTION:** Residents were randomized to receive standard care plus a concentrated, fortified, collagen protein hydrolysate supplement (n = 56) or standard care plus placebo (n = 33) 3 times daily for 8 weeks. Wound healing was assessed biweekly using the PUSH tool, version 3.0. This tool categorizes pressure ulcers by surface area, exudate, and type of wound tissue.

**PRIMARY OUTCOME MEASURE:** Change in PUSH tool scores in each group at 8 weeks.

**RESULTS:** After 8 weeks of treatment, residents who received standard care plus the concentrated, fortified, collagen protein hydrolysate supplement had significantly better PUSH tool scores compared with those who received standard care plus placebo (3.55 +/- 4.66 vs. 3.22 +/- 4.11, respectively; P < .05).

**CONCLUSION:** By week 8, PUSH tool scores—a measurement of pressure ulcer healing—showed approximately twice the rate of pressure ulcer healing in the treatment group compared with the control group. A concentrated, fortified, collagen protein hydrolysate supplement may be of benefit to residents of long-term-care facilities who have pressure ulcers.

**Werkman H, Simodejka P, Defilippis, J. Partnering for prevention: a pressure ulcer prevention collaborative project. *Home Healthcare Nurse*. 2008; 26(1):17-22.**

In a statewide initiative, coordinated by the New Jersey Hospital Association (NJHA) Quality Institute, hospitals together with nursing home and home care agencies were asked to participate in a Pressure Ulcer Prevention Collaborative. The goal of this collaborative was to decrease the incidence and prevalence of pressure ulcers across the state by 25% within a 12-month

period. This article discusses the rationale for the Collaborative as well as the requirements and implementation of the initiative within Community Medical Center's Home Health Program.

### **OTHER/ANY SETTING:**

**Abbas, S. Diamorphine intrasite dressings for painful pressure ulcers. *Journal of Pain and Symptom Management*. 2004; 28(6) 532-533.**  
Letter to the editor

**Brienza, D.M., Geyer, M.J. & Jan, Y.K. A comparison of changes in rhythms of sacral skin blood flow in response to heating and indentation. *Archives of Physical Medicine and Rehabilitation*. 2005; 86(6), 1245-1251.**

Objective: To differentiate blood flow control mechanisms associated with indentation from those associated with heating and to discern heat-induced and pressure-induced changes by comparing the effect of externally applied stress on skin blood flow (SBF) to the response to externally applied heat.

Design: Repeated-measures design.

Setting: A university research laboratory.

Participants: Ten healthy, young adults (5 men, 5 women; mean age  $\pm$  standard deviation, 30.0 $\pm$ 3.1y).

Intervention: Incremental heat (35 $^{\circ}$ –45 $^{\circ}$ C, 1 $^{\circ}$  step/min) and pressure (0–60mmHg, 5mmHg step/3min) on the sacrum using a computer-controlled indenter. Sessions for heat and pressure protocols were separated by 7 $\pm$ 2 days.

Main Outcome Measures: We used a Laserflo Blood Perfusion Monitor 2 and Softip pencil probe to measure capillary blood perfusion and wavelet analysis to decompose the blood flow signal. The power spectrum was divided into 5 ranges corresponding to metabolic, neurogenic, myogenic, respiratory, and cardiac control mechanisms. The average relative (ie, normalized) power in each frequency range was computed to determine of the relative contribution of each control mechanism.

Results: Power in the myogenic frequency range was higher after incremental pressure and lower after incremental heating, whereas power in the metabolic frequency range was lower after incremental pressure and higher after incremental heating ( $P<.01$ ). Mean blood flow decreased as pressure increased from 0 to 15mmHg; mean blood flow increased as pressure increased from 15 to 60mmHg.

Conclusions: SBF, as recorded by the laser Doppler, suggests that there may be a myogenic control mechanism mediating blood flow after incremental tissue loads and that a metabolic control mechanism may mediate blood flow after heat application to the tissue. The study of local blood flow control mechanisms and their response to pathomechanical perturbations may be possible using wavelet analysis of blood flow oscillations. More research is needed to establish the clinical utility of these findings in the development of support surfaces intended to reduce the risk of developing pressure ulcers.

**Bouza, C., Saz, Z., Munoz, A., & Amate, J.M. Efficacy of advanced dressings in the treatment of pressure ulcers: A systematic review. *Journal of Wound Care*. 2005; 14(5), 193-199.**

Abstract: This meta-analysis explored the current scientific evidence to ascertain if there is a real benefit in using advanced dressings and whether there are significant differences between the different types of advanced dressings in the treatment of pressure ulcers. Studies selected for analysis were randomized or quasi-randomized trials as well as a controlled clinical trial. Joint analysis of the studies found that hydrocolloids significantly improved healing rates of pressure ulcers when compared with conventional treatment. However, there were no significant differences between advanced dressings in healing rates. There were substantial methodological limitations in the studies reviewed, which reduced the validity of the results. The vast majority had a short duration, which does not reflect the often chronic and refractory nature of pressure ulcers. Also, there were little data on the use of advanced dressings on infected pressure ulcers, and their effect on pain, quality of life and patients' perceived health and preferences. The authors say this raises concerns about the scientific literature's capacity to provide evidence to support the use of this wound management strategy.

**Coskunfirat, O.K., & Ozgentas, H.E. Gluteal perforator flaps for coverage of pressure sores at various locations. *Plastic and Reconstructive Surgery*. 2003; 113(7), 2012-2017.**

Flap coverage is essential for successful treatment of pressure sores, and musculocutaneous flaps have been preferred universally. Development of perforator flaps supplied by musculocutaneous perforators has allowed reconstructive surgeons to harvest flaps without including muscles. Perforator flaps have enhanced the possibility of donor sites because a flap can be supplied by any musculocutaneous perforator, and donor-site morbidity is also reduced. Between November of 1998 and June of 2002, the authors used 35 gluteal perforator flaps in 32 consecutive patients for coverage of pressure sores located at sacral (n= 22), ischial (n= 7), and trochanteric (n= 6) regions. The mean age of the patients was 53.1 years (range, 5 to 87 years), and there were 16 male and 16 female patients. All

flaps in this series were supplied by musculocutaneous arteries arising from gluteal muscles. Patients were followed up for a mean period of 13.6 months. Wound dehiscence was observed in two patients and treated by secondary closure. Three patients died during the follow-up period. All flaps survived except one that had undergone total necrosis, and only one recurrence was noted during the follow-up period. Gluteal perforator flaps are safe and reliable options for coverage of pressure sores located at different locations. Freedom in flap design and low donor-site morbidity make gluteal perforator flaps an excellent choice for pressure sore coverage.

**Duimel-Peeters, I.G.P., Halfens, R.J.G., Ambergen, A.W., Houwing, R.H., Berger, M.P.F., & Snoeckx, L.H.E. H. The effectiveness of massage with and without dimethyl sulfoxide in preventing pressure ulcers: A randomized, double-blind cross-over trial in patients prone to pressure ulcers. *International Journal of Nursing Studies*. 2007; 44, 1285-1295.**

Background: Although guidelines advise against massage, it is one of the methods widely regarded and used by nurses to prevent pressure ulcers (PU).

Objectives: The purpose of this study was to examine the effectiveness of different variations of massage in preventing pressure ulcers.

Methods: A randomized, double-blind cross-over design, in which patients of nursing homes who are prone to PU underwent two of the three possible interventions; 'position changes only', 'massaging with an indifferent cream' and 'massaging with a dimethyl sulfoxide (DMSO) cream'.

Results: The results of three interventions did not differ significantly. DMSO did not fulfill the expectations raised by literature and a previous pilot-study.

**Ellis, S.L., Finn, P., Noone, M., & Leaper, D.J. Eradication of methicillin-resistant *Staphylococcus aureus* from pressure sores using warming therapy. *Surgical Infections*. 2003; 4(1), 53-55.**

Background: Nosocomial infection is a major cause of surgical morbidity and mortality. Methicillin-resistant *Staphylococcus aureus* (MRSA) has become a prominent organism in colonization and infection in surgical patients. Pressure sores are a major reservoir of MRSA.

Materials and Methods: In this study, 33 patients with full-thickness pressure sores were randomized to receive standard care or radiant heat therapy using a Warm Up device (Augustine Medical, Eden Prairie, MN). Weekly microbial sampling was used for assessment of bacterial presence. None of the patients received antibiotics prior to or during the eight weeks of study.

Results: More than 50 species of bacteria were present in the pressure sores with a median of four organisms per sample. Methicillin-resistant *S. aureus* was found in 14 of the patients' pressure sores. In the warming group (n = 8), MRSA was eradicated in six patients within 2 weeks of warming, whereas in the control group none had eradication (Fisher's exact test, p = 0.01). Eradication was defined as three consecutive weekly swabs without bacterial growth.

Conclusion: The warming of pressure sores is being assessed as an adjunct to healing, but there is some promise that colonization by MRSA may be eradicated, thereby reducing a potential reservoir of organisms. The risk to surgical patients when patients are harboring MRSA may be minimized by warming therapy.

**Flock, P. Pilot study to determine the effectiveness of diamorphine gel to control pressure ulcer pain. *Journal of Pain Symptom Management*. 2003; 25(6), 547-554.**

Pressure ulcer pain, a common problem among palliative care patients, does not respond well to oral analgesics. There have been case reports in the medical literature describing the successful use of topical opioids for painful skin conditions. So far, these topical opioids have not been compared to placebo. To determine the effectiveness of diamorphine gel to control pressure ulcer pain and compare it with placebo, a randomized, double blind, placebo-controlled crossover trial was conducted in 13 patients with painful grade II or III pressure ulcers. Patients resided on the inpatient unit at St. Christopher's Hospice, London, UK. Seven patients completed the study and provided pain scores before and after diamorphine or placebo gel application. Pain scores improved significantly after diamorphine gel application compared with placebo (P<0.05). Diamorphine gel appears to be an effective treatment for pain caused by stage II or III pressure ulcers. It is probably as safe as placebo in regards to side effects, but a larger study would be required to confirm these results.

**Granick, M.S., Posnett, J., Jacoby, M., Noruthun, S., Ganchi, P.A., & Datiashvili, R.O. Efficacy and cost-effectiveness of a high-powered parallel waterjet for wound debridement. *Wound Repair and Regeneration*. 2006; 14(4), 394-397.**

Current concepts of wound healing acknowledge the essential role of wound bed preparation in achieving a wound with good healing potential. Critical to wound bed preparation is the removal of necrosis, unhealthy tissue, foreign matter, and infection. One of the accepted methods of wound bed preparation is surgery. The high-power parallel waterjet is a new surgical device, which allows the operator to remove very precisely undesirable

tissue and debris with maximal preservation of viable tissue. A retrospective study was performed to evaluate the efficacy, safety, and economic impact of using this technique of surgical debridement. Forty patients who had waterjet debridements were compared with 22 patients with matched wounds who had conventional surgical debridement. The waterjet group had significantly fewer procedures ( $p < 0.002$ ) than the conventional group. Based on these outcomes, the use of the new device in appropriate patients is expected to lead to cost savings of approximately \$1,900 per patient.

**Helberg D, Mertens E, Halfens R, Dassen T. Treatment of Pressure Ulcers: Results of a Study Comparing Evidence and Practice. *Ostomy Wound Management*. 2006; 52: 60-71.**

Although pressure ulcers are presumed to be preventable, their prevalence remains high. A 2002 survey of 55 German hospitals and nursing homes found that 25% of the hospital patients and 17% of the nursing home residents identified by the Braden Scale as at-risk had pressure ulcers.<sup>1</sup> These wounds are costly in terms of financial expense and human suffering.<sup>2,3</sup> Their prevention and treatment must be based on the best available evidence. To examine the regimens used to treat pressure ulcers in German hospitals and nursing homes, the treatment regimens used, and whether treatment was based on best available evidence, the results of a literature review were compared with data from two pressure ulcer prevalence surveys on the use of wound dressings conducted in hospitals and nursing homes in Germany in 2001<sup>4</sup> and 2002.<sup>1</sup> Specifically, the purpose of this study was to evaluate the quantity and level of evidence-based pressure ulcer prevention and treatment literature and its application in practice.

**Houghton, P.E., Kincaid, C.B., Lovell, M., Campbell, K.E., Keast, D.H., Woodbury, M.G., & Harris K.A. Effect of electrical stimulation on Chronic leg ulcer size and appearance. *Physical Therapy*. 2003; 83(1), 17-28.**

**Background and Purpose:** Electrical current has been recommended for use on chronic pressure ulcers; however, the ability of this modality to improve healing of other types of chronic ulcers is less well established. The purpose of this study was to examine the effect of high-voltage pulsed current (HVPC) on healing of chronic leg ulcers.

**Subjects:** Twenty-seven people with 42 chronic leg ulcers participated in the study.

**Methods:** The subjects were separated into subgroups according to primary etiology of the wound (diabetes, arterial insufficiency, venous insufficiency) and then randomly assigned to receive either HVPC (100 microseconds, 150



V, 100 Hz) or a sham treatment for 45 minutes, 3 times weekly, for 4 weeks. Wound surface area and wound appearance were assessed during an initial examination, following a 1- to 2-week period during which subjects received only conventional wound therapy, after 4 weeks of sham or HVPC treatment, and at 1 month following treatments.

Results: The results indicated that HVPC applied to chronic leg ulcers reduced the wound surface area over the 4-week treatment period to approximately one half the initial wound size (mean decrease=44.3%, SD=8.8%, range=2.8%-100%), which was over 2 times greater than that observed in wounds treated with sham units (mean decrease=16.0%, SD=8.9%, range=-30.3%-83.7%).

Discussion and Conclusion: The results of the study indicate that HVPC administered 3 times a week should be considered to accelerate wound closure of chronic leg ulcers.

**Huber, J., Reddy, R., Pitham, T., & Huber, D. Increasing heel skin perfusion by elevation. *Advances in Skin & Wound Care*. 2008; 21(1), 37-441.**

Huber et al determine the efficacy of elevation in the primary prevention and treatment of pressure ulcers by studying the blood flow in tissue at risk of ulceration. Results show that perfusion in the heel was significantly greater when elevated than when using the other devices tested. In conclusion, elevation is therefore an important technique in pressure ulcer prevention and treatment and should be incorporated into health care practice.

**Madhuri, R., Gill, S.S., Kalkar, S.R., Wu, W., Anderson, P.J., & Rochon, P.A. Treatment of pressure ulcers: a systematic review. *JAMA*. 2008; 300(22): 2647-2662.**

Context: Many treatments for pressure ulcers are promoted, but their relative efficacy is unclear.

Objective: To systematically review published randomized controlled trials (RCTs) evaluating therapies for pressure ulcers.

Data Sources and Study Selection: The databases of MEDLINE, EMBASE, and CINAHL were searched (from inception through August 23, 2008) to identify relevant RCTs published in the English language. Data Extraction: Methodological characteristics and outcomes were extracted by 3 investigators.

Data Synthesis: A total of 103 RCTs met inclusion criteria. Of these, 83 did not provide sufficient information about authors' potential financial conflicts of interest. Methodological quality was variable. Most trials were conducted in acute care (38 [37%]), mixed care (25 [24%]), or long-term care (22 [21%]) settings. Among 12 RCTs evaluating support surfaces, no clear evidence favored one support surface over another. No trials compared a specialized support surface with a standard mattress and repositioning. Among 7 RCTs evaluating nutritional supplements, 1 higher-quality trial found that protein supplementation of long-term care residents improved wound healing compared with placebo (improvement in Pressure Ulcer Scale for Healing mean [SD] score of 3.55 [4.66] vs 3.22 [4.11], respectively;  $P_{.05}$ ). Other nutritional supplement RCTs showed mixed results. Among 54 RCTs evaluating absorbent wound dressings, 1 found calcium alginate dressings improved healing compared with dextranomer paste (mean wound surface area reduction per week, 2.39 cm<sup>2</sup> vs 0.27 cm<sup>2</sup>, respectively;  $P_{.001}$ ). No other dressing was superior to alternatives. Among 9 RCTs evaluating biological agents, several trials reported benefits with different topical growth factors. However, the incremental benefit of these biological agents over less expensive standard wound care remains uncertain. No clear benefit was identified in 21 RCTs evaluating adjunctive therapies including electric current, ultrasound, light therapy, and vacuum therapy.

Conclusions: Little evidence supports the use of a specific support surface or dressing over other alternatives. Similarly, there is little evidence to support routine nutritional supplementation or adjunctive therapies compared with standard care.

**Meaume, S., Vallet, D., Morere, M., & Teot, L. Evaluation of a silver-releasing hydroalginate dressing in chronic wounds with signs of local infection. *Journal of Wound Care*. 2005; 14(9), 411-419.**

Objective: To evaluate the clinical impact of using a silver-releasing hydroalginate dressing to minimize the risk of local infection in colonized chronic wounds.

Method: This was a randomized (stratification according to wound type) open-label multicentre comparative two-arm parallel-group study. Thirteen centers recruited 99 patients with either a venous leg ulcer or a pressure ulcer. None of the wounds required systemic antibiotics or were associated with lymphangitis and/or fever, but at least two of the following criteria had to be present: continuous pain; erythema; edema; heat; and moderate to high levels of serous exudate. Patients were allocated to receive either a silver-releasing hydroalginate dressing (Silvercel, the test group) or a pure calcium alginate dressing (Algosteril, the control group). Wounds were assessed daily

over 14 days to complete a modified ASEPSIS index to evaluate risk of infection, and then weekly for two additional weeks. A global wound severity score and area tracings were recorded weekly.

