

Wounds UK Pressure Care Newsletter –April 2008 References

This month's pressure ulcer references come from MEDLINE and cover all new entries to the database that consider pressure ulcers.

Ayello, E. A. and C. H. Lyder (2008). "A new era of pressure ulcer accountability in acute care." *Advances in Skin & Wound Care* 21(3): 141-2.

PURPOSE:: To familiarize wound care practitioners with the 5 Million Lives Campaign's pressure ulcer prevention intervention. **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:

Baath, C., M.-L. Hall-Lord, et al. (2008). "Interrater reliability using Modified Norton Scale, Pressure Ulcer Card, Short Form-Mini Nutritional Assessment by registered and enrolled nurses in clinical practice." *Journal of Clinical Nursing* 17(5): 618-26.

AIM: Examine the interrater reliability between and among registered and enrolled nurses using Modified Norton Scale, Pressure Ulcer Card and Short Form-Mini Nutritional Assessment. **BACKGROUND:** In Sweden, registered nurses and enrolled nurses usually co-operate in patient care. National guidelines emphasize that reliable and valid assessment tools should be used. Interrater reliability for regular use of assessment tools is seldom studied. **DESIGN CROSS-SECTIONAL:** Registered nurses and enrolled nurses made 228 assessments of patients' skin, risk for pressure ulcer and malnutrition, in patients with hip fracture and patients who had

suffered a stroke. RESULTS: The interrater reliability of the Modified Norton Score total score was very good among registered nurses, good among enrolled nurses and between both groups. There was good, moderate and fair agreement on the subscales. Interrater reliability of Short Form Mini-Nutritional Assessment screening score was very good between both groups, good among registered nurses and moderate among enrolled nurses. There was good and moderate agreement on the items. There was good, moderate and fair agreement between and among registered nurses and enrolled nurses when using the Pressure Ulcer Card. CONCLUSION: The Modified Norton Scale and Short Form Mini-Nutritional Assessment were reasonably understandable and easy to utilize in clinical care. Therefore, it seems possible for nurses to accomplish assessment using these tools. The agreement level was low for most skin sites except sacrum when nurses assessed patients' skin with the Pressure Ulcer Card. RELEVANCE TO CLINICAL PRACTICE: The utilize of reliable and valid assessment tools is important in clinical practice. The tools could be used as an aid to the clinical judgement and therefore identify patients at risk for pressure ulcers and malnutrition. Pressure ulcer grading is a difficult skill that requires training and time to develop.

Baldelli, P. and M. Paciella (2008). "Creation and implementation of a pressure ulcer prevention bundle improves patient outcomes." *American Journal of Medical Quality* 23(2): 136-42.

Background: Increased pressure ulcer prevalence and incidence rates led to the development of a pressure ulcer prevention program. Objectives: To decrease pressure ulcer rates below national levels by implementing strategies to improve

patient outcomes. Methods: Patients admitted to the Stony Brook University Medical Center (SBUMC) are assessed for placement in the pressure ulcer prevention program. The central element of the program is an evidence-based Pressure Ulcer Prevention Bundle using the "Bundle" concept from the Institute for Healthcare Improvement. Results: The March 2006 Prevalence and Incidence Benchmarking Study demonstrates not only a decrease in institutional prevalence and incidence rates but also places SBUMC rates below last year's national benchmark rates. Conclusion: The implementation of a pressure ulcer prevention program has decreased prevalence and incidence rates at SBUMC and improved the quality of patient care. (Am J Med Qual 2008;23:136-142).

Beeckman, D., L. Schoonhoven, et al. (2007). "EPUAP classification system for pressure ulcers: European reliability study." *Journal of Advanced Nursing* 60(6): 682-91.

AIM: This paper is a report of a study of the inter-observer reliability of the European Pressure Ulcer Advisory Panel pressure ulcer classification system and of the differential diagnosis between moisture lesions and pressure ulcers. BACKGROUND: Pressure ulcer classification is a valuable tool to provide a common description of ulcer severity for the purposes of clinical practice, audit and research. Despite everyday use of the European Pressure Ulcer Advisory Panel system, its reliability has been evaluated in only a limited number of studies. METHODS: A survey was carried out between September 2005 and February 2006 with a convenience sample of 1452 nurses from five European countries. Respondents classified 20 validated photographs as normal skin, blanchable erythema, pressure

ulcers (four grades), moisture lesion or combined lesion. The nurses were familiar with the use of the European Pressure Ulcer Advisory Panel classification scale.

RESULTS: Pressure ulcers were often classified erroneously ($\kappa = 0.33$) and only a minority of nurses reached a substantial level of agreement. Grade 3 lesions were regularly classified as grade 2. Non-blanchable erythema was frequently assessed incorrectly as blanchable erythema. Furthermore, the differential diagnosis between moisture lesions and pressure ulcers appeared to be complicated.