Results: Fifty-one and 48 patients were randomized in the test and control groups respectively: 28 pressure ulcers and 71 venous leg ulcers. The total mASEPSIS score over 14 days did not differ significantly between groups:  $95.4 \pm 62.2$  and  $104.2 \pm 72.8$  in control and test groups respectively ( $p=0.791$ ). Of the patients who completed the total four-week study duration, four out of 38 (10.5%) in the control group and none of the 40 in the test group were treated with systemic antibiotics at the final visit ( $p=0.053$ ). According to the investigators, fewer wounds developed a clinical infection over the four-week follow-up in the test group (33% versus 46%;  $p=0.223$ ). Overall, the four-week closure rate was statistically greater in the test group ( $0.32 \pm 0.57\text{cm}^2/\text{day}$  versus  $0.16 \pm 0.40\text{cm}^2/\text{day}$ ;  $p=0.024$ ). Compared with baseline, the absolute decrease in wound severity score at week four was higher in the test group ( $-5.6 \pm 3.2$  versus  $-4.1 \pm 4.3$ ;  $p=0.063$ ); this was also true of the percentage reduction ( $-32 \pm 17\%$  versus  $-23 \pm 25\%$ ;  $p=0.034$ ). Poor dressing acceptability and/or tolerability was noted in five out of 48 patients (10.4%) in the control group and in five out of 51 (9.8%) in the test group.

Conclusion: This study suggests that the use of silver-releasing dressings in the management of wounds at high risk of infection may have a clinically favorable influence on wound prognosis; the dressings also appeared to be well tolerated. However, the evaluation of these advantages in controlled clinical trials is complex and requires potent studies and the development of more specific endpoints than those currently used.

**Meaume, S., Van De Looverbosch, D., Heyman, H, Romanelli, M., Ciangherotti, A., & Charpin, S. A study to compare a new self-adherent soft silicone dressing with a self-adherent polymer dressing in stage II pressure ulcers. *Ostomy Wound Management*. 2003; 49(9), 44-49.**

Pressure ulcers are a common and painful problem among the elderly. Despite progress in prevention, many patients still develop pressure ulcers, and managing these wounds remains a challenge to healthcare professionals. Most wound management products are designed to achieve a number of goals. Many provide a moist environment in order to promote healing.<sup>1,2</sup> An effective dressing should absorb large amounts of exudate and stay in place a reasonable length of time. Another important aspect of dressing performance is minimizing pain and trauma to the wound and surrounding skin on removal. Dressing removal is a major challenge for the clinician when the patient's skin is fragile and easily broken, especially around sacral pressure ulcers in elderly patients where body fluids (often due to incontinence)

and/or microbial proliferation can damage the surrounding skin. In addition, removing a dressing with a strong adhesive can damage the surrounding skin, be painful, and cause new wounds. A variety of techniques has been used to protect and treat peri-wound skin, including skin barriers, powders, pastes, and skin sealant. Analgesia is sometimes given to reduce the procedural pain of dressing changes. One traditional approach to producing adhesive dressings involves use of an adhesive plaster that makes contact only with the peaks of the skin. However, when dressings coated with these adhesives are removed from the skin, the adhesion threshold is reached and a layer of epidermal cells is peeled off. The hydropolymer dressing, like many adhesive dressings, consists of an adhesive that may remove epithelial cells when the dressing is changed. A new dressing, with an adhesive technology consisting of a soft silicone layer that adheres to the surrounding skin but does not stick to the moist wound (silicone is hydrophobic), has been developed. The soft silicone layer is more flexible than other wound dressing adhesives and moves into the uneven skin surface to create a larger effective contact area with the skin. As a result, less adhesion force per square millimeter is needed with a level of adhesion that is comparable to traditional adhesive dressings. When the same peeling force is applied, the soft silicone will distribute the forces over a larger area of skin under the dressing. This means that dressings with what has been termed atraumatic soft silicone technology cause significantly less epidermal stripping on removal than dressings with other adhesive technologies.<sup>3</sup> To compare the new self-adherent soft silicone dressing to a commonly used hydropolymer dressing in the treatment of Stage II pressure ulcers, an open, randomized, controlled clinical study was conducted.

**Parnell, L.K.S., Ciufi, B., & Gokoo, C.F. Preliminary use of a hydrogel Containing enzymes in the treatment of stage II and stage III pressure ulcers. *Ostomy Wound Management*. 2005; 51(8), 50-60.**

Pressure ulcers present a serious and common problem, especially in the elderly. More than 1 million individuals develop pressure ulcers annually. The prevalence of pressure ulcers has been reported as 11% in skilled-care and nursing homes, 10% in the acute care setting, and 6.8% in the home care setting, with a range of 0.5% to 35.7% reported between agencies. In 2001, the National Pressure Ulcer Advisory Panel reported an incidence rate of pressure ulcers from 2.2% to 23.9% in long-term care settings.

Pressure ulcers impair quality of life because of pain, stress, and loss of independence leading to grief reactions,<sup>6</sup> depression, and social isolation. Furthermore, treatment of pressure ulcers is costly. In 1994, Miller and Delozier, in a publication sponsored by the Agency for Health Care Policy and Research (AHCPR), estimated that the total national cost of pressure ulcer treatment exceeded \$1.35 billion annually. In 1999, Berkrich reported an

estimated yearly cost to treat 1 to 1.7 million hospital-acquired pressure ulcers, limited to an acute care setting, at \$5 billion to \$8.5 billion. Reports of estimates of costs to treat pressure ulcers have ranged from \$4,000 to \$40,000, depending on the stage of the pressure ulcer.

Cost estimates for treatment are related to pressure ulcer severity. Optimal care of more severe ulcers requires increased time and resources. In 1996, Xakellis and Frantz reported the average cost for treatment of Stage II ulcers as \$1,119, versus \$10,185 for Stage III and IV ulcers, across healthcare settings. Treatment costs escalate when patients require hospitalization for complications. Pompeo coined the term “wound burden” to classify wounds according to their stage and size as follows: Class 1 (Stage II: <5 cm<sup>2</sup>), Class 2 (Stage II: >5 cm<sup>2</sup>), Class 3 (multiple Stage II or single Stage III: <5 cm<sup>2</sup>), Class 4 (Stage IV: <5 cm<sup>2</sup>), and Class 5 (Stage III or Stage IV: >5 cm<sup>2</sup> or multiple Stage III or Stage IV). Using this approach, Pompeo found a statistically significantly greater cost for wound care with an increasing wound burden. For example, total average costs per patient in a long-term acute care hospital with Class 4 pressure ulcers (N = 71) were \$54,954 as compared to an average cost of \$38,228 for those with Class 3 pressure ulcers (N = 89).

Pompeo further contends that these analyses grossly underestimate the true cost of wound care because most studies base cost estimates on acute care settings, while the majority of costs occur in long-term care. Additionally, while prevalence rates are generally estimated using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD 9-CM) codes such as 707.0 for decubitus, many ulcers are not coded.<sup>15</sup> In fact, in the National Health and Nutrition Survey Examination Study follow-up (NHANES1), Guralnik<sup>16</sup> reported that only 9 out of 54 pressure ulcers were reported in discharge summaries; in the other 45 cases, patients or their representatives subsequently identified pressure ulcers.

The impact of pressure ulcers is highlighted by a four-fold increased risk of death in geriatric patients who develop a pressure ulcer; this risk is increased to six times when the pressure ulcer does not heal. Furthermore, as pressure ulcers increase in severity, the probability of healing decreases, while morbidity and mortality increase. A marked risk of complications from pressure ulcers occurs in nursing home or home care settings; in one study, the cumulative incidence did not plateau after a 2-year follow-up period. Pressure reduction is a crucial component of pressure ulcer treatment; redistribution of the tissue load and improved circulation allow pressure ulcers to heal. Pressure reduction is provided by specialty beds, including air-fluidized therapy (Group 3); low-air-loss beds, powered, and non-powered overlays or mattresses (Group 2); and, to some extent, static overlays and replacement mattresses (Group 1). Air-fluidized therapy, initially developed in the 1960s, provides an effective treatment that not only reduces pressure, but also reduces friction and shear forces and decreases

moisture. Support for improved healing with air-fluidized therapy has been reported in a variety of randomized trials and clinical reports. However, few large clinical outcomes studies have directly compared the relative effectiveness of air-fluidized therapy with that of other specialty support surfaces. This retrospective study was designed to compare the relative effectiveness of different support surface groups using existing data from the National Pressure Ulcer Long-Term Care Study (NPULS).

**Sherman, R.A. Debriding pressure ulcers with maggot versus conventional therapy. *Wound Repair and Regeneration*. 2002; 10(4), 208-214.**

Abstract: To define the efficacy and safety of maggot therapy, a cohort of 103 inpatients with 145 pressure ulcers was evaluated. Sixty-one ulcers in 50 patients received maggot therapy at some point during their monitored course; 84 ulcers in 70 patients did not. Debridement and wound healing could be quantified for 43 maggot-treated wounds and 49 conventionally treated wounds. Eighty percent of maggot-treated wounds were completely debrided, while only 48% of wounds were completely debrided with conventional therapy alone ( $p=0.021$ ). Within 3 weeks, maggot-treated wounds contained one-third the necrotic tissue ( $p = 0.05$ ) and twice the granulation tissue ( $p < 0.001$ ), compared to non-maggot-treated wounds. Of the 31 measurable maggot-treated wounds monitored initially during conventional therapy, necrotic tissue decreased 0.2 cm<sup>2</sup> per week during conventional therapy, while total wound area increased 1.2 cm<sup>2</sup> per week. During maggot therapy, necrotic tissue decreased 0.8 cm<sup>2</sup> per week ( $p = 0.003$ ) and total wound surface area decreased 1.2 cm<sup>2</sup> per week ( $p = 0.001$ ). Maggot therapy was more effective and efficient in debriding chronic pressure ulcers than were the conventional treatments prescribed. Patients readily accepted maggot therapy, and adverse events were uncommon.

**Thai, T.P., Keast, D.H., Campbell, K.E., Woodbury, M.G., & Houghton, P.E. Effect of ultraviolet light C on bacterial colonization in chronic wounds. *Ostomy Wound Management*. 2005; 51(10), 32-45.**

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a strain of antibiotic-resistant bacteria commonly found in wounds. The prevalence of MRSA increased from less than 3% to rates as high as 40% between the early 1980s and 1990s in many hospitals in the US and Europe.<sup>1,2</sup> In Canada, hospitals and long-term care facilities have recorded cases of MRSA,<sup>3,4</sup> and community-acquired cases also have surfaced.<sup>5</sup> Methicillin-resistant *S. aureus* is spread primarily by direct or indirect person-to-person contact. In hospitals, hand, environment, and equipment contamination are the acknowledged vehicles for the spread of MRSA from one individual to another.<sup>6</sup>

The development of antibiotic-resistant bacteria in chronic wounds has

resulted in the search for new antimicrobial therapies.<sup>7</sup> Antibiotic resistance is most often recognized in vulnerable groups such as the very young or old<sup>8</sup>; the consequences of antibiotic resistance may include increased length of hospitalization, costs of diagnostic testing, and risk of morbidity and mortality to the individual.<sup>9,10</sup>

Ultraviolet light (UVL) occupies the electromagnetic spectrum between X-rays and visible light. The wavelengths of UVL are divided into three bands: UVA (320 nm to 400 nm), UVB (290 nm to 320 nm), and UVC (200 nm to 290 nm). Previous studies have suggested that UVL, a combination of UVA, UVB, and UVC wavelengths, triggers cellular actions and physiological effects required for treating chronic wounds by stimulating cell proliferation,<sup>11</sup> increasing epidermal thickening,<sup>12</sup> enhancing blood flow in the cutaneous capillaries,<sup>13</sup> facilitating wound debridement,<sup>14</sup> and killing bacteria.<sup>15,16</sup> Ultraviolet light A and B, the longer and mid-range wavelengths, respectively, have minimal bactericidal properties. They are used primarily to treat dermatological conditions such as psoriasis and dermatitis.<sup>17</sup> Ultraviolet light C is used primarily in wound healing. Relatively few studies have examined the efficacy of UVL treatment in chronic wounds. The results of a randomized controlled study by Wills et al<sup>18</sup> suggested that subjects with superficial pressure ulcers treated with a combination of UVA, B, and C healed faster than control subjects receiving only standardized wound care. Crous and Malherbe<sup>19</sup> compared the effects of UVL and laser irradiation on the healing of chronic ulcers and observed that the effectiveness of both modalities in the treatment of chronic ulcers was clinically significant. Nussbaum et al<sup>14</sup> reported that a combined therapy of ultrasound and UVC had a greater effect than laser therapy on wound healing. However, in both studies UVC was given in combination with either other types of UVL (UVA and UVB<sup>18</sup>) or together with ultrasound<sup>14</sup>; therefore, from this previous study, determining the effects of UVC alone on healing of chronic wounds is not possible.

Ultraviolet light C has been reported in previous *in vitro* and *in vivo* studies to have the ability to kill bacteria, including antibiotic-resistant bacteria such as MRSA, in laboratory cells and in animal tissue.<sup>20-23</sup> Conner-Kerr et al<sup>20</sup> studied the effects of UVC on laboratory cells of MRSA and reported a MRSA kill rate of 99.9% at 5 seconds and 100% at 90 seconds. In a follow-up *in vivo* study, Conner-Kerr et al<sup>21</sup> examined the effects of UVC on experimental wounds placed in mice artificially inoculated with MRSA. Ultraviolet light C was effective in lowering MRSA without adversely effecting healthy wound tissue. However, clinical studies to demonstrate that UVC can affect antibiotic-resistant bacteria that have colonized chronic wounds are not available.

A technique often used to assess wound bioburden in chronic wounds is the

semi-quantitative swab. Clinically, the semi-quantitative swab is the preferred method for bacterial determination because it is economically feasible, non-invasive, and easily administered. The semi-quantitative swab technique, correlated with the gold standard quantitative tissue biopsy, is a valid method for determining bacterial growth in the superficial layers of the wound bed. Nonetheless, no published reports have documented whether repeated assessments of bacteria burden in chronic wounds using semi-quantitative swabs are reliable and reproducible.

Hence, the objectives of this prospective study were to: 1) establish the test-retest reliability of the semi-quantitative swab technique; and 2) determine whether a single exposure of UVC for 180 seconds per wound site has an effect on the relative amount of bacteria present in superficial layers of chronic pressure ulcers and leg wounds colonized with bacteria, including MRSA.

**Vuerstaek, J.D., Vainas, T., Wuite, J., Nelemans, P., Neumann, M.H., & Veraart, J.C. State-of-the-art treatment of chronic leg ulcers: A randomized controlled trial comparing vacuum-assisted closure (V.A.C.) with modern wound dressings. *J Vasc Surg.* 2006 Nov; 44(5): 1029-37; discussion 1038. Epub 2006 Sep.**

**Background:** Current treatment modalities for chronic leg ulcers are time consuming, expensive, and only moderately successful. Recent data suggest that creating a subatmospheric pressure by vacuum-assisted closure (V.A.C., KCI Concepts, San Antonio, Texas) therapy supports the wound healing process.

**Methods:** The efficacy of vacuum-assisted closure in the treatment of chronic leg ulcers was prospectively studied in a randomized controlled trial in which 60 hospitalized patients with chronic leg ulcers were randomly assigned to either treatment by V.A.C. or therapy with conventional wound care techniques. The primary outcome measure was the time to complete healing (days). Statistical analysis was performed on the intention-to-treat basis.

**Results:** The median time to complete healing was 29 days (95% confidence interval [CI], 25.5 to 32.5) in the V.A.C. group compared with 45 days (95% CI, 36.2 to 53.8) in the control group ( $P = .0001$ ). Further, wound bed preparation during V.A.C. therapy was also significantly shorter at 7 days (95% CI 5.7 to 8.3) than during conventional wound care at 17 days (95% CI, 10 to 24,  $P = .005$ ). The costs of conventional wound care were higher than those of V.A.C. Both groups showed a significant increase in quality of life at



the end of therapy and a significant decrease in pain scores at the end of follow-up.

Conclusions: V.A.C. therapy should be considered as the treatment of choice for chronic leg ulcers owing to its significant advantages in the time to complete healing and wound bed preparation time compared with conventional wound care. Particularly during the preparation stage, V.A.C. therapy appears to be superior to conventional wound care techniques.

## 2.0 Measuring Incidence and Prevalence (Pros and Cons)

### HOSPITAL/ACUTE CARE:

**Amlung, S.R., Miller, W.L., & Bosley, L.M. The 1999 National Pressure Ulcer Survey: a benchmarking approach. *Adv Skin Wound Care*. 2001 Nov-Dec; 14(6): 297-301.**

OBJECTIVE: Health care professionals are faced with the ongoing challenge of improving performance. From physicians and nurses to process improvement experts, health care professionals are discovering new approaches to increasing the overall effectiveness of procedures used in clinical areas. One way to collect data useful for benchmarking specific clinical practices is through the use of prevalence studies.

DESIGN: A 1-day pressure ulcer prevalence survey was performed in March 1999. Acute care facilities across the United States volunteered to participate in the data collection process. Patients' demographic information, pressure ulcer stages, locations, and support surfaces were noted.

SETTING: 356 acute care facilities.

PARTICIPANTS: 42,817 patients.

RESULTS: The overall pressure ulcer prevalence was 14.896, with a nosocomial pressure ulcer prevalence of 7.190.

CONCLUSIONS: Benchmarking is one of the tools that enables health care professionals to measure and identify inconsistencies in patient care practices. Understanding these inconsistencies enables the health care team to develop processes that are innovative and efficient. National pressure ulcer prevalence surveys provide a benchmark to evaluate an individual facility's care and treatment of patients at risk for pressure ulcer development. Success, however, lies in the health care professional's ability to take the information and apply it to clinical practice. Through the use of a

benchmarking approach, performance gaps can be identified, processes can be put into place, and improved patient outcomes can be monitored and maintained.

**Cole, L., & Nesbitt, C. A three-year multiphase pressure ulcer prevalence/incidence study in a regional referral hospital. *Ostomy Wound Management*. 2004; 50(11), 32-40.**

A pressure ulcer is any lesion caused by pressure resulting in damage of underlying tissue. At least 3 million adults in the US are reported to have pressure ulcers yearly. Pressure ulcers can have a devastating impact on health and care provision, ranging from patient discomfort to increased healthcare costs. Conservative cost estimates of caring for a patient with a pressure ulcer range from \$500 to \$50,000. The average hospital incurs \$400,000 to \$700,000 annually in direct costs to treat pressure ulcers. Nosocomial pressure ulcers in hospitals are one indicator for quality of care. The key to successful outcomes is early assessment and interventions to prevent or reduce their incidence. Baseline and ongoing prevalence and incidence studies can help achieve the desired outcomes and measure the effectiveness of interventions implemented in pursuit of those outcomes.

Prevalence is defined as the proportion of a group that has a pressure ulcer at a given time, which may be a single point in time or a time period during which the cases are counted. Incidence is the proportion of the group initially free of pressure ulcers that develop them during a specified period of study.

The cornerstone of pressure ulcer prevention is identifying and minimizing risk factors with the use of a validated risk assessment tool such as the Braden Scale. The AHRQ Pressure Ulcer Prediction and Prevention Guidelines list several other recommendations related to maintaining tissue tolerance to pressure. Among these recommendations are the use of mild cleansing agents to minimize dryness and treating dry skin with moisturizers. Healthcare agencies that implement focused skin care protocols to prevent pressure ulcers and intervene as early as possible have been able to demonstrate reductions in the prevalence and incidence of pressure ulcers.

**Gerson, L.W. The incidence of pressure sores in active treatment hospitals. *Int J Nurs Stud*. 1975; 12(4): 201-4.**

*Abstract not available electronically*

**Gunningberg, L., Lindholm, C., Carlsson, M., & Sjoden, P.O. Reduced incidence of pressure ulcers in patients with hip fractures: a 2-year follow-up of quality indicators. *Int. J Qual Health Care*. 2001 Oct; 13(5): 399-407.**

Objective: The aims of the present study were to (i) investigate the incidence of pressure ulcers in 1997 and 1999 among patients with hip fracture, (ii) study changes of nursing and treatment routines during the same period and (iii) to identify predictors of pressure ulcer development.

Design: The present comparative study was based partly on data collected in two prospective, randomized, controlled studies conducted in 1997 and 1999.

Setting: The study was carried out in the Accident [amp ] Emergency (A[amp ]E) Department and the Department of Orthopaedics at the University Hospital in Uppsala, Sweden.

Study participants: Inclusion criteria: patient with hip fracture, e 65 years, admitted without pressure ulcers. Forty-five patients were included in 1997 and 101 in 1999.

Interventions: Risk assessment, pressure ulcer grading, pressure-reducing mattress and educational program.

Main outcome measures: Incidence of pressure ulcers.

Results: There was a significant reduction of the overall incidence of pressure ulcers from 55% in 1997 to 29% in 1999. The nursing notes had become significantly more informative. Nursing and treatment routines for patients with hip fractures had changed both in the A[amp ]E Department and the orthopedic ward through initiatives developed and implemented by pressure ulcer nurses.

Conclusion: In the framework of a quality improvement project, where research activities were integrated with practice-based developmental work, the incidence of pressure ulcers was reduced significantly in patients with hip fractures. The best predictor of pressure ulcer development was increased age.

**Thoroddsen, A. Pressure sore prevalence: a national survey. *Journal of Clinical Nursing*. 1999; 8(2): 170-179.**

A cross-sectional nation-wide sample was used to determine the point prevalence and grading of pressure sores in patients in all hospitals in Iceland (22 hospitals). The pressure sore prevalence was 8.90% (n = 57 patients), 7.12% for women (n = 26) and 11.2% for men (n = 31); the mean age for both sexes with pressure sores was 78.4 years. Grade I sores were most frequently identified and Grade IV the least. Eighty-five per cent of pressure sores were located below the waist. 'No dressings' and occlusive dressings

were the treatment of choice for pressure sores. Results from this study are important for international comparisons.

**Whitfield MD, Kalthenthaler EC, Akehurst RL et al. How effective are prevention strategies in reducing the prevalence of pressure ulcers? *J Wound Care*. 2000; 9(6): 261-66.**

The prevalence of pressure ulcers has remained constant at about 7% over the past 20 years, even though considerable time and money has been invested in various prevention strategies. This literature review explores whether pressure-prevention programs can reduce the prevalence rate still lower or whether they are working but are limited by an increasingly aged population and rising patient acuity.

**Whittington, K.T. National Prevalence and Incidence Study: 6-year sequential acute care data. *Advances in Skin and Wound Care*. 2004; 17(9), 490-494.**

**OBJECTIVE:** To provide health care organizations with a benchmark to measure pressure ulcer prevalence and incidence.

**SUBJECTS:** Medical, surgical, and intensive care unit patients at participating health care organizations.

**DESIGN:** Pressure ulcer prevalence was measured during a predetermined 24-hour period at each participating health care organization, using a standardized data collection form. Incidence was measured over the average length of stay determined for each participating health care organization. Patient demographics, pressure ulcer stages, pressure ulcer locations, and contributing factors were collected during the study. Collected data forms were audited prior to being submitted to a central site for database entry, analysis, and report generation.

**RESULTS:** Pressure ulcer prevalence ranged from a low of 14% (2001 and 2002) to a high of 17% (1999). Incidence ranged from a low of 7% (2001, 2003, 2004) to a high of 9% (2000). Comprehensive reports were delivered to the participating health care organizations, with each health care organization's data compiled to create a comparison database.

**CONCLUSION:** A standardized methodology for prevalence and incidence study data collection/reporting has been developed and used in successive studies and years. This provides a tool to help health care organizations measure the effectiveness of interventions, improve patient outcomes on an ongoing basis, and begin trending analysis.

### POST-ACUTE/NH/LTC:

**Ellis, I., Santamaria, N., Carville, K., Prentice, J., Ellis, T., Lewin, G., & Newall, N. Improving pressure ulcer management in Australian nursing homes: Results of the PRIME trial organizational study. *Primary Intention*. 2006; 14(3), 106-111.**

Pressure ulcer prevalence is frequently cited as a factor used to determine the quality of nursing care and is used as a proxy measure for nursing home quality. This paper reports the results of the organizational study conducted as a subcomponent of the PRIME trial. The PRIME trial was a multi-dimensional clinical trial designed to investigate the effectiveness of an integrated pressure ulcer management system in reducing the pressure ulcer prevalence and incidence in a cohort of Australian nursing homes. A stratified random sample of staff were interviewed from 17 consenting nursing homes (n=120). The interviews used a 10 question, semi structured questionnaire covering four organizational quality factors and six PRIME trial implementation factors. Responses to questions were ranked on a scale of 1-5, 1 representing no evidence and 5 representing embedded practice. Data were aggregated by nursing home and the mean scores were calculated. Data were correlated with baseline pressure ulcer prevalence and the post PRIME pressure ulcer prevalence. The results of this study show that there was no relationship between baseline pressure ulcer prevalence and the context of care as measured by a range of organizational factors, including staff development planning, equipment and resource management, communication management and effectiveness of staff and resident feedback. The PRIME trial was able to significantly reduce prevalence of pressure ulcers regardless of the context of care. Paired sample t-tests showed a significant difference between the mean baseline prevalence (25.8%) and the mean post PRIME pressure ulcer prevalence (16.6%) ( $p=0.008$ ) in nursing homes participating in the organizational component of the PRIME trial.

**Lynn, J., West, J., Hausmann, S., Gifford, D., Nelson, R., McGann, P., Bergstrom, N., & Ryan, J.A. Collaborative clinical quality improvement for pressure ulcers in nursing homes. *J Am Geriatric Soc*. 2007 Oct; 55(10): 1663-9. Epub 2007 Aug 21.**

The National Nursing Home Improvement Collaborative aimed to reduce pressure ulcer (PU) incidence and prevalence. Guided by subject matter and process experts, 29 quality improvement organizations and six multistate long-term care corporations recruited 52 nursing homes in 39 states to implement recommended practices using quality improvement methods. Facilities monitored monthly PU incidence and prevalence, healing, and adoption of key care processes.

In residents at 35 regularly reporting facilities, the total number of new nosocomial Stage III to IV PUs declined 69%. The facility median incidence of Stage III to IV lesions declined from 0.3 per 100 occupied beds per month to 0.0 (Po.001) and the incidence of Stage II to IV lesions declined from 3.2 to 2.3 per 100 occupied beds per month (P5.03). Prevalence of Stage III to IV lesions trended down (from 1.3 to 1.1 residents affected per 100 occupied beds (P5.12). The incidence and prevalence of Stage II lesions and the healing time of Stage II to IV lesions remained unchanged. Improvement teams reported that Stage II lesions usually healed quickly and that new PUs corresponded with hospital transfer, admission, scars, obesity, and immobility and with noncompliant, younger, or newly declining residents. The publicly reported quality measure, prevalence of Stage I to IV lesions, did not improve. Participants documented disseminating methods and tools to more than 5,359 contacts in other facilities.

Results suggest that facilities can reduce incidence of Stage III to IV lesions, that the incidence of Stage II lesions may not correlate with the incidence of Stage III to IV lesions, and that the publicly reported quality measure is insensitive to substantial improvement. The project demonstrated multiple opportunities in collaborative quality improvement, including improving the measurement of quality and identifying research priorities, as well as improving care.

### OP/COMMUNITY

**Berlowitz, D.R., Young, G.J., Brandeis, G.H., Kader, B., & Anderson, J.J. Health care reorganization and quality of care: unintended effects on pressure ulcer. *Med Care*. 2001 Feb; 39(2): 138-46.**

Background: Health care reorganizations, with a change in focus from inpatient to outpatient care, are becoming increasingly frequent. Little is known regarding how reorganizations may affect risk-adjusted outcomes for those programs, usually inpatient, that lose resources as a result of the change in organizational focus.

Objectives: To determine changes in risk-adjusted rates of pressure ulcer development over an 8-year period, the final 3 of which were characterized by a significant reorganization of the health care system.

Design: This was an observational study that used an existing database.

Subjects: Subjects were residents of Department of Veterans Affairs long-term care units between 1990 and 1997 who were without a pressure ulcer at an index assessment.

Measures: The study examined risk-adjusted rates of pressure ulcer development, and proportions of new ulcers that were severe (stages 3 or 4) were calculated for successive 6-month periods.

Results: Between 1990 and 1994, risk-adjusted rates of pressure ulcer development declined significantly, by 27%. However, beginning in 1995, rates began to increase, and in 1997 they were similar to those in 1990. The proportion of new ulcers that were severe increased significantly over time ( $P = 0.01$ ).

Conclusions: The reorganization of the VA that began in 1995, with its emphasis on outpatient care, was associated with an increase in rates of pressure ulcer development. This highlights the need to carefully monitor the quality of care in programs that may be losing resources as a result of the reorganization.

**Bergquist, S., & Frantz, R. Pressure ulcers in older adults receiving home health care: Prevalence, incidence and associated risk factors. *Advances in Wound Care*. 1999; 12(7), 339-351.**

Objectives: To determine the prevalence and incidence of pressure ulcers in community-based adults receiving home health care and to identify risk factors for incident Stage II to IV pressure ulcers.

Design: Retrospective cohort study.

Setting: A large Midwestern urban home health care agency.

Patients: The study cohort was 1711 non-hospice, non-intravenous therapy subjects admitted between January 1995 and March 1996 who were  $\geq$  age 60 and pressure ulcer-free on admission.

Measurements: Data on risk factors were extracted from admission information. Patient records were followed forward chronologically to the outcomes: pressure ulcer development or no pressure ulcer.

Main Results: The incidence of Stage II to IV pressure ulcers was 3.2%. Cox regression analyses revealed that limitation in activity to a wheelchair, needing assistance with the activities of daily living – dressing, bowel and/or bladder incontinence, a Braden Scale mobility subscore of very limited,

anemia, adult child as primary caregiver, male gender, a recent fracture, oxygen use, and skin drainage predicted pressure ulcer development ( $P \leq 0.05$ ) in this exploratory model.

Conclusions: Patients  $\geq$  age 60 who are admitted to a home health care agency with 1 or more of these risk factors require close monitoring for pressure ulcer development and should be taught preventive interventions on admission.

### 3.0 Multiple level of analysis (providers, systems, communities and geographical areas)

#### HOSPITAL/ACUTE CARE:

**Gunningberg, L., & Ehrenberg, A. Accuracy and quality in the nursing documentation or pressure ulcers: A comparison of record content and patient examination. *J Wound Ostomy Continence Nurs.* 2004 Nov-Dec; 31(6): 328-35.**

OBJECTIVE: To determine the accuracy and describe the quality of nursing documentation of pressure ulcers in a hospital care setting.

DESIGN: A cross-sectional survey was used comparing retrospective audits of nursing documentation of pressure ulcers to previous physical examinations of patients.

SETTING AND SUBJECTS: All inpatient records (n = 413) from February 5, 2002, at the surgical/orthopedic (n = 144), medical (n = 182), and geriatric (n = 87) departments of one Swedish University hospital.

INSTRUMENTS: The European Pressure Ulcer Advisory Panel data collection form and the Comprehensiveness In Nursing Documentation.

METHODS: All 413 records were reviewed for presence of notes on pressure ulcers; the findings were compared with the previous examination of patients' skin condition. Records with notes on pressure ulcers (n = 59) were audited using the European Pressure Ulcer Advisory Panel and Comprehensiveness In Nursing Documentation instruments.

RESULTS: The overall prevalence of pressure ulcers obtained by audit of patient records was 14.3% compared to 33.3% when the patients' skin was examined. The lack of accuracy was most evident in the documentation of grade 1 pressure ulcers. The quality of the nursing documentation of pressure ulcer (n = 59) was generally poor.



CONCLUSIONS: Patient records did not present valid and reliable data about pressure ulcers. There is a need for guidelines to support the care planning process and facilitate the use of research-based knowledge in clinical practice. More attention must be focused on the quality of clinical data to make proper use of electronic patient records in the future.

**Gunningberg, L., & Stotts, N.A. Tracking quality over time: what do pressure ulcer data show? *Int J Qual Health Care*. 2008 Aug; 20(4): 246-53. Epub 2008 Apr.**

Objective: To compare the prevalence of pressure ulcers and prevention before and after a quality improvement program; determine whether patient characteristics differed for those who did and did not develop pressure ulcers; identify pressure ulcer prevention implemented at admission and whether prevention and risk factors varied by pressure ulcer severity.

Design: Descriptive comparative study based on two cross-sectional pressure ulcer surveys conducted in 2002 and 2006, complemented with a retrospective audit of the electronic health record and administrative system for patients identified with pressure ulcers.

Setting: 1100-bed Swedish university hospital.

Participants: 612 hospitalized patients in 2002 and 632 in 2006.

Main outcome measures: Prevalence of pressure ulcers and prevention (pressure-reducing mattresses; planned repositioning; chair, heel and 30° lateral positioning cushions).

Results: Pressure ulcer prevalence was 23.9% in 2002 and 22.9% in 2006. When non-blanchable erythema was excluded, the prevalence was 8.0 and 12.0%, respectively. The use of pressure-reducing mattresses increased while planned repositioning decreased. Those who developed ulcers were older, at-risk for ulcers, incontinent and had longer length of stay. Little prevention was documented at admission. Some prevention strategies and risk factors were related to severity of ulcers.

Conclusions: Pressure ulcer prevalence did not decrease, despite a comprehensive quality improvement program. Special attention is needed to provide prevention to older patients with acute admission. Skin and risk assessment, as well as prevention, should start early in the hospitalization. Identifying those persons with community-acquired versus hospital-acquired ulcers will strengthen pressure ulcers as an accurate marker of quality of care

for hospitalized patients. If possible, data should be reported by ward level for comparison over time.

### **POST-ACUTE/NH/LTC:**

**Baier, R., Gifford, D.R., Lyder, C.H., Schall, M.W., Funston-Dillon, D.L., Lewis, J.M., & Ordin, D.L. Quality improvement for pressure ulcer care in the nursing home setting: the Northeast Pressure Ulcer Project. *J Am Med Dir Assoc.* 2003 Nov-Dec; 4(6): 291-301.**

Objectives: The objectives of this study were to evaluate the impact of a collaborative model of quality improvement in nursing homes on processes of care for the prevention and treatment of pressure ulcers.

Study Design: The study design was experimental.

Setting: We studied 29 nursing homes in New Jersey, Pennsylvania, and Rhode Island.

Participants: Participants consisted of pressure ulcer quality improvement teams in 29 nursing homes.

Intervention: Quality improvement teams attended a series of workshops to review clinical guidelines and quality improvement principles and to share best practices, and worked one-on-one with mentors to implement quality improvement techniques and to collect data independently.

Measurements: We calculated process measures based on the Agency for Healthcare Research and Quality (AHRQ) guidelines. Process measures addressed each facility's processes of care for the prevention and treatment of pressure ulcers at baseline and after 12 months of intervention. Prevention measures focused on recent admissions and high-risk residents; treatment measures focused on patients newly diagnosed with pressure ulcers and all patients with pressure ulcers.

Results: Overall, 6 of 8 prevention process measures improved significantly, with percent difference between baseline and follow up ranging from 11.6% to 24.5%. Three of 4 treatment process measures improved significantly, with 5.0%, 8.9%, and 25.9% difference between baseline and follow up. For each process measure, between 5 and 12 facilities demonstrated significant improvement between baseline and follow up, and only 2 or fewer declined for each process measure.