CONCLUSION: Inter-observer reliability of the European Pressure Ulcer Advisory Panel classification system was low. Evaluation thus needs to focus on both the clarity and complexity of the system. Definitions and unambiguous descriptions of pressure ulcer grades and the distinction between moisture lesions will probably enhance clarity. To simplify the current classification system, a reduction in the number of grades is suggested.

Benati, G., S. Delvecchio, et al. (2001). "Impact on pressure ulcer healing of an arginine-enriched nutritional solution in patients with severe cognitive impairment." *Archives of Gerontology & Geriatrics - Supplement 7*: 43-7.

Braden, B. J. (2008). "The effect of web-based braden scale training on the reliability and precision of braden scale pressure ulcer risk assessments." *Journal of Wound, Ostomy, & Continence Nursing* 35(2): 209-10.

Butler, F. (2008). "Essence of Care and the pressure ulcer benchmark - An evaluation." *Journal of Tissue Viability* 17(2): 44-59.

Cadue, J.-F., S. Karolewicz, et al. (2008). "[Prevention of heel pressure sores with a foam body-support device. A randomized controlled trial in a medical intensive care unit]." *Presse Medicale* 37(1 Pt 1): 30-6.

BACKGROUND: To assess in a prospective controlled study the efficacy and safety of a specific foam body-support device designed as to prevent heel pressure ulcers. **METHODS:** A randomization table was used to allocate 70 patients into 2 groups. The control group was treated with our standard pressure sore prevention protocol (half-seated position, water-mattress and preventive massages 6 times a day); the experimental group was treated with the same standard protocol as well as with the foam body-support device being evaluated. Patients were included if their Waterlow score was >10, indicating a high risk of developing pressure ulcers and if they had no skin lesion on the heels. Foam devices, covered with jersey, were constructed for the legs and allowed the heels to be free of any contact with the bed; another foam block was arranged perpendicularly to the first, in contact with the soles, to prevent ankles from assuming an equinus position (to prevent a dropfoot condition). The principal criterion for efficacy was the number of irreversible skin lesions on the heel (that is, beyond the stage of blanching hyperemia, reversible after finger pressure); these lesions were assessed every day until the end of the study (up to 30 days). **FINDINGS:** The number of irreversible heel pressure ulcers was lower in the experimental (3 patients, 8.6%) than in the control group (19 patients, 55.4%) ($p < 0.0001$). Mean time without any pressure ulcer was higher in the

experimental group (5.6 days, compared with 2.8 days, $p=0.01$). The groups did not differ in the number of pressure sores on the sacrum and leg. CONCLUSION: An anatomical foam body-support is effective in preventing heel pressure ulcers in patients on a medical intensive care unit and is well tolerated.

de Luis, D. and R. Aller (2007). "[Systematic review of nutritional support in pressure ulcer]." *Anales de Medicina Interna* 24(7): 342-5.

Pressure ulcer is an area of localised damage to the skin and underlying tissue caused by pressure, shear, friction and/or combination of these things. Prevalence of this entity is between 3 and 66%, depending of the patients and the pathology. Pressure ulcer is associated with an increased risk of morbidity and mortality. One of the most important risk factors to develop a pressure ulcer is nutritional status. We can use different interventional strategies, first of all (primary intervention) before the patient has developed a ulcer and secondly, the treatment of a established ulcer (secondary prevention). In the most important primary prevention study with 662 patients, two oral nutritional supplements per day were given to the patients. The incidence of pressure ulcer was 40% (118/295) in the interventional group and 48% (181/377) in control group. A relative risk to develop a pressure ulcer with supplementation of 0.83 (CI95%: 0.70 a 0.99). In the studies with secondary prevention, when we analyze in an individual way the different nutrients, zinc has not demonstrated the utility in an independent way. Vitamin C shows contradictory data in two randomized clinical trial with the same dose (500 mg each 12 hours). Recently, some randomized clinical trials have demonstrated an improvement in healing rates with enhanced enteral formulas (zinc, arginine, vitamin C). Oral

supplementation without taking account micronutrients decreases risk of pressure ulcer. However, studies of secondary prevention due to heterogeneity have not let clear conclusions. However, enteral enhanced formula could improve ulcer healing.

de Souza, D. M. S. T. and V. L. C. d. G. Santos (2007). "Risk factors for pressure ulcer development in institutionalized elderly." *Revista Latino-Americana de Enfermagem* 15(5): 958-64.

This study aimed to analyze the risk factors for the development of Pressure Ulcers (PU) in old people living in Long Staying Institutions. It is a prospective and cohort study carried out in four Institutions. A total of 94 old people composed the sample and were assessed during three consecutive months. The total scores of the Braden Scale were different between the groups with and without PU, at the first ($p=0.030$) and last assessments ($p=0.001$); humidity, nutrition and friction/shearing were significantly different between those with and without PU, and were always worst among the first. Female gender and previous PU were confirmed as predictive for the development of PU ($r(2)=0.311$).

Dehlin, O., S. Elmstahl, et al. (2007). "Monochromatic phototherapy: effective treatment for grade II chronic pressure ulcers in elderly patients." *Aging-Clinical & Experimental Research* 19(6): 478-83.

BACKGROUND AND AIMS: Monochromatic pulsating light may have effects on wound healing. In an earlier study of grade II ulcers, there was a tendency toward better healing in the phototherapy group ($p=0.06$). The present study on patients with

grade II ulcers was performed to verify these findings. Data from this study were pooled with data from the earlier study. METHODS: Ninety-four patients were offered participation in the new study and 76 patients were evaluated. They were pooled with 87 patients from the earlier study, bringing the total to 163. All patients were treated with monochromatic pulsating light or placebo over the ulcerated area, according to a specified program up to 12 weeks. RESULTS: The mean normalized reduction in pressure ulcer size at week 12 was 0.79 for the phototherapy group and 0.50 for the placebo group (95% confidence interval 0.01-0.53; $p=0.039$). No serious side-effects were noted. CONCLUSIONS: Monochromatic pulsating light accelerates healing in grade II pressure ulcers in elderly patients.

Dellefield, M. E. (2008). "Nursing staff descriptions of clinical supervision and management in Veterans Affairs-affiliated nursing homes." *Journal of Nursing Care Quality* 23(1): 66-74.

Forty nursing staff from 2 urban VA-affiliated nursing homes participated in separate focus groups for certified nursing assistants, licensed vocational nurses, and registered nurses. Staff described their experiences with nursing supervisory and managerial staff work behaviors related to 5 common clinical practices, including incontinence, mobility, nutrition, pain, and pressure ulcer management. Themes associated with these behaviors were identified using content analysis. Implications for nurses in supervisory, managerial, and leadership roles in nursing homes and other clinical settings are presented.

Deprez, J.-F., G. Cloutier, et al. (2007). "3D ultrasound elastography for early detection of lesions. evaluation on a pressure ulcer mimicking phantom." Conference Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine & Biology Society 2007: 79-82.

A pressure ulcer is a damaged tissue area induced by an unrelieved pressure compressing the tissue during a prolonged period of immobility. The lack of information and studies on the development of this pathology makes its prevention difficult. However, it is both acknowledged that lesions initiate in the deep muscular tissues before they expand to the skin, and that lesions are harder than healthy tissues. Elastography is therefore an interesting tool for an early detection of the pathology. A 3D strain estimation algorithm is presented and evaluated on a PVA-cryogel phantom, mimicking a pressure ulcer at an early stage.

Dimant, J. and Amda (2001). "Implementing pressure ulcer prevention and treatment programs: using AMDA Clinical Practice Guidelines." Journal of the American Medical Directors Association 2(6): 315-25.

Dopierala, L., M. T. Szewczyk, et al. (2007). "Level of preparation for preventive procedures and pressure ulcer treatment in health care units from the Kujawsko-Pomorski region." Advances in Medical Sciences 52 Suppl 1: 81-4.

PURPOSE: Prevention of pressure ulcer development is one of the most important tasks of chronic diseases management. This diseases are the risk factors of pressure ulcer development. The effectiveness of prevention depends on medical

staff work organization, material resources (e.g. dressings), training system and education. The aim of the study was to assess the level of preparation for prevention activities, risk assessment, pressure ulcer treatment and documentation in health care units from Kujawsko-Pomorski region. MATERIAL AND METHODS: This study was based on the questionnaire and was performed in 21 health care units. We assessed basic equipment of 1060 beds from internal, neurological and long-term care wards. RESULTS: The highest risk of pressure ulcer development was identified in neurological wards. Hospitalisation longer than 10 days increases the risk. The highest morbidity was presented in long-term care wards. In 50% of hospitals there was a lack of equipment and materials used for pressure ulcer management and prevention, especially pressure-reducing mattresses. CONCLUSIONS: Hospitals are not well performed for effective prevention and management of pressure ulcers.

Duncan, K. D. (2007). "Preventing pressure ulcers: the goal is zero." Joint Commission Journal on Quality & Patient Safety 33(10): 605-10.