Conclusion: Improvement in processes of care after the use of a structured collaborative quality improvement approach is possible in the nursing home setting.

**Bates-Jensen, B.M., Cadogan, M., Jorge, J., & Schnelle, J.F. Standardized quality-assessment system to evaluate pressure ulcer care in the nursing home. *J Am Med Dir Assoc.* 2003 Nov-Dec; 4(6): 291-301.**

OBJECTIVES: To demonstrate reliability and feasibility of a standardized protocol to assess and score quality indicators relevant to pressure ulcer (PU) care processes in nursing homes (NHs).

DESIGN: Descriptive.

SETTING: Eight NHs.

PARTICIPANTS: One hundred ninety-one NH residents for whom the PU Resident Assessment Protocol of the Minimum Data Set was initiated.

MEASUREMENTS: Nine quality indicators (two related to screening and prevention of PU, two focused on assessment, and five addressing management) were scored using medical record data, direct human observation, and wireless thigh monitor observation data. Feasibility and reliability of medical record, observation, and thigh monitor protocols were determined.

RESULTS: The percentage of participants who passed each of the indicators, indicating care consistent with practice guidelines, ranged from 0% to 98% across all indicators. In general, participants in NHs passed fewer indicators and had more problems with medical record accuracy before a PU was detected (screening/prevention indicators) than they did once an ulcer was documented (assessment and management indicators). Reliability of the medical record protocol showed kappa statistics ranging from 0.689 to 1.00 and percentage agreement from 80% to 100%. Direct observation protocols yielded kappa statistics of 0.979 and 0.928. Thigh monitor protocols showed kappa statistics ranging from 0.609 to 0.842. Training was variable, with the observation protocol requiring 1 to 2 hours, medical records requiring joint review of 20 charts with average time to complete the review of 20 minutes, and the thigh monitor data requiring 1 week for training in data preparation and interpretation.

CONCLUSION: The standardized quality assessment system generated scores for nine PU quality indicators with good reliability and provided

explicit scoring rules that permit reproducible conclusions about PU care. The focus of the indicators on care processes that are under the control of NH staff made the protocol useful for external survey and internal quality improvement purposes, and the thigh monitor observational technology provided a method for monitoring repositioning care processes that were otherwise difficult to monitor and manage.

**Horn, S.D., Bender, S.A., Ferguson, M.L., Smout, R.J., Bergstrom, N., Taler, G., Cook, A.S., Sharkey, S.S., & Voss, A.C. The National Pressure Ulcer Long-Term Care Study: pressure ulcer development in long-term care residents. *J Am Geriatr Soc.* 2004 Mar; 52(3): 359-67.**

**OBJECTIVES:** To identify resident, treatment, and facility characteristics associated with pressure ulcer (PU) development in long-term care residents.

**DESIGN:** Retrospective cohort study with convenience sampling.

**SETTING:** Ninety-five long-term care facilities participating in the National Pressure Ulcer Long-Term Care Study throughout the United States.

**PARTICIPANTS:** A total of 1,524 residents aged 18 and older, with length of stay of 14 days or longer, who did not have an existing PU but were at risk of developing a PU, as defined by a Braden Scale for Predicting Pressure Sore Risk score of 17 or less, on study entry.

**MEASUREMENTS:** Data collected for each resident over a 12-week period included resident characteristics (e.g., demographics, medical history, severity of illness using the Comprehensive Severity Index, Braden Scale scores, nutritional factors), treatment characteristics (nutritional interventions, pressure management strategies, incontinence treatments, medications), staffing ratios and other facility characteristics, and outcome (PU development during study period). Data were obtained from medical records, Minimum Data Set, and other written records (e.g., physician orders, medication logs).

**RESULTS:** Seventy-one percent of subjects (n=1,081) did not develop a PU during the 12-week study period; the remaining 29% of residents (n=443) developed a new PU. Resident, treatment, and facility characteristics associated with greater likelihood of developing a Stage I to IV PU included higher initial severity of illness, history of recent PU, significant weight loss, oral eating problems, use of catheters, and use of positioning devices. Characteristics associated with decreased likelihood of developing a Stage I to IV PU included new resident, nutritional intervention (e.g., use of oral medical nutritional supplements and tube feeding for 421 days),

antidepressant use, use of disposable briefs for more than 14 days, registered nurse hours of 0.25 hours per resident per day or more, nurses' aide hours of 2 hours per resident per day or more, and licensed practical nurse turnover rate of less than 25%. When Stage I Pus were excluded from the analyses, the same variables were significant, with the addition of fluid orders associated with decreased likelihood of developing a PU.

**CONCLUSION:** A broad range of factors, including nutritional interventions, fluid orders, medications, and staffing patterns, are associated with prevention of PUs in long-term care residents. Research-based PU prevention protocols need to be developed that include these factors and target interventions for reducing risk factors.

**Saliba, D., Rubenstein, L.V., Simon, B. Hickey, E., Ferrell, B., Czarnowski, E., & Berlowitz, D. Adherence to pressure ulcer prevention guidelines: implications for nursing home quality. *J Am Geriatr Soc.* 2003 Jan; 51(1): 56-62.**

**OBJECTIVES:** This study aims to assess overall nursing home (NH) implementation of pressure ulcer (PU) prevention guidelines and variation in implementation rates among a geographically diverse sample of NHs.

**DESIGN:** Review of NH medical records.

**SETTING:** A geographically diverse sample of 35 Veterans Health Administration NHs.

**PARTICIPANTS:** A nested random sample of 834 residents free of PU on admission.

**MEASUREMENTS:** Adherence to explicit quality review criteria based on the Agency for Healthcare Research and Quality Practice Guidelines for PU prevention was measured. Medical record review was used to determine overall and facility-specific adherence rates for 15 PU guideline recommendations and for a subset of six key recommendations judged as most critical.

**RESULTS:** Six thousand two hundred eighty-three instances were identified in which one of the 15 guideline recommendations was applicable to a study patient based on a specific indication or resident characteristic in the medical record. NH clinicians adhered to the appropriate recommendation in 41% of these instances. For the six key recommendations, clinicians adhered in 50% of instances. NHs varied significantly in adherence to indicated guideline recommendations, ranging from 29% to 51% overall adherence across all 15

recommendations ( $P_{.001}$ ) and from 24% to 75% across the six key recommendations ( $P_{.001}$ ). Adherence rates for specific indications also varied, ranging from 94% (skin inspection) to 1% (education of residents or families). Standardized assessment of PU risk was identified as one of the most important and measurable recommendations. Clinicians performed this assessment in only 61% of patients for whom it was indicated.

**CONCLUSIONS:** NHs' overall adherence to PU prevention guidelines is relatively low and is characterized by large variations between homes in adherence to many recommendations. The low level of adherence and high level of variation to many best-care practices for PU prevention indicate a continued need for quality improvement, particularly for some guidelines.

### **COMMUNITY:**

**Bolton, Laura PhD. Which Pressure Ulcer Risk Assessment Scales are Valid for Use in the Clinical Setting? *Journal of Wound, Ostomy & Continence Nursing*. 2007 July/August; 34(4):368-381.**

Questions addressed in this evidence review: 1. What are the most reliable valid scales for assessing pressure ulcer risk?, 2. Based on available evidence, how should pressure ulcer risk assessment scales (PURAS) be used?, 3. Does use of a PURAS guide preventive interventions?

**Franks, P.J., Winterberg, H., & Moffatt, C.J. Health-related quality of life and pressure ulceration assessment in patients treated in the community. *Wound Repair Regen*. 2002 May/Jun; 10(3): 133-40.**

Little is known of the impact of pressure ulceration on adult patients' health-related quality of life. The purpose of this study was to determine the impact pressure ulceration has on pressure ulcer patients cared for in the community. A case control study design was used by drawing a random sample from patients receiving community nursing care, stratified by the presence of pressure ulceration. In all, 75 patients with pressure ulcers were compared with 100 controls without ulcers using the four-point ulcer grading scale described by United Kingdom consensus guidelines. Patients were interviewed using the Short Form-36 (SF-36) questionnaire and activities of daily living assessed using the modified Barthel scale. Patients with pressure ulcers had significantly poorer physical function (mean difference (d) = 37.6, 95% CI 28.6-46.6,  $p < 0,001$ ) and social functioning (d = 33,9, 95 % CI 24,0-43,9,  $p < 0,001$ ) than published age- and sex-matched normative data from the United Kingdom. The difference between cases and controls was much smaller in these domains, with neither approaching statistical significance. After adjustment for age and gender, scores for bodily pain were poorer in patients with no ulceration (d = -10,5, 95% CI - 20,6 to - 0,4,  $p = 0.042$ )

indicating greater pain in these patients compared with the cases with ulceration, Activities of daily living determined by the modified Barthel scale showed reduced self-care ( $d = -7,6, 95\% \text{ CI } -12,5 \text{ to } -2,7, p = 0,010$ ) and mobility ( $d = -9,2, 95\% \text{ CI } -14,6 \text{ to } -3,8, p = 0,001$ ) in patients with pressure ulceration. The overall ability to perform these activities was also significantly poorer in this group ( $d = -16,3, 95\% \text{ CI } -27,3 \text{ to } -5,3, p = 0,004$ ). While patients with pressure ulceration experience some deficits in their health-related quality of life compared with a normal population, these differences are similar to those experienced by other patients receiving community nursing care.

### **OTHER/ANY SETTINGS:**

**Bates-Jensen, B. M., & MacLean, C. H. Quality indicators for the care of pressure ulcers in vulnerable elders. *Journal of the American Geriatrics Society*. 2007; 55(S2), S409-S416.**

*Abstract unavailable*

**Charlifue, S., Lammertse, D.P., & Adkins, R.H. Aging with spinal cord injury: Changes in selected health indices and life satisfaction. *Archives of Physical Medicine and Rehabilitation*. 2004; 85(11), 1848-1853.**

Objectives: To document the impact of age, age at injury, years post injury, and injury severity on changes over time in selected physical and psychosocial outcomes of people aging with spinal cord injury (SCI), and to identify the best predictors of these outcomes.

Design: Retrospective cross-sectional and longitudinal examination of people with SCI.

Setting: Follow-up of people who received initial rehabilitation in a regional Model Spinal Cord Injury System.

Participants: People who meet the inclusion criteria for the National Spinal Cord Injury Database were studied at 5, 10, 15, 20, and 25 years post injury.

Interventions: Not applicable.

Main outcome measures: Number of pressure ulcers, number of times rehospitalized, number of days rehospitalized, perceived health status, satisfaction with life, and pain during the most recent follow-up year.

Results: The number of days rehospitalized and frequency of rehospitalizations decreased and the number of pressure ulcers increased as time passed. For the variables of pressure ulcers, poor perceived health, the

perception of pain and lower life satisfaction, the best predictor of each outcome was the previous existence or poor rating of that same outcome.

Conclusions: Common complications of SCI often herald the recurrence of those same complications at a later point in time, highlighting the importance of early intervention to prevent future health and psychosocial difficulties.

**Kjaer, M.L., Mainz, J., Soernsen, L.T., Karlsmark, T., & Gottrup, F. Clinical quality indicators of venous leg ulcers: development, feasibility, and reliability. *Ostomy Wound Manage.* 2005 May; 51(5): 64-6, 68-72, 74.**

Studies on venous leg ulcer patients show large variations in the use of proven efficacious diagnostic and therapeutic modalities. This suggests that the quality of medical technical care — e.g., provision of appropriate prevention, diagnosis, treatment, and rehabilitation — is far from optimal. Paradoxically, even though the medical technical care is the core product of any healthcare organization treating venous leg ulcer patients, as well as the goal of healthcare professionals and the most important concern of venous leg ulcer patients<sup>6</sup> — quality in relation to medical technical care is seldom measured.

To ensure the provision of high quality venous leg ulcer medical technical care, most healthcare institutions are periodically evaluated/accredited to verify that the structure and organization to deliver that care are in place. However, this does not provide information about the actual diagnosis and treatment patients receive in everyday clinical life (i.e., to what extent are patients provided the diagnosis and treatment to which they are entitled). For instance, internationally, it appears most facilities are not able to document their own healing or recurrence rates and therefore are not able to determine how well they actually are performing. Clinical quality indicators of medical technical care are needed.

Clinical quality indicators are quantitative measures used to monitor and evaluate the quality of important clinical functions that affect patient outcomes of care.<sup>7</sup> Documenting quality of care using clinical indicators provides a statistically valid and data-driven mechanism that generates a continuous stream of performance information<sup>8,9</sup> provided the clinical indicators are developed and tested using rigorous scientific principles.<sup>10,11</sup> This enables clinicians to determine current patient status, set appropriate goals, and evaluate progress toward set goals in a valid and reliable fashion, an ability that is sorely needed in the art of healing venous leg ulcers. However, no published reports of rigorous quality indicator development for venous leg ulceration appear to exist. The purpose of this paper is to describe the scientific development of evidence-based clinical quality indicators of



medical technical care for patients with venous leg ulceration and to show that quality of care can be measured reliably using a few meaningful clinical indicators.

#### **4.0 Accountability as the patient moves across settings of care, i.e., present on admission, etc.**

**Armstrong, D.G., Ayello, E.A., Capitolo, K.L., Fowler, E., Krasner, D.L., Levine, J.M., Sibbald, R.G., & Smith, A.P.S. New opportunities to improve pressure ulcer prevention and treatment: implications of the CMS inpatient hospital care present on admission (poa) indicators/hospital-acquired conditions (hac) policy. *Consensus paper from the International Expert Wound Care Advisory Panel. 2008.***

As part of the Deficit Reduction Act of 2005, the Centers for Medicare & Medicaid Services (CMS) initially identified eight preventable adverse events on August 1, 2007, with nine more conditions proposed on April 14, 2008.<sup>1,2</sup> They have introduced a plan to help contain costs by rejecting payment of the higher diagnostic category when such events occur as a secondary diagnosis in acute care facilities. This policy, which began a phased rollout in the acute-care setting in October 2007 (culminating in October 2008), has created some logistical and implementation concerns in the clinical community. The financial implications for pressure ulcers will be determined by the Present on Admission Indicator (POA). The POA Indicator identifies if a patient has a pressure ulcer at the time the order for admission occurs.

**Brown, G. Long-term outcomes of full-thickness pressure ulcers: Healing and mortality. *Ostomy/Wound Management. 2003; 49(10), 42-50.***

Despite advances in preventive interventions such as pressure-reduction surfaces, risk assessment scales, and improved knowledge of prevention techniques, pressure ulcers continue to occur in healthcare facilities. Pressure ulcer prevalence and incidence studies show that overall rates in the last decade have remained essentially the same, averaging between 8% and 15% from 1989 to 1999. Wound care specialists do not agree on whether the majority of pressure ulcers are preventable. The concept of skin failure in relation to pressure ulcer development has been suggested. The Centers for Medicare and Medicaid Services, whose directives are the foundation for the majority of state healthcare regulations, include the determination of avoidable versus unavoidable pressure ulcers in their surveyor guidelines. Nevertheless, the occurrence of a pressure ulcer continues to stigmatize caregivers - whether medical/nursing professionals, healthcare facilities, or patient family members - with an aura of negligence. This can result in guilt on the part of the caregiver for "letting" the ulcer occur or the pursuit of legal

action by aggrieved family members.

Less publicized in the debate surrounding pressure ulcer risk assessment, prevention, and treatment are follow-up studies on outcomes of patients with pressure ulcers. Berlowitz demonstrated in a study of 19,981 nursing home residents that while patients with pressure ulcers are more likely to die, the increased risk is largely related to the frailty and high disease burden of the resident and is not a direct result of the ulcer. Thomas, in a study of 286 hospital patients, determined that 59.5% of residents who developed a pressure ulcer died within 1 year of developing the ulcer. It appeared that the development of new pressure ulcers was a marker of coexisting illnesses, impaired nutrition, and functional status and not an independent risk factor for increased mortality. Berlowitz, studying a group of 301 nursing home admissions, also discovered that the presence of a pressure ulcer on admission, the development of a new ulcer, and failure of the ulcer to heal were all associated with a two- to threefold increase in the risk of dying during a 6-week period following admission. The results of this study also suggested that the pressure ulcer itself did not cause the observed increased mortality. Other research has shown that death occurs in acute hospitalizations in 67% of patients who develop pressure ulcers, 55.7% of nursing home residents who die with a pressure ulcer do so within 6 weeks of the onset of the pressure ulcer, and nursing home residents with pressure ulcers experience a 6-month mortality rate of 77.3%.

Data on pressure ulcer healing and mortality outcomes are difficult to acquire in many healthcare settings. A comprehensive patient chart often lacks information due to the common practice of transferring patients to multiple facilities based on the level of care. Acquisition of a complete chart from several facilities is, therefore, a time-consuming and expensive undertaking for any researcher. The Veterans Affairs Health Care System is unique among healthcare systems and since 1999, virtually all patient data for any admission at the facility where this study was conducted are available through the Computerized Patient Record System (CPRS). This allows broad, efficient access to a variety of data from history, physical assessments, and discharge summaries to laboratory tests and progress notes. To determine if outcomes were consistent with published literature, quality-assurance data on facility-acquired pressure ulcers were obtained and analyzed. The facility, a tertiary referral center in the North Central Texas area, comprises 173 acute care (medical/surgical), 45 intensive care (medical, coronary, surgical, and thoracic), and 120 long-term care (geriatric rehabilitation, interval placement, and hospice) beds. Yearly average admissions to this center total 8,134 for acute care, 956 for intensive care, and 632 for long-term care. For all facilities, the average pressure ulcer prevalence rates (Stage I to Stage IV) were 8.4% upon admission and 6.2% for nosocomial only. Specifically, the total prevalence in acute care was 4.4%

(3.1% nosocomial) and 27% (25.6% nosocomial) in intensive care. In long-term care, the prevalence rate was 8.6% (4.9% nosocomial). Ulcer severity distribution was as follows: 40.4% were Stage II, 14.4% were Stage III, 29.9% were Stage IV, and 7.3% could not be staged because the ulcer was covered with eschar.

## 5.0 Measuring and staging of pressure ulcers, including temporarily “unstageable” and scoring systems

**Bergquist-Beringer, S., Dunton, N., Gajewski, B., Klaus, S., & Hart, S. The reliability of the NDNQI® pressure ulcer indicator: A triangulation approach. Poster Presentation. Translating Research into Policy and Practice Meeting, Washington, DC. AHRQ. 2006 July.**  
Substantial reliability in pressure ulcer staging overall.

Certified wound care nurses and teams led by certified wound care nurses have higher reliability in pressure ulcer staging than nurses not certified in wound care

**Black, J.M., Baharestani, M., Cuddigan, J., et al. National Pressure Ulcer Advisory Panel’s Updated Pressure Ulcer Staging System. *Urologic Nursing*. 2007; 27(2), 144-150.**

The National Pressure Ulcer Advisory Panel has updated the definition of a pressure ulcer and the stages of pressure ulcers based on current research and expert opinion solicited from hundreds of clinicians, educators, and researchers across the country. The amount of anatomical tissue loss described with each stage has not changed. New definitions were drafted to achieve accuracy, clarity, succinctness, clinical utility, and discrimination between and among the definitions of other pressure ulcer stages and other types of wounds. Deep tissue injury was also added as a distinct pressure ulcer in this updated system.

**Fette, A.M. A clinimetric analysis of wound measurement tools. *World Wide Wounds*. 2008.**

<http://www.worldwidewounds.com/2006/january/Fette/Clinimetric-Analysis-Wound-Measurement-Tools.html>. Last accessed February 2009.

The assessment of wound healing is often subjective so there is a need to develop a standard methodology to enable accurate comparisons between treatment outcomes and the accumulation of a reliable body of knowledge in this clinical area. There are many methods of measuring wounds, some simple and practical and others more suited to clinical research. Clinimetrics, which emphasizes the quantitative measurement of clinical data through

accurate measurement and data collection, was used to assess a number of these methods. The results reveal that wound tracing, combined with an area calculation using a planimetric scale in wounds (with an area greater than 40cm<sup>2</sup>), is a cheap and reliable method of accurately assessing relative changes in wound area over time.

**Hart, S., Bergquist, S., Gajewski, B., & Dunton, N. Reliability testing of the National Database of Nursing Quality Indicator's pressure ulcer indicator. *Journal of Nursing Care Quality*. 2006; 21(3), 256-265.**

A criterion-referenced Web-based test was designed and administered to 256 individuals at 48 randomly sampled National Database of Nursing Quality Indicators (NDNQI) member hospitals to determine the reliability of the NDNQI pressure ulcer indicator. Overall [kappa] values for pressure ulcer identification, staging, and sourcing indicate moderate to near perfect reliability. Findings suggest that nurses can accurately differentiate pressure ulcers from other ulcerous wounds in Web-based photographs, reliably stage pressure ulcers, and reliably identify community versus nosocomial pressure ulcers.

**Keast, D.H., Bowering, K., Wayne, E., et al. Measure: a proposed assessment framework for developing best practice recommendations for wound assessment. *Wound Repair and Regeneration*. 2004; 12:S1-S17.**

The effective management of non-healing wounds is based on a complete patient history, a detailed initial assessment of the wound, and an analysis of probable causative factors. This information is used to individualize a management strategy to the underlying pathophysiology preventing healing and to implement appropriate wound interventions. Regular reassessment of progress toward healing and appropriate modification of the intervention are also necessary. Accurate and clinically relevant wound assessment is an important clinical tool, but this process remains a substantial challenge. Wound assessment terminology is non-uniform, many questions surrounding wound assessment remain unanswered, agreement has yet to be reached on the key wound parameters to measure in clinical practice, and the accuracy and reliability of available wound assessment techniques vary. This article, which resulted from a meeting of wound healing experts in June 2003, reviews clinically useful wound measurement approaches, provides an overview of the principles and practice of chronic wound assessment geared to a clinical audience, and introduces a simple mnemonic, MEASURE. MEASURE encapsulates key wound parameters that should be addressed in the assessment and management of chronic wounds: Measure (length, width, depth, and area), Exudate (quantity and quality), Appearance (wound bed, including tissue type and amount), Suffering (pain type and level), Undermining (presence or absence), Reevaluate (monitoring of all parameters

regularly), and Edge (condition of edge and surrounding skin). This article also provides some preliminary recommendations targeted to developing best practice guidelines for wound assessment.

**Langemo, D., Anderson, J., Hanson, D., et al. Measuring wound length, width, and which technique? *Advances in Skin & Wound Care*. 2008; 21(1): 42-45.**

**PURPOSE:** To provide practitioners with evidence-based recommendations for measuring wound size.

**TARGET AUDIENCE:** This continuing education activity is intended for physicians and nurses with an interest in wound care.

**OBJECTIVES:** After reading this article and taking this test, the reader should be able to:

1. Describe different methods of measuring wound size and their advantages and disadvantages.
2. Discuss a research study conducted to determine the most accurate ruler technique for measuring wounds.
3. Identify evidence-based wound measurement data and recommendations for clinical practice.

**Zulkowski K, Ratliff CR. Perineal dermatitis or pressure ulcer: How can you tell? *Nursing*. 2006; 36(12): 22-23.**

## 6.0 Multiple lesions and deep tissue injury in evolution

**Berke, C., Black, J. Retrospective study to identify a risk profile for pressure related deep tissue injury. *Journal of Wound, Ostomy, and Continence Nursing*. 2007; 34(3S), S61.**

**Black, J.M. Thanks for asking! *Inside the NPUAP*. 2007; 21, 1.**

**Black, J.M., & Black, S.B. Deep tissue injury. *Wounds*. 2007; 15(11), 380.**

**Fleck, C.A. Suspected deep tissue injury. *Advances in Skin & Wound Care*. 2007; 20(7), 413-415.**

**Q:** What is deep tissue injury and how is it diagnosed and treated?

**A:** Although thought to be a modern-day phenomenon, deep tissue injury (DTI) has been noted in the literature since the late 1800s. DTI caused by pressure exists as a form of pressure ulcer, but is not well captured by the current staging system. Several pressure ulcer staging systems are frequently

cited but none defines pressure-related injury under intact skin. The National Pressure Ulcer Advisory Panel (NPUAP) recommended using the terms “pressure related deep tissue injury under intact skin” or “deep tissue injury under intact skin” for describing these lesions. Since their February 2007 Consensus Meeting and NPUAP Biennial Conference: Charting the Course for Pressure Ulcer Prevention & Treatment, the definition has been updated to reflect accuracy, clarity, succinctness, utility, and discrimination. The new definition is: Suspected Deep Tissue Injury - Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer, or cooler as compared to adjacent tissue.

Further description: DTI may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar. Evolution may be rapid, exposing additional layers of tissue even with optimal treatment. The NPUAP defined DTI in 2002 as, “A pressure related injury to subcutaneous tissue under intact skin.” Initially, these lesions have the appearance of a deep bruise. They may herald the subsequent development of a Stage III-IV pressure ulcer even with optimal treatment. The incidence and prevalence of these ulcers is unknown due to the mixture of reporting styles. Deep tissue injury is really a developing expression that articulates a deviation of pressure ulcers that emerges primarily as bruised or dark tissue. Previously, these wounds have been described as “malignant lesions,” closed pressure ulcers, and purple pressure ulcers in the literature.

**Gefen, A. How much time does it take to get a pressure ulcer? Integrated evidence from human, animal, and in vitro studies. *Ostomy Wound Management*. 2008; 54(10), 26-35.**

Severe pressure ulcers and deep tissue injury are associated with higher mortality rates, longer hospital stays, and costly treatment. Time is a critical factor in commonly employed measures (e.g., pressure redistribution for wheelchair users and patient turning schedules) to prevent pressure ulcers and deep tissue injury. Surprisingly, information regarding the timeframe for pressure ulcer onset, particularly for deep tissue injury onset, is scant. To create a timeframe for the development of pressure ulcers and deep tissue injury, available evidence from the following study types was obtained and reviewed: 1) studies involving patients who underwent surgeries of known duration and subsequently developed a serious pressure ulcer with subcutaneous tissue damage or deep tissue injury; 2) animal studies in which loads were applied on soft tissues of anesthetized animals and tissue viability monitored in real time or using histology post-euthanasia; and 3) in vitro

models in cell cultures and tissue-engineered constructs. Findings from the three models indicate that pressure ulcers in sub-dermal tissues under bony prominences very likely occur between the first hour and 4 to 6 hours after sustained loading. However, research examining these timeframes in sitting patients is not available. Further fundamental research, employing animal and cell culture models, is required to narrow this range further and to correlate the time factor to the extent of tissue damage.

**Stekelenburg, A., Gawlitta, D., Bader, D.L., Oomens, C.W. Deep tissue injury: How deep is our understanding, *Archives of Physical and Medical Rehabilitation*. 2008; 89, 1410-1413.**

Deep pressure ulcers, necessarily involving deep tissue injury (DTI), arise in the muscle layers adjacent to bony prominences because of sustained loading. They represent a serious type of pressure ulcer because they start in underlying tissues and are often not visible until they reach an advanced stage, at which time treatment becomes problematic. Underlying mechanisms of DTI require further investigation if appropriate preventive measures are to be determined. The present commentary illustrates a hierarchic research approach selected to study these mechanisms. To differentiate between the individual roles of deformation and ischemia in the onset of skeletal muscle damage, 2 complementary approaches have been selected. In an in vivo animal model, the effects of ischemia combined with deformation and ischemia per se were studied. An in vitro muscle model was used to study the separate effects of deformation and several aspects of ischemia, including hypoxia, glucose depletion, and tissue acidification, in more detail. Based on the results of both models a sequence of events leading to cell necrosis is proposed. Deformation levels exceeding a threshold value can result in rapid tissue damage that may persist, whereas ischemia has a more gradual effect as a result of glucose depletion and tissue acidification.

## 7.0 Harmonization of measure specifications across settings of care

*No information could be located thus far*

## 8.0 Pressure redistribution

**Berthe, J.V., Bustillo, A., Melot, C., & de Fontaine, S. Does a foamy-block mattress system prevent pressure sores? A prospective randomized clinical trial in 1729 patients. *Acta Chir Belg*. 2007; 107, 155-161.**

Background: Pressure ulcers are a frequent complication of bed rest. The development of an efficient and low cost pressure relieving system for the prevention of bed-sores would be of considerable hospital health and

economic interest. Our study was designed to determine the effectiveness in pressure-sore prevention of an interface pressure-decreasing mattress, the Kliniplot® mattress, used in our institution since 1978.

**Methods:** In a prospective randomized controlled 7-month clinical trial we compared the Kliniplot® mattress with our standard hospital mattress in 1729 patients admitted to medical and surgical departments (neurology, cardiology, oncology-hematology, neurosurgery, thoracic surgery and orthopedic surgery). Two groups (Kliniplot® mattress and standard hospital mattress) were monitored for the prevention of pressure sores. The patients were evaluated on a daily basis from their admission until the eventual occurrence of a bed-sore. Patients' characteristics and pressure-sore risk factors were similar at the baseline in both groups. Patients presenting with a pressure sore at the time of admission were excluded.

**Results:** Forty-two of the 1729 patients (2.4%) who entered the study developed at least one pressure sore. Twenty-one of the 657 patients (3.2%) nursed on the Kliniplot® mattress, and 21 of the 1072 patients (1.9%) on the standard mattress developed bed-sores ( $p = 0.154$ ). The median time for the occurrence of pressure sores was 31 days (range 6-87) with the Kliniplot® mattress and 18 days (range 2 to 38) with the standard mattress ( $p < 0.001$ ). The risk categories for developing bed-sores using the modified Ek's scale were no different at the baseline between both groups ( $p = 0.764$ ). The severity of the pressure sores was no different between both groups ( $p = 0.918$ ). **Conclusions:** Our results show that the occurrence of pressure sores is not reduced but is delayed when patients are nursed on a Kliniplot® pressure-decreasing mattress.

**Coggrave, M.J., & Rose, L.S. A specialist seating assessment clinic: Changing Pressure Relief Practice. *Spinal Cord*. 2003; 41, 692-695.**

**STUDY DESIGN:** Description of a clinical service, evaluation of pressure relief practices.

**OBJECTIVES:** To describe a specialist seating assessment clinic and a change in clinical practice arising from its work.

**SETTING:** National Spinal Injuries Centre, Stoke Mandeville Hospital, UK.

**METHODS:** Retrospective review of the ischial transcutaneous oxygen measurements of 50 newly injured and chronic spinal cord-injured (SCI) individuals seen in a specialist seating assessment clinic. Tissue oxygenation was measured in the sitting position (loaded) and during pressure relief (unloaded). **RESULTS:** Mean duration of pressure relief required to raise tissue oxygen to unloaded levels was 1?min 51?s (range 42?s-3?min 30?s).

**CONCLUSION:** These results confirmed the clinical perception that brief pressure lifts of 15-30?s are ineffective in raising transcutaneous oxygen



tension (TcPO<sub>2</sub>) to the unloaded level for most individuals. Sustaining the traditional pressure relief by lifting up from the seat for the necessary extended duration is neither practical nor desirable for the majority of clients. It was found that alternative methods of pressure relief were more easily sustainable and very efficient.

**Cullum N, McInnes E, Bell-Syer SEM, Legood R. Support surfaces for pressure ulcer prevention. *The Cochrane Database of Systematic Review*. 2006; 204, Issue 3.**

Background: Pressure ulcers (also known as bedsores, pressure sores, decubitus ulcers) are areas of localized damage to the skin and underlying tissue due to pressure, shear or friction. They are common in the elderly and immobile and costly in financial and human terms. Pressure-relieving beds, mattresses and seat cushions are widely used as aids to prevention in both institutional and non-institutional settings.

Objectives: This systematic review seeks to answer the following questions:  
(1) to what extent do pressure-relieving cushions, beds, mattress overlays and mattress replacements reduce the incidence of pressure ulcers compared with standard support surfaces?  
(2) how effective are different pressure-relieving surfaces in preventing pressure ulcers, compared to one another?

Search strategy: For this second update the Cochrane Wounds Group Specialized Register was searched (28/2/08), The Cochrane Central Register of Controlled Trials (CENTRAL)(2008 Issue 1), Ovid MEDLINE (1950 to February Week 3 2008), Ovid EMBASE (1980 to 2008 Week 08) and Ovid CINAHL (1982 to February Week 3 2008). The reference sections of included studies were searched for further trials.

Selection criteria: Randomized controlled trials (RCTs), published or unpublished, which assessed the effectiveness of beds, mattresses, mattress overlays, and seating cushions for the prevention of pressure ulcers, in any patient group, in any setting. Study selection was undertaken by at least two authors independently with a third author resolving uncertainty. RCTs were eligible for inclusion if they reported an objective, clinical outcome measure such as incidence and severity of new or pressure ulcers developed. Studies which only reported proxy outcome measures such as interface pressure were excluded.

Data collection and analysis: Trial data were extracted by one researcher and checked by a second. The results from each study are presented as relative

risk for dichotomous variables. Where deemed appropriate, similar studies were pooled in a meta-analysis.

Main results: For this second update 11 trials met the inclusion criteria bringing the total number of RCTs included in the review to 52. Foam alternatives to the standard hospital foam mattress can reduce the incidence of pressure ulcers in people at risk. The relative merits of alternating and constant low pressure devices are unclear. There is one high quality trial comparing the different alternating pressure devices for pressure ulcer prevention which suggests that alternating pressure mattresses may be more cost effective than alternating pressure overlays. Pressure-relieving overlays on the operating table have been shown to reduce postoperative pressure ulcer incidence, although two studies indicated that foam overlays resulted in adverse skin changes. Two trials indicated that Australian standard medical sheepskins prevented pressure ulcers. There is insufficient evidence to draw conclusions on the value of seat cushions, limb protectors and various constant low pressure devices as pressure ulcer prevention strategies. A study of Accident & Emergency trolley overlays did not identify a reduction in pressure ulcer incidence. There are tentative indications that foot waffle heel elevators, a particular low air loss hydrotherapy mattress and two types of operating theatre overlays are harmful.

Authors' conclusions: In people at high risk of pressure ulcer development higher specification foam mattresses rather than standard hospital foam mattresses should be used. The relative merits of higher-tech constant low pressure and alternating pressure for prevention are unclear but alternating pressure mattresses may be more cost effective than alternating pressure overlays. Medical grade sheepskins are associated with a decrease in pressure ulcer development. Organizations might consider the use of some forms of pressure relief for high risk patients in the operating theatre. Seat cushions and overlays designed for use in Accident & Emergency settings have not been adequately evaluated.

**Defloor, T. The risk of pressure sores: A conceptual scheme. *Journal of Clinical Nursing*. 1999; 8(2), 206-16.**

Based on a review of the literature related to the prediction and prevention of pressure sores, a conceptual scheme on pressure sores is introduced

The article highlights the four elements of the scheme: pressure, shearing force, tissue tolerance for pressure and tissue tolerance for oxygen. Factors influencing pressure and shearing forces, the pressure distribution capacity of tissue and oxygen need of tissue and oxygen supply to tissue are discussed.

**DeFloor T, DeBacquer D, Grydonck MH. The effects of various combinations of turning and pressure reducing devices on the incidence of pressure ulcers.**

*Int J Nurs Stud.* 2005; 42(1):37-26.

Background: Turning is considered to be an effective way of preventing pressure ulcers, however almost no research has been undertaken on this method.

Aim: The aim of the study was to investigate the effect of four different preventative regimes involving either frequent turning (2, 3 hourly) or the use of a pressure-reducing mattress in combination with less frequent turning (4, 6 hourly).

Subjects: 838 geriatric nursing home patients participated in the study.

Methods: During 28 days, four different turning schemes were used: turning every 2 h on a standard institutional (SI) mattress (n ¼ 65), turning every 3 h on a SI mattress (n ¼ 65), turning every 4 h on a viscoelastic foam(VE) mattress (n ¼ 67), and turning every 6 h on a VE mattress (n ¼ 65). The remaining patients (n ¼ 576) received standard preventive care.

Main results: The incidence of non-blanchable erythema (34.8–38.1%) was not different between the groups. The incidence of grade II and higher pressure ulcers in the 4 h interval group was 3.0%, compared with incidence figures in the other groups varying between 14.3% and 24.1%.

Conclusions: Turning every 4 h on a VE mattress resulted in a significant reduction in the number of pressure ulcer lesions and makes turning a feasible preventive method in terms of effort and cost.

**Feuchtinger, J., de Bie, R., Dassen, T, & Halfens, R. A 4-cm thermoactive viscoelastic foam pad on the operating room table to prevent pressure ulcer during cardiac surgery. *Journal of Clinical Nursing.* 2006; 15, 162-167.**

AIMS AND OBJECTIVES: In this experimental study, a 4-cm thermoactive viscoelastic foam overlay and a heating source on the operating room table was compared with the standard operating room table with a heating source for the effect on the postoperative pressure ulcer incidence in cardiac surgery patients.

BACKGROUND: Pressure ulcer incidence in the cardiac surgery population is reported to be up to 29.5%. The prolonged compressive forces from lying on the operating room table are one source of pressure ulcer development in

this population. Pressure-reducing devices on the operating room (OR)-table should reduce the patients' interface pressure and thus the hazard of skin breakdown.

**METHODS:** A randomized controlled trial was performed to test the effect of a 4-cm thermoactive viscoelastic foam overlay with a water-filled warming mattress on the OR-table (test OR-table) compared with the standard OR-table (a water-filled warming mattress, no pressure-reducing device) on the postoperative pressure ulcer incidence in cardiac surgery patients.

**INSTRUMENTS:** The pressure ulcer classification system of the European Pressure Ulcer Advisory Panel (EPUAP) was used for pressure ulcer grading.

**RESULTS:** The results show that patients lying on the 4-cm thermoactive viscoelastic foam overlay suffer slightly more pressure ulcer (17.6%) than patients on the standard OR-table without the foam overlay (11.1%). Because of the clinical relevance of the results, the randomized controlled trial was terminated after 175 patients at the interim analysis although the power calculation stated 350 patients.

**CONCLUSIONS:** The combination of a 4-cm viscoelastic foam overlay and a warming source cannot be recommended for pressure ulcer prevention on the operating room table.

**RELEVANCE TO CLINICAL PRACTICE:** Foam overlays are used to prevent pressure ulcers in patients. It is necessary to use such devices according to patient safety and use of resources.

**Iglesias, C., Nixon, J., Cranny, G., Nelson, E.A., Hawkins, K., Phillips, A, Torgerson, D., Mason, S., & Cullum, N. Pressure relieving support surfaces (PRESSURE) trial: Cost effectiveness analysis. *British Medical Journal*. 2006; 332, 1416-1419.**

**Objective:** To assess the cost effectiveness of alternating pressure mattresses compared with alternating pressure overlays for the prevention of pressure ulcers in patients admitted to hospital.

**Design:** Cost effectiveness analysis carried out alongside the pressure relieving support surfaces (PRESSURE) trial; a multicentre UK based pragmatic randomized controlled trial.

**Setting:** 11 hospitals in six UK NHS trusts.

**Participants:** Intention to treat population comprising 1971 participants.

Main outcome measures: Kaplan Meier estimates of restricted mean time to development of pressure ulcers and total costs for treatment in hospital.

Results: Alternating pressure mattresses were associated with lower overall costs (£283.6 per patient on average, 95% confidence interval -£377.59 to £976.79) mainly due to reduced length of stay in hospital, and greater benefits (a delay in time to ulceration of 10.64 days on average, -24.40 to 3.09). The differences in health benefits and total costs for hospital stay between alternating pressure mattresses and alternating pressure overlays were not statistically significant; however, a cost effectiveness acceptability curve indicated that on average alternating pressure mattresses compared with alternating pressure overlays were associated with an 80% probability of being cost saving.

Conclusion: Alternating pressure mattresses for the prevention of pressure ulcers are more likely to be cost effective and are more acceptable to patients than alternating pressure overlays.

**Karwowski, W., Rodrick, D., & Boratyn, G. Experimental evaluation of pressure distribution changes when using clinical support surfaces. *Occupational Ergonomics*. 2004; 4, 41-50.**

The main objective of this study was to perform experimental evaluation of the human body-pad interface pressure distribution changes when using five different clinical support surfaces (pads). The studied pads included the support surfaces for: head, heel, hip, lower back, and multipurpose pad for relevant body segments. For each pad, experimental data from 44 independent trials were obtained using 22 participants (12 male and 10 female) who voluntarily participated in the study. To measure the human body interface pressure, an Advanced ClinSeat pressure measurement system was utilized. For pads of the head, heel, lower back, and shoulder, the participants were positioned on their back, while for the hip pad, the participants were placed on their side. The results showed that in all cases the recorded pressures were significantly lower when the participants used the comfort pads compared to the no-pad condition. Specific recommendations for improvements in the current pad design were provided.

**Mayrovitz, H.N., Sims, N., Taylor, M.C., & Dribin, L. Effects of support surface Relief pressures on heel skin blood perfusion. *Advances in Skin & Wound Care*. 2003; 16(3), 141-145.**

OBJECTIVE: To investigate the effect of pressure-relief magnitude on heel blood flow.

DESIGN: 12 healthy subjects (5 male, 7 female; 21 to 43 years of age) lay on a support surface for 50 minutes with 1 heel on the end cell of the support surface. Cell pressure was computer controlled to vary cyclically at 5-minute intervals between a constant 20 mm Hg during loading and 10, 5, and 0 mm Hg during off-loading. Heel skin blood perfusion was monitored by laser Doppler probes on the heel and foot dorsum. Average skin blood perfusion during each 10-minute cycle and the hyperemic response after pressure relief were determined absolutely and relative to baseline.

SETTING: University research center

RESULTS: An inverse relationship was found between relief pressure and heel skin blood perfusion over each pressurization-relief cycle and during the hyperemia phase. Full-cycle average skin blood perfusion associated with release to 0, 5, and 10 mm Hg were  $34.1 \pm 7.5$  arbitrary units (AU),  $26.4 \pm 7.5$  AU, and  $9.3 \pm 3.3$  AU, respectively ( $P < .001$ ).

CONCLUSIONS: The reduced average skin blood perfusion is attributable to blunting of hyperemia when relief pressure is too high. When it corresponded to an interface pressure near diastolic pressure, little, if any, functional pressure relief or hyperemia is realized. Suitable relief pressures are likely dependent on an individual's diastolic blood pressure and the net tissue forces acting on heel blood vessels. This suggests that lower blood pressures need lower pressure-relief levels. It is suspected that if depressed vascular responsiveness and/or diminished hyperemic reserve is also present, even lower relief pressures are needed.

Pressure ulcers due to sustained unrelieved or inadequately relieved pressure are an important clinical, humanitarian, and economic problem.<sup>1-3</sup> Pressure-dependent blood flow changes play a major role in the skin breakdown process, with the greatest breakdown frequency at sites of bony prominences. The heel is particularly prone to such effects,<sup>4</sup> in part because of its relatively lower resting blood perfusion level<sup>5</sup> and higher amount of surface pressure when under load.<sup>6-9</sup> Local blood flow decreases during heel loading<sup>5</sup> and flow recovery after unloading are involved in the breakdown process.<sup>10-12</sup>

Previous work has shown that when the pressure supporting the heel was cycled at different rates, the average blood flow over complete cycles was significantly greater when the level of pressure was zero (full release) when compared with a nonzero-pressure value (partial release).<sup>13</sup> However, because only 2 levels of pressure relief were investigated, the blood flow

effects of intermediary levels of pressure relief are unknown. The present study sought to characterize the flow responses of the heel to 3 separate pressure-relief levels when the heel was supported with a uniform load magnitude and duration.

**Ochs, R.F., Horn, S.D., van Rijswijk, L., Pietsch, C, & Smout, R.J.**  
**Comparison of air-fluidized therapy with other support surfaces used to treat pressure ulcers in nursing home residents-Part I. *Ostomy Wound Management*. 2005; 51(2), 38-68.**

To provide empirical evidence comparing pressure ulcer healing rates between different support surfaces, data were analyzed from eligible residents with pressure ulcers (N = 664) enrolled in the National Pressure Ulcer Long-Term Care Study, a retrospective pressure ulcer prevention and treatment study. Support surfaces were categorized as: Group 1 (static overlays and replacement mattresses), Group 2 (low-air-loss beds, alternating pressure, and powered/non-powered overlays/mattresses), and Group 3 (air-fluidized beds). Calculation of healing rates, using the largest ulcer from each resident, found mean healing rates greatest for air-fluidized therapy (Group 3) (mean = 5.2 cm<sup>2</sup>/week) versus Group 1 (mean = 1.5 cm<sup>2</sup>/week) and Group 2 (mean = 1.8 cm<sup>2</sup>/week) surfaces (P = 0.007). Healing rates also were assessed using 7- to 10-day "episodes"; each ulcer generated separate episode(s) that included all ulcers when residents had multiple ulcers. Mean healing rates were significantly greater for Stage III/IV ulcers on Group 3 surfaces (mean = 3.1 cm<sup>2</sup>/week) versus Group 1 (mean = 0.6 cm<sup>2</sup>/week) and Group 2 (mean = 0.7 cm<sup>2</sup>/week) surfaces (Group 2 versus Group 3: P = 0.0211). This finding persisted for ulcers with comparable initial baseline areas (20 cm<sup>2</sup> to 75 cm<sup>2</sup>) on Group 2 and Group 3 surfaces; healing improved on Group 3 surfaces (+2.3 cm<sup>2</sup>/week) versus Group 2 surfaces (-2.1 cm<sup>2</sup>/week, P = 0.0399). Residents on Group 3 (6 out of 82; 7.3%) and Group 1 (47 out of 461; 10.2%) surfaces had fewer hospitalizations and emergency room visits than those on Group 2 surfaces (23 out of 121; 19.0%, P = 0.01) despite significantly greater illness in residents on Group 2 and 3 versus Group 1 surfaces (P is less than 0.0001). Despite limitations inherent in retrospective studies, ulcers on Group 3 surfaces versus Groups 1 and Group 2 surfaces had statistically significant faster healing rates (particularly for Stage III/IV ulcers) with significantly fewer hospitalizations and emergency room visits (Group 3 versus Group 2), despite significantly more illness in residents on Group 2 or Group 3 versus Group 1 surfaces. Episode analyses -- providing greater power, uniform treatment duration, and comparable baseline sizes -- confirmed these findings. Air-fluidized support surfaces represent great healing potential that justifies further exploration.

**Vanderwee, K., Grypdonck, M.H.F., Defloor, T. Effectiveness of an alternating pressure air mattress for the prevention of pressure ulcers. *Age and Ageing*. 2005; 34, 261-267.**

Background: studies of the effectiveness of alternating pressure air mattresses (APAMs) for the prevention of pressure ulcers are scarce and in conflict.

Objective: evaluating whether an APAM is more or equally effective as the standard prevention.

Design: randomized controlled trial. Setting and subjects: patients admitted to 19 surgical, internal, or geriatric wards in seven Belgian hospitals were included if they were in need of prevention of pressure ulcers. To define this need, two methods were used randomly: the Braden Scale or the presence of non-blanchable erythema (NBE).

Methods: 447 patients were randomized into either an experimental or a control group. In the experimental group, 222 patients were lying on an APAM (Alpha-X-Cell, Huntleigh Healthcare, UK). In the control group, 225 patients were lying on a visco-elastic foam mattress (Tempur, Tempur-World Inc., USA) in combination with turning every 4 hours. Both groups had identical sitting protocols. Results: there was no significant difference in incidence of pressure ulcers (grade 2-4) between the experimental (15.6%) and control group (15.3%) ( $P = 1$ ). There were significantly more heel pressure ulcers in the control group ( $P = 0.006$ ). There was an interaction effect between the risk assessment method and preventive measures for the development of all pressure ulcers and sacral pressure ulcers. Conclusion: fewer patients developed heel pressure ulcers on an APAM. Patients identified as being in need of prevention based on the presence of NBE had a tendency to develop fewer pressure ulcers on an APAM. Patients identified as being in need of prevention, based on the Braden Scale, appeared to develop more sacral pressure ulcers on an APAM.

## 9.0 Link to MDS

**Berlowitz, D.R., Brandeis, G.H., Morris, J.N., Ash, A.S., Anderson, J.J., Kader, B., & Moskowitz, M.A. Deriving a Risk-adjustment model for pressure ulcer development using the Minimum Data Set. *J Am Geriatr Soc*. 2001 Jul; 49(7):866-71.**

OBJECTIVE: To use the Minimum Data Set (MDS) to derive a risk-adjustment model for pressure ulcer development that may be used in assessing the quality of nursing home care.

DESIGN: Perspective observational study using MDS data from 1997.

SETTING: A large, for-profit, nursing home chain.



**PARTICIPANTS:** Our unit of analysis was 39,649 observations made on 14,607 nursing home residents who were without a stage 2 or larger pressure ulcer on an index assessment.

**MEASUREMENTS:** Pressure ulcer status was determined at an outcome assessment approximately 90 days after an index assessment. Potential predictors of pressure ulcer development were examined for bivariate associations, contributing to the development of a multivariate logistic regression model.

**RESULTS:**

A stage 2 or larger pressure ulcer developed in 2.3% of the observations. Seventeen resident characteristics were found to be associated with pressure ulcer development. These included dependence in mobility and transferring, diabetes mellitus, peripheral vascular disease, urinary incontinence, lower body mass index, and end-stage disease. A risk adjustment model based on these characteristics was well calibrated and able to discriminate among residents with different levels of risk for ulcer development (model c-statistic = 0.73).

**CONCLUSION:**

A clinically credible risk-adjustment model with good performance properties can be developed using the MDS. This model may be useful in profiling nursing homes on their rate of pressure ulcer development.

## 10.0 "Pressure-ulcer free time"

*No information could be located thus far*

## 11.0 Staging across continuum

*No information could be located thus far*

## 12.0 Assessment tools

**Bergstrom, N., & Braden, B. A prospective study of pressure sore risk among institutionalized elderly. *JAGS*. 1992; 40(8), 747-758.**

Risk assessment is recommended upon admission to a nursing home and weekly for the first month. Risk status can be effectively predicted by using the Braden Scale in combination with knowledge of age, blood pressure, temperature, and dietary protein intake.

**Bergstrom, N., Braden, B., Kemp, M. Champagne, M., & Rube, E. Predicting pressure ulcer risk- A multisite study of the predictive validity of the Braden Scale. *Nurs Res.* 1998; 47(5), 261-269.**

Background: There have been no studies that have tested the Braden Scale for predictive validity and established cutoff points for assessing risk specific to different settings.

Objectives: To evaluate the predictive validity of the Braden Scale in a variety of settings (tertiary care hospitals, Veterans Administration Medical Centers [VAMCs], and skilled nursing facilities [SNFs]). To determine the critical cutoff point for classifying risk in these settings and whether this cutoff point differs between settings. To determine the optimal timing for assessing risk across settings.

Method: Randomly selected subjects (N=843) older than 19 years of age from a variety of care settings who did not have pressure ulcers on admission were included. Subjects were 63% men, 79% Caucasian, and had a mean age of 63(±16) years. Subjects were assessed for pressure ulcers using the Braden Scale every 48 to 72 hours for 1 to 4 weeks. The Braden Scale score and skin assessment were independently rated, and the data collectors were blind to the findings of the other measures.

Results: One hundred eight of 843 (12.8%) subjects developed pressure ulcers. The incidence was 8.5%, 7.4%, and 23.9% in tertiary care hospitals, VAMCs, and SNFs, respectively. Subjects who developed pressure ulcers were older and more likely to be female than those who did not develop ulcers. Braden Scale scores were significantly ( $p = .0001$ ) lower in those who developed ulcers than in those who did not develop ulcers. Overall, the critical cutoff score for predicting risk was 18. Risk assessment on admission is highly predictive of pressure ulcer development in all settings but not as predictive as the assessment completed 48 to 72 hours after admission.

Conclusions: Risk assessment on admission is important for timely planning of preventive strategies. Ongoing assessment in SNFs and VAMCs improves prediction and permits fine-tuning of the risk-based prevention protocols. In tertiary care the most accurate prediction occurs at 48 to 72 hours after admission and at this time the care plan can be refined.

**Bergstrom, N., Braden, B.J., Laguzza, A., & Holman, V. The Braden scale for predicting pressure sore risk. *Nurs Res.* 1987; 36: 205-210.**

*No abstract available at this time*

**Berlowitz, D.R., Ratliff, C., Cuddigan, J., Rodeheaver, G.T., National Pressure Ulcer Advisory Panel. The PUSH tool: a survey to determine its perceived usefulness. *Adv Skin Wound Care*. 2005 Nov-Dec; 18(9): 480-3.**  
OBJECTIVE: To determine the perceived usefulness of the Pressure Ulcer Scale for Healing (PUSH).

PARTICIPANTS: A convenience sample identified through the National Pressure Ulcer Advisory Panel Web site as users or registered users of the PUSH tool.

MAIN OUTCOME MEASURE: A survey instrument was developed to capture experience, ease of use, and perceived utility and weakness of the PUSH tool.

RESULTS: Of 103 respondents, most (79) agreed or strongly agreed that PUSH required an appropriate amount of time to complete. It was also found to be reliable and easy to use and teach to others. Respondents were not as positive regarding usefulness, with 75% indicating that increased PUSH scores prompt patient and treatment reassessment. Respondents agreed or strongly agreed that improvement is possible in the size subscale (59%), the tissue type subscale (49%), and the exudate amount subscale (32%). Most commonly indicated for improvement was the addition of wound depth information.

CONCLUSION: Respondents generally found PUSH easy to use and helpful in pressure ulcer management. Specific areas of improvement were also identified.

**Bolton, L.L., Girolami, S., Slayton, S., Berger, T.M., Foster, L., Whittington, K.T., & Merkle, D. and the Association for the Advancement of Wound Care Guideline Subcommittee. Assessing the need for developing a comprehensive content-validated pressure ulcer guideline. *Ostomy Wound Management*. 2008; 54(11): 22-30.**

Healthcare professionals need evidence-based strategies and guidelines for care to optimize pressure ulcer prevention and management. Differences among pressure ulcer guidelines confuse caregivers, reducing consistency of care. To assess the need for a comprehensive content-validated guideline document, the Association for the Advancement of Wound Care Guideline Subcommittee evaluated current pressure ulcer guideline recommendations by compiling 10 pressure ulcer-specific guidelines existing before June 2008 on the National Guideline Clearinghouse website along with the National Pressure Ulcer Advisory Panel (draft), European Pressure Ulcer Advisory Panel (draft), and Wound Healing Society guidelines. Steps for each aspect of

pressure ulcer management were compiled and inconsistent recommendations identified. Currently available pressure ulcer guidelines were found to differ in definitions, aspects of care, validation, evidence criteria, and procedural recommendations, potentially affecting consistency and quality of all aspects of pressure ulcer management, including diagnosis, prevention, treatment, and outcomes measurement. To address these inconsistencies, a comprehensive list of Pressure Ulcer Care Initiative (PUCI) steps was prepared for content validation and posted on <http://www.aawconline.org/>, enabling healthcare professionals interested in improving the consistency and quality of pressure ulcer prevention and care to participate in this process. All steps with a content validity index >0.75 (rated clinically relevant by survey respondents) and/or with A-level standardized clinical evidence support will be included in the comprehensive PUCI guideline. Content validation of recommendations is an important first step to improving the consistency of pressure ulcer care.

**Defloor, T., & Grypdonck, M.F. H. Pressure ulcers: Validation of two risk assessment scales. *Journal of Clinical Nursing*. 2005; 14, 373-382.**

**AIMS AND OBJECTIVES:** To compare the predictive value of two pressure ulcer risk assessment scales (Braden and Norton) and of clinical judgment. To evaluate the impact of effective preventive measures on the predictive validity of the two risk assessment scales.

**METHODS:** Of the 1772 participating older patients, 314 were randomly selected and assigned to the 'turning' group; 1458 patients were assigned to the "non-turning" group. Using the Braden and the Norton scale the pressure ulcer risk was scored twice weekly during a four-week period. Clinical assessment was monitored daily. The patients at risk in the "turning" group (Braden score <17 or Norton score <12) were randomly assigned to a two-hour turning schedule or to a four-hour turning schedule in combination with a pressure-reducing mattress. The "non-turning" group received preventive care based on the clinical judgment of the nurses.

**RESULTS:** The diagnostic accuracy was similar for both scales. If nurses act according to risk assessment scales, 80% of the patients would unnecessarily receive preventive measures. The use of effective preventive measures decreased the predictive value of the risk assessment scales. Nurses predicted pressure ulcer development less well than the Braden and the Norton scale. Only activity, sensory perception, skin condition and existence of old pressure ulcers were significant predictors of pressure ulcer lesions.

**RELEVANCE TO CLINICAL PRACTICE:** The effectiveness of the Norton and Braden scales is very low. Much needless work is done and expensive

material is wrongly allocated. The use of effective preventive measures decreases the predictive value of the risk assessment scales. Although the performance of the risk assessment scales is poor, using a risk assessment tool seems to be a better alternative than relying on the clinical judgment of the nurses.

**Kim, T. Y., & Lang, N. Predictive modeling for the prevention of hospital-acquired pressure ulcers: Correlational Study. *AMIA Annual Symposium Proceedings*. 2006; 434-8.**

A one-to-one case control study was conducted on a pre-existing dataset to examine a predictive model with a set of risk factors for pressure ulcer development in acute care settings. Various techniques were used to select the most relevant predictors from ten subsets of a pre-existing dataset. The predictors identified were further examined using ten additional subsets by measuring sensitivities, specificities, positive/negative predictive values, and the areas under the ROC (receiver operating characteristic) curves. The best components for identifying at-risk patients consisted of three Braden subscales and five risk factors routinely collected through electronic health records. Entering these eight predictors into the logistic regression model yielded a sensitivity of 92%, a specificity of 67%, and an area under the ROC curve of 89%. Further evaluation, however, is needed to explore the validity of the model.

**Pancorbo-Hidalgo, P. L., Garcia-Fernandez, F. P., Lopez-Medina, I. M., & Alvarez-Nieto, C. Risk assessment scales for pressure ulcer prevention: A systematic review. *Journal of Advanced Nursing*. 2006; 54(1), 94-110.**

Risk assessment scales for pressure ulcer prevention: a systematic review  
Aim: This paper reports a systematic review conducted to determine the effectiveness of the use of risk assessment scales for pressure ulcer prevention in clinical practice, degree of validation of risk assessment scales, and effectiveness of risk assessment scales as indicators of risk of developing a pressure ulcer.

Background: Pressure ulcers are an important health problem. The best strategy to avoid them is prevention. There are several risk assessment scales for pressure ulcer prevention which complement nurses' clinical judgment. However, some of these have not undergone proper validation.

Method: A systematic bibliographical review was conducted, based on a search of 14 databases in four languages using the keywords pressure ulcer or pressure sore or decubitus ulcer and risk assessment. Reports of clinical trials or prospective studies of validation were included in the review.

Findings: Thirty-three studies were included in the review, three on clinical effectiveness and the rest on scale validation. There is no decrease in pressure ulcer incidence was found which might be attributed to use of an assessment scale. However, the use of scales increases the intensity and effectiveness of prevention interventions. The Braden Scale shows optimal validation and the best sensitivity/specificity balance (57Æ1%/67Æ5%, respectively); its score is a good pressure ulcer risk predictor (odds ratio ¼ 4Æ08, CI 95% ¼ 2Æ56–6Æ48). The Norton Scale has reasonable scores for sensitivity (46Æ8%), specificity (61Æ8%) and risk prediction (OR ¼ 2Æ16, CI 95% ¼ 1Æ03–4Æ54). The Waterlow Scale offers a high sensitivity score (82Æ4%), but low specificity (27Æ4%); with a good risk prediction score (OR ¼ 2Æ05, CI 95% ¼ 1Æ11–3Æ76). Nurses' clinical judgment (only considered in three studies) gives moderate scores for sensitivity (50Æ6%) and specificity (60Æ1%), but is not a good pressure ulcer risk predictor (OR ¼ 1Æ69, CI 95% ¼ 0Æ76–3Æ75).

Conclusion: There is no evidence that the use of risk assessment scales decreases pressure ulcer incidence. The Braden Scale offers the best balance between sensitivity and specificity and the best risk estimate. Both the Braden and Norton 94 \_ 2006 Blackwell Publishing Ltd, Journal of Advanced Nursing Scales are more accurate than nurses' clinical judgment in predicting pressure ulcer risk.

**Papanikolaou, P., Lyne, P., & Anthony, D. Risk assessment scales for pressure ulcers: A methodological review. *International Journal of Nursing Studies*. 2007; 44(2), 285-96.**

Much is written about risk-assessment scales (RASs) for pressure ulcers (PU) and their properties demonstrating that they are of limited value. Less is known about the reasons for these limitations and the scope for improvement. This review examines issues such as structure and scoring for the Norton, Waterlow and Braden scales, showing that the equal-weighting technique behind the current RASs is too simplistic and leads to limitations. It concludes that properly trained, experienced nurses should conduct PU risk assessments, whilst more robust data-driven RASs should be developed using the differential weighting scoring method together with advanced statistical techniques.

**Schoonhoven, L., Grobbee, D.E., Donders, A.R., Algra, A., Grypdonck, M.H., Bousema, M.T., Schrijvers, A.J., Buskens, E., & prePURSE Study Group. Prediction of pressure ulcer development in hospitalized patients: a tool for risk assessment. *Qual Saf Health Care*. 2006 Feb; 15(1): 65-70.**

Objectives: To identify independent predictors for development of pressure ulcers in hospitalized patients and to develop a simple prediction rule for pressure ulcer development.

Design: The Prevention and Pressure Ulcer Risk Score Evaluation (prePURSE) study is a prospective cohort study in which patients are followed up once a week until pressure ulcer occurrence, discharge from hospital, or length of stay over 12 weeks. Data were collected between January 1999 and June 2000.

Setting: Two large hospitals in the Netherlands.

Participants: Adult patients admitted to the surgical, internal, neurological and geriatric wards for more than 5 days were eligible. A consecutive sample of 1536 patients was visited, 1431 (93%) of whom agreed to participate. Complete follow up data were available for 1229 (80%) patients.

Main outcome measures: Occurrence of a pressure ulcer grade 2 or worse during admission to hospital.

Results: Independent predictors of pressure ulcers were age, weight at admission, abnormal appearance of the skin, friction and shear, and planned surgery in coming week. The area under the curve of the final prediction rule was 0.70 after bootstrapping. At a cut off score of 20, 42% of the patient weeks were identified as at risk for pressure ulcer development, thus correctly identifying 70% of the patient weeks in which a pressure ulcer occurred.

Conclusion: A simple clinical prediction rule based on five patient characteristics may help to identify patients at increased risk for pressure ulcer development and in need of preventive measures.

**Schoonhoven L, Haalboom JRE et al. Prospective cohort study of routine use of risk assessment scales for prediction of pressure ulcers. *BMJ*. 2002; 325(7368):797.**

Objective: To evaluate whether risk assessment scales can be used to identify patients who are likely to get pressure ulcers.

Design: Prospective cohort study.

Setting: Two large hospitals in the Netherlands.

Participants: 1229 patients admitted to the surgical, internal, neurological, or geriatric wards between January 1999 and June 2000.

Main outcome measure: Occurrence of a pressure ulcer of grade 2 or worse while in hospital.

Results: 135 patients developed pressure ulcers during four weeks after admission. The weekly incidence of patients with pressure ulcers was 6.2% (95% confidence interval 5.2% to 7.2%). The area under the receiver operating characteristic curve was 0.56 (0.51 to 0.61) for the Norton scale, 0.55 (0.49 to 0.60) for the Braden scale, and 0.61 (0.56 to 0.66) for the Waterlow scale; the areas for the subpopulation, excluding patients who received preventive measures without developing pressure ulcers and excluding surgical patients, were 0.71 (0.65 to 0.77), 0.71 (0.64 to 0.78), and 0.68 (0.61 to 0.74), respectively. In this subpopulation, using the recommended cut-off points, the positive predictive value was 7.0% for the Norton, 7.8% for the Braden, and 5.3% for the Waterlow scale.

Conclusion: Although risk assessment scales predict the occurrence of pressure ulcers to some extent, routine use of these scales leads to inefficient use of preventive measures. An accurate risk assessment scale based on prospectively gathered data should be developed.

## 13.0 Pediatrics

**Baharestani MM, Ratliff CR. Pressure Ulcers in Neonates and Children: An NPUAP White Paper. *Adv Skin Wound Care*. 2007; 20(4): 208-220.**

ABSTRACT: Acutely ill and immobilized neonates and children are at risk for pressure ulcers, but a paucity of evidence-based research exists on which to base guidelines for clinical practice. Most prevention and treatment protocols for pressure ulcers in the pediatric population are extrapolated from adult practice. Clinical practice guidelines for prevention and treatment of pressure ulcers that specifically address the needs of the pediatric population are needed. The purpose of this article is to highlight the research that is currently available and to identify gaps that need to be addressed so that science-based, age-appropriate prevention and treatment pressure ulcer guidelines can be developed.

**Dixon M, Ratliff CR. Pediatric Pressure Ulcer Prevalence-One Hospital's Experience. *Ostomy/Wound Management*. 2005; 51(6): 44-50.**

A pressure ulcer is an area of localized tissue destruction directly related to prolonged pressure usually created over a bony prominence by an external surface. The management, financial cost, and suffering associated with loss of skin integrity in hospitalized adult and geriatric populations are well documented. Prevalence for pressure ulcers in acute care settings for adults ranges between 10% and 18% and the cost for care is estimated in the billions of dollars. Nosocomial infection and extended hospitalization are complications of pressure ulcers that contribute immeasurably to emotional



costs. Consensus guidelines for pressure ulcer prevention and treatment in these populations are widely available.

The development of pressure ulcers in children, however, has been less well studied – in part because of their presumed relative rarity compared to adult populations. However, a new focus in pressure ulcer research aims to determine whether pressure ulcers are, indeed, relatively uncommon in the pediatric population and takes into account the unique physiologic and psychosocial needs of children. Physiologically, fluid and electrolyte disturbances occur more frequently and develop more rapidly in infants and young children than in older children and adults. The higher proportion of water content and greater surface area of young bodies coupled with the metabolic demands associated with infection and fever increase risk of dehydration. Hypovolemia is a physiologic vasoconstrictor resulting in decreased peripheral perfusion. Skin cells that are not well perfused may be hypoxic and are at risk for breaking down even with minimal trauma. Psychosocially, the very young child depends on caregivers for providing a safe physical environment that includes repositioning and turning. Children who do not have someone to turn and reposition them or children who do not have caregivers educated in the importance of repositioning are placed at a higher risk than those who have a knowledgeable caregiver.

Knowledge of pediatric pressure ulcer prevalence is essential for planning a pediatric ulcer prevention and treatment program. To start a pressure ulcer reduction and prevention program in the University of Virginia Children's Hospital, a major university-affiliated teaching facility, two wound ostomy continence (WOC) nurses completed pressure ulcer prevalence studies of pediatric patients hospitalized in June 2003 and June 2004. Although adult pressure ulcer prevalence studies had been completed yearly for the past 10 years in this institution, this was the first time pediatric data were collected.

## 14.0 Nutrition

**Beckrick K, Aronovitch SA. Hospital acquired pressure ulcers: a comparison of costs in medical vs. surgical patients. *Nurs Econ.* 1999; 17:263-271.**

The estimated costs associated with the estimated 1 to 1.7 million annual pressure ulcers is between \$5 billion and \$8.5 billion. Studies indicate that LOS increased between two and five times the typical LOS for patients who develop pressure ulcers in the hospital. Hip fracture patients who develop pressure ulcers had twice the average LOS as those who did not, representing an incremental cost of \$12,186 per patient. There were 34,000 patients admitted in 1992 with a primary diagnosis of pressure ulcers with an

average 20.5 day LOS at an estimated cost of \$24,575 per patient. Overall costs were estimated at \$836 million. It can be projected that approximately 53,000 pressure ulcers will be found on the study day which means that about 2.5 to 2.6 million ulcers pass through an acute care setting at some point during a year. The overall costs of (largely preventable) is between \$2.2 and \$3.6 billion.

**Benati, G., Delvecchio, S., Cilla, D., & Pedone, V. (2001). Impact on pressure ulcer healing of an arginine-enriched nutritional solution in patients with severe cognitive impairment. *Archives of Gerontology and Geriatrics*, 7, 43-47.**

Thirty-six inpatients with severe cognitive impairment and pressure ulcers were treated for two weeks with normal hospital diet (A), normal hospital diet plus oral supplementation with high protein calorie solution (B), normal hospital diet plus an oral supplementation with an iso-calorie and iso-protein solution enriched with arginine, vitamins and trace elements with antioxidant effects (C). Preliminary data show that patients with treatment C have a more rapid improvement in pressure ulcer healing than patients with treatment A and B.

**Breslow, RA, Bergstrom N. Nutritional prediction of pressure sores. *J. Am Diet Assoc.* 1994; 94: 1301-1306.**

Risk factors for the development of pressure ulcers include inadequate energy and protein intake, underweight and low triceps skinfold measurement. The nutritional risk factors that predict the development of pressure ulcers in hospital and nursing home patients are discussed.

**Byrne, DW, Salzberg, CA, Major risk factors for pressure ulcers in the spinal cord disabled: a literature review. *Spinal Cord.* 1996: 43:255-263.**  
*Abstract/Journal unavailable electronically*

**Chernoff, R.D., Milton, K., Lipschitz, D.A. The effect of a very high protein liquid formula on decubitus ulcer healing in long-term tube-fed institutionalized patients. *Journal of the American Dietetic Association.* 1990; 90(9), A-130.**  
*Abstract unavailable electronically*

**Chin, DE, Kearns, P. Nutrition in the Spinal-Injured Patient, *NCP.* 1991; 6(6):213-222.**

The response to spinal cord injury (SCI) occurs in phases with an initial phase of muscle flaccidity and absence of spontaneous skeletal muscle function followed by a chronic phase where muscles become hyperexcitable and spastic. The eventual course after SCI depends on the extent of neural

damage. Nutritional assessment presents a particular challenge in this patient population because essentially all of the traditional markers are effected by the SCI. Therefore, the use of anthropometric measurements, biochemical markers, and functional markers requires reinterpretation in this setting. Nutritional management is a further challenge because of alterations in appetite, gastrointestinal dysfunction, and possible pancreatitis. Metabolic changes include altered energy and nitrogen metabolism, hypercalcemia, hyponatremia, and initial weight loss followed by later weight gain. This review summarizes the unique nutritional problems that patients with SCI present and guidelines for nutritionally supporting the patient in both the acute and chronic phases.

**Clark, M., Schols, J.M.G.A., Benati, G., Jackson, P., Engfer, M., Langer, G., et al. Pressure ulcers and nutrition: a new European guideline. *Journal of Wound Care*. 2004; 13(7), 267-272.**

Existing guidelines give little advice on the treatment of malnutrition in patients with pressure ulcers. The European Pressure Ulcer Advisory Panel (EPUAP) has addressed this oversight in a new guideline, which is published here in full.

**Consortium for Spinal Cord Medicine Clinical Practice Guidelines. Pressure Ulcer Prevention and Treatment Following Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals. *J. Spinal Cord Med*. 1002:24: Suppl 1:S40-S101.**

*Abstract/Journal unavailable electronically*

**Desneves, K.J., Todorovic, B.E., Cassar, A., & Crowe, T.C. Treatment with supplementary arginine, vitamin C and zinc in patients with pressure ulcers: A randomised controlled trial. *Clinical Nutrition*. 2005; 24(6), 979-987.**

Background & Aims: Nutrients putatively implicated in pressure ulcer healing were evaluated in a clinical setting.

Methods: Sixteen inpatients with a stage 2, 3 or 4 pressure ulcer randomized to receive daily a standard hospital diet; a standard diet plus two high-protein/energy supplements; or a standard diet plus two high-protein/energy supplements containing additional arginine (9g), vitamin C (500mg) and zinc (30mg). Nutritional status measurements (dietary, anthropometric and biochemical) and pressure ulcer size and severity (by PUSH tool; Pressure Ulcer Scale for Healing; 0=completely healed, 17=greatest severity) were measured weekly for 3 weeks.

Results: Patients' age and BMI ranges were 37-92 years and 16.4-28.1kg/m<sup>2</sup>, respectively. Baseline PUSH scores were similar between groups (8.7±0.5).

Only patients receiving additional arginine, vitamin C and zinc demonstrated a clinically significant improvement in pressure ulcer healing ( $9.4\pm 1.2$  vs.  $2.6\pm 0.6$ ; baseline and week 3, respectively;  $P<0.01$ ). All patient groups presented with low serum albumin and zinc and elevated C-reactive protein. There were no significant changes in biochemical markers, oral dietary intake or weight in any group.

Conclusions: In this small set of patients, supplementary arginine, vitamin C and zinc significantly improved the rate of pressure ulcer healing. The results need to be confirmed in a larger study.

**Fuoco U, Scivoletto C, Pace A, Vona VU, Castellano V. Anaemia and serum Protein Alteration in Patients with Pressure Ulcers. *Spinal Cord*. 1997; 35: 58-60.**

Abstract: The presence of anemia and serum protein alteration frequently makes the treatment of pressure ulcers more difficult. Several hematoma-chemical parameters were observed in 40 patients with sacral pressure ulcers in order to determine the pathogenesis of these complications. All of the patients showed mild-moderate anemia with low serum iron and normal or increased ferritin and hypoproteinemia with hypoalbuminemia. Our results suggest that both anemia and serum protein alteration depend on the chronic inflammatory state due to the presence of pressure ulcers. Both anemia and hypoproteinemia disappeared after pressure ulcer healing. A correct diagnosis is important for the treatment. Iron therapy is useless and potentially dangerous (iatrogenic haemochromatosis) since anemia is the result of the inability to use iron stores and not iron deficiency. The treatment of serum protein alterations should be based on a dietary therapy rich in protein and calories; the administration of albumin should be reduced, since albumin is low in essential amino-acids and too expensive; albumin administration should be limited to cases with severe hypoproteinemia and edema.

**Gilmore, S.A., Robinson, G., Posthauer, M.E. & Raymond, J. Clinical indicators associated with unintentional weight loss and pressure ulcers in elderly residents of nursing facilities. *J Am Diet Assoc*. 1995; 95(9), 984-992.**

A study monitored adults older than 65 years living in nursing facilities and who experienced unintentional weight loss of more than 10% of actual body weight in 6 months or more than 5% in 1 month or who have stage II, III, or IV pressure ulcers. Inappropriate dietary intake, disease, and disability place residents in nursing facilities at risk for malnutrition.

**Hartgrink, H.H., Wille, J., Konig, P., Hermans, J., & Breslau, P.J. Press sores and tube feeding in patients with a fracture of the hip: a randomized clinical trial. *Clinical Nutrition*. 1998; 17(6), 287.**

Pressure sores are a frequent problem, especially in elderly patients. Nutritional status may influence the incidence, progression and severity of pressure sores, data, however, are contradictory (1). The purpose of this study was to determine the effect of supplemental feeding on the nutritional status and the development and severity of pressure sores. The effect of supplemental feeding overnight (tube +) on patients with a fracture of the hip and a high pressure-sore risk score, was studied in a randomized clinical trial. The control group (tube -) had no supplemental feeding. After informed consent, 140 patients were randomized, and 129 of these took part in the trial (62 tube +, and 67 tube -). Protein and energy intake, hemoglobin, serum albumin, total serum protein and pressure-sore grade were measured at admission and after 1 and 2 weeks.

Of the 62 patients randomized for tube feeding (tube +), only 25 tolerated their tube for more than 1 week and 16 for 2 weeks. Nevertheless, energy and protein intake was significantly higher in the tube + group ( $P < 0.001$ ). This, however, did not significantly influence total serum protein, serum albumin and development and severity of pressure sores after 1 and 2 weeks. Comparison of the actually tube fed group ( $n=25$  at 1 week,  $n = 16$  at 2 weeks) and the control group showed a 2-3 times higher protein and energy intake ( $P < 0.0001$ ), and a significantly higher total serum protein and serum albumin after 1 and 2 weeks in the actually tube fed group (all  $P < 0.001$ ). Pressure-sore development and severity were not significantly influenced in the actually tube fed group.

We conclude that we were not able to show a significant decrease in development and severity of pressure sores, because the nasogastric tube for supplemental feeding was not well tolerated in this patient group. Nevertheless, tube feeding overnight does result in a significant higher protein and energy intake, and has a significant effect on nutritional status in the actually tube-fed group. Other means of supplemental feeding will have to be used in order to answer the question of whether supplemental feeding can decrease development and severity of pressure sores.

**Jackobs MK. The cost of Medical Nutrition Therapy in Healing Pressure Ulcers. *Top Clin Nutrition*. 1999; 14(2):41-47.**

Abstract: Thirteen residents in long-term care, with an average age of 82.3 years, and Stage II or Stage III pressure ulcers were studied to evaluate the cost of medical nutrition therapy in effecting healing. The residents' physical condition and diagnoses were noted along with weight, laboratory data, and

the actual time in healing. The Stage II pressure ulcers took 10 to 45 days to heal, with the cost of medical nutrition therapy evaluated at an average of \$58.55 per ulcer. Stage III pressure ulcers took 49 to 138 days to heal, with the cost of medical nutrition therapy evaluated at an average of \$179.02 per ulcer. These figures help to quantify the cost of medical nutrition therapy in this one treatment area. Copyright © 1999 by Aspen Publishers, Inc.

**Langkamp-Henken, B., Hudgens, J., Stechmiller, J.K. & Herrlinger-Garcia, K.A. Mini nutritional assessment and screening scores are associated with nutritional indicators in elderly people with pressure ulcers. *Journal of the American Dietetic Association*. 2005; 105(10(print), 1590-1596.**

Objective: To determine the association between the Mini Nutritional Assessment (MNA) or MNA Screening Form and standard indicators of nutritional status in male elders with pressure ulcers.

Design: Cross-sectional study. MNA and MNA Screening Form scores were related to nutritional indicators using the Pearson correlation.

Subjects/Setting: Residents ( $79\pm 1$  years,  $N=23$  men) of Veterans Affairs medical center nursing home care units with stage I to IV pressure ulcers were enrolled.

Main Outcome Measures: Correlation coefficients were obtained from correlations between the MNA or MNA Screening Form scores and biochemical and anthropometric indices of nutritional status or measures of body composition normalized for height by dividing by height in meters<sup>2</sup>.

Results: Hemoglobin ( $106\pm 4$  g/L;  $r=0.43$ ,  $P=.0409$ , mean, standard error of the mean, Pearson's  $r$ ,  $P$  value), hematocrit ( $0.32\pm 0.01$ ;  $r=0.44$ ,  $P=.0358$ ), body mass index ( $23.1\pm 1.0$ ;  $r=0.66$ ,  $P=.0006$ ), calf circumference ( $30.4\pm 1.1$  cm;  $r=0.46$ ,  $P=.0286$ ), fat-free mass index ( $18.3\pm 0$ ;  $r=0.60$ ,  $P=.0063$ ), body cell mass index ( $8.3\pm 0.5$ ;  $r=0.64$ ,  $P=.0033$ ), and fat mass index ( $3.7\pm 0.4$ ;  $r=0.50$ ,  $P=.0275$ ) positively correlated with MNA score. Serum albumin ( $31\pm 1$  g/L) and prealbumin ( $180\pm 17$  mg/L) did not correlate with MNA, but prealbumin inversely correlated with erythrocyte sedimentation rate ( $r=-0.52$ ,  $P=.0134$ ), a marker of inflammation. The inverse correlation between albumin and erythrocyte sedimentation rate approached statistical significance ( $r=-0.42$ ,  $P=.0542$ ). The MNA Screening Form showed similar correlations or lack of correlations observed with the MNA with the exception of hemoglobin and hematocrit.

Conclusions: The MNA and MNA Screening Form provide advantages over using visceral proteins in screening and assessing nutritional status of elderly people with pressure ulcers.

**Liu MH, Spungen AM, Fink L, Lasoda M, Bauman WA, Increased energy needs in patients with quadriplegia and pressure ulcers. *Advances in Wound Care* 1996; 9(3): 41-45.**

Health individuals with quadriplegia generally have a reduced metabolic rate. However, individuals with quadriplegia who develop pressure ulcers may have an elevated metabolic rate. In this study, energy expenditure in 16 individuals with quadriplegia and pressure ulcers (PU-QUAD) was compared to the energy expenditure in 16 individuals with quadriplegia but no pressure ulcers (NPU-QUAD) and 16 healthy non-spinal cord injured subjects (controls). Resting energy expenditure (REE) was measured by indirect calorimetry. Both measured REE ( $t(30) = 2.38, p = 0.24$ ) and percent predicted REE ( $t(30) = 3.23, p = .003$ ) were significantly higher in subjects with quadriplegia and pressure ulcers compared with subjects with quadriplegia but no pressure ulcers. On average, REE in the PU-QUAD subjects was nearly equal to the absolute energy expenditure of healthy non-spinal cord injured controls. To ensure optimal care of patients with quadriplegia and pressure ulcers, quantification of energy expenditure with provision of adequate caloric intake is recommended.

**Pompeo, M. (2007). Misconceptions about protein requirements for wound healing: results of a prospective study. *Ostomy/Wound Management*, 53(8), 30.**

The importance of nutrition for wound prevention and healing is well established.<sup>1-5</sup> Formulas such as the Harris-Benedict equation<sup>6</sup> currently used to determine initial amounts of protein necessary utilize weight, height, age, and gender with an added "stress" factor that takes into account additional requirements for wound healing. Current approaches to address protein malnutrition involve daily intake of 1.5 to 1.8 g/Kg of protein without wound size considerations.<sup>7</sup> The author's experience treating patients with massive wounds has shown that these recommendations may not be sufficient to normalize protein stores.

**Robinson, MK, Trujillo EB, Mogensen KM, Rounds, J, McManus K., Jacobs DO. Improving nutritional screening of hospitalized patients: the role of prealbumin. *J Parenter Enteral Nutr.* 2004 Jul/Aug; 28(4):281.**

Background: Limited resources prevent hospitals from having all patients formally evaluated by a nutrition expert. Thus, hospitals rely on nutrition-screening tools to identify malnourished patients. The purpose of this study was to determine the effectiveness of a nutrition-screening protocol,

prealbumin (PAB), retinol binding protein (RBP), and albumin (ALB) in identifying malnourished hospitalized patients.

**Methods:** A nutrition screening protocol was prospectively used in medical and surgical patients and consisted of a nurse administering a questionnaire to patients and requesting formal evaluation by a registered dietitian (RD) only if nutritional issues were identified. Patients also had ALB, PAB, and RBP drawn, which were used to both screen and identify the malnourished. PAB, RBP, and ALB were compared as predictors of RD classification of patient nutritional status.

**Results:** The nutrition-screening protocol classified 104 of 320 patients (33%) as malnourished. However, 43% of the patients were not deemed at nutritional risk according to this protocol and therefore did not receive RD assessment. PAB was a significant predictor of RD-determined nutritional status.

**Salzberg CA, Byrne, DW, Cayten CG, van Niewerburgh P, Murphy JG, Viehbeck M. A new Pressure Ulcer Risk Assessment for Individuals with Spinal Cord Injury. *Am J Phys Med Rehabil.* 1996; 75(2): 96-104.**

Each year, one-fourth of the 200,000 individuals with spinal cord injury in the United States develop pressure ulcers. No method currently exists, however, to accurately identify which of these individuals are at increased risk for development of pressure ulcers. We studied 219 spinal cord-injured patients, seen at a Veterans Affairs Medical Center, during a 6-yr period. Our goal was to develop a pressure ulcer risk assessment scale, specifically for persons with SCI. Each risk factor had to meet four criteria: (1) statistical association with pressure ulcer development; (2) biologically plausible mechanism; (3) literature support; (4) improved prediction. Among the 219 spinal cord-injured patients evaluated, 176 (80.4 percent) had a history of one or more pressure ulcers. Fifteen risk factors met the four criteria for inclusion into the risk assessment scale. They were as follows: restricted activity level, degree of immobility, complete spinal cord injury, urinary incontinence, autonomic dysreflexia, advanced age, the co-morbidities of cardiac, pulmonary, and renal disease, impaired cognitive function, diabetes, cigarette smoking, residence in a nursing home or hospital, hypoalbuminemia, and anemia. Compared with the more general scales available, for quantifying the risk of pressure ulcer development, preliminary results suggest that this new scale is a significant improvement for the spinal cord-disabled.

**Ter Riet, G., Kessels, A.G., & Knipschild, P.G. Randomized clinical trial of ascorbic acid in the treatment of pressure ulcers. *J Clin Epidemiol.* 1995; 48(12), 1453-1460.**



The objective of this study was to assess the effects of ascorbic acid supplementation, 500 mg twice daily in the treatment of pressure ulcers as an adjunct to standardized treatment.

The design consisted of a multicenter blinded randomized trial. The control group received 10 mg of ascorbic acid twice daily.

Patients from 11 nursing homes and 1 hospital participated.

Main outcome measures included wound survival, healing rates of wound surfaces, and clinimetric changes over 12 weeks.

Eighty-eight patients were randomized. Intention-to-treat analysis showed that the wound closure probability per unit time (i.e., the closure rate) was not higher in the intervention group than in the control group (Cox hazard ratio of 0.78 [90% precision interval, 0.44–1.39]). Mean absolute healing rates were 0.21 and 0.27 cm<sup>2</sup>/week in the intervention and control group, respectively (PI of the adjusted difference: –0.17 to 0.13). Relative healing rates and healing velocities did not show favorable results of ascorbic acid supplementation, either. A panel scored slides of the ulcers with a report mark between 1 (bad) and 10 (excellent). The improvement was 0.45 and 0.72 points per week in the intervention and control group, respectively (PI of the adjusted difference: –0.50 to 0.20). With another clinimetric index we could not show any differences, either.

These data do not support the idea that ascorbic acid supplementation (500 vs. 10 mg twice daily) speeds up the healing of pressure ulcers.

**Thomas, DR. The role of nutrition in prevention and healing of pressure ulcers. *Clin Geriatr Med.* 1997; 13:497-511.**

Among the many risk factors for pressure ulcers, malnutrition is potentially reversible. This article examines the relationship of malnutrition to the prevention and healing of pressure ulcers. Evidence for nutrition in preventing and healing pressure ulcers is presented. Specific nutrients, including some amino acids, vitamins, and minerals, have been evaluated for their effects on wound healing.

**Torra I Bou, J.E., Gomez, T.S. The effectiveness of a hyper-oxygenated fatty acid compound in preventing pressure ulcers. *Journal of Wound Care.* 2005; 14(3), 117-121.**

Abstract: Application of hyperoxygenated fatty acids - essential fatty acids that have undergone hyperoxygenation - helps to prevent the development of grade I pressure ulcers. This multicentre double-blind randomized clinical

trial compared the effects of Mepentol, a hyperoxygenated fatty acid preparation, with a placebo treatment in preventing the development of pressure ulcers. Incidence of pressure ulcers, relative risk (RR), preventable fraction and number necessary to treat (NNT) were calculated. In addition, Kaplan-Meier survival curves, with log-rank test, and Cox's proportional hazards regression model were used to compare both groups. A total of 331 patients completed the study: 167 in the control group and 164 in the study group. Pressure-ulcer incidence during the study was 7.32% in the intervention group versus 17.37% in the placebo group ( $p=0.006$ ). These results show that for each 10 patients treated with Mepentol one pressure ulcer was prevented (NNT = 9.95). Survival curves and the regression model showed a significant statistical difference for both groups ( $p<0.001$ ). The average cost of Mepentol during the study was 7.74 Euros. The investigators conclude that Mepentol is an effective measure for pressure ulcer prevention, commenting that it was more effective than a greasy placebo product and was found to be cost-effective.