BACKGROUND: One of the 12 interventions that the Institute for Healthcare Improvement (IHI) recommends for its 5 Million Lives Campaign is "Prevent Pressure Ulcers ... by reliably using science-based guidelines for their prevention." Pressure ulcers cause considerable harm to patients, hindering functional recovery, frequently causing pain, and often serving as vehicles for the development of serious infections. Although the goal for health care facilities to reduce pressure ulcers is admirable, the goal for pressure ulcer incidence should be zero. THE CASE FOR PREVENTION: Pressure ulcer prevention entails two major steps: identifying patients at risk and reliably implementing prevention strategies for all patients identified as at risk.

Prevention strategies include six key elements (elements 3-6 address patients at risk): (1) conduct a pressure ulcer admission assessment for all patients, (2) reassess risk for all patients daily, (3) inspect skin daily, (4) manage moisture, (5) optimize nutrition and hydration, and (6) minimize pressure. Facilities may wish to form a multidisciplinary team to develop a pressure ulcer prevention program.

CONCLUSION: The development of pressure ulcers is a painful, expensive, and unnecessary harm event that is all too prevalent in American hospitals. The prevention of pressure ulcers is a key intervention that is not new, not expensive, and has the potential to save thousands of patients from unnecessary harm.

Dunleavy, K. (2008). "Putting a dent in pressure ulcer rates." *Nursing* 38(1): 20-1.

Factora, R. (2004). "Year in review: National Pressure Ulcer Long-Term Care Study (NPULS)." *Journal of the American Medical Directors Association* 5(5): 356-7.

Fleurence, R. L. (2007). "Setting priorities for research: a practical application of 'payback' and expected value of information." *Health Economics* 16(12): 1345-57.

BACKGROUND: Setting priorities for research using economic in addition to scientific criteria can ensure that resources are spent efficiently and equitably.

OBJECTIVE: This study applies two priority setting methods 'payback' and expected value of information (EVI) to two research areas (osteoporosis and pressure ulcers) and where appropriate to four clinical trials: the Record Trial, the Vitamin D and Calcium Trial and the Hip Protector Trial (osteoporosis), and the Pressure Trial

(wound care). METHODS: Two decision-analytic models were developed. For 'payback', the PATHS model was used to estimate the expected net benefits of conducting the four clinical trials. An EVI framework was applied to estimate the cost-effectiveness of conducting further research in the two disease areas investigated. RESULTS: The application of 'payback' suggests that the Record Trial and the Vitamin D and Calcium Trial would be cost-effective. The Hip Protector and the Pressure Ulcer Trial are cost-effective under certain assumptions concerning the likelihood of obtaining positive, negative or inconclusive results. The EVI method suggests that research would be potentially cost-effective in these areas in the populations considered. CONCLUSION: EVI provides strategic information for setting priorities for research between disease areas and study populations. 'Payback' provides information on the cost-effectiveness of specific research designs. However, further work in this area, particularly concerning the issue of implementation of research, is required. Copyright (c) 2007 John Wiley & Sons, Ltd.

Fogerty, M. D., N. N. Abumrad, et al. (2008). "Risk factors for pressure ulcers in acute care hospitals." *Wound Repair & Regeneration* 16(1): 11-8.

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.

Frain, R. (2008). "Decreasing the Incidence of Heel Pressure Ulcers in Long-term Care by Increasing Awareness: Results of a 1-Year Program." *Ostomy Wound Management* 54(2): 62-7.

Heel pressure ulcers are a major problem in healthcare today. They involve extended clinician time, patient discomfort, and increased healthcare costs. In an attempt to decrease the incidence of heel pressure ulcers in one long-term care facility, a 1-year program was implemented that involved residents of one long-term care unit. In addition to staff education and awareness interventions, residents' heels were assessed daily and heel pressure-relieving measures were implemented. Kites were used to identify pressure ulcer stage, photo posters helped staff visualize the stages of heel pressure ulcers, and pencils marked with "Float Heels" were used to remind staff of the importance of prevention. Ulcer incidence rates were calculated every month. All residents (n = 40, mean age 67 years) on the unit at the beginning

of the program were followed for as long as they were in the facility. At the start of the program, 50% of residents were at risk for developing ulcers and 22.5% had a heel ulcer. While the at-risk profile of residents remained relatively unchanged, no new ulcers were documented during nine of the subsequent 13 months, with incidence rates in the other 4 months ranging from 2.6% to 9.1%. Program costs were minimal and the results seem to confirm previously published studies about the positive effects of a comprehensive approach to the pressure ulcer problem.

Frankel, H., J. Sperry, et al. (2007). "Risk factors for pressure ulcer development in a best practice surgical intensive care unit." *American Surgeon* 73(12): 1215-7.

We describe the incidence of and define risk factors for pressure ulcers (PU) in the surgical intensive care unit (ICU). Twelve months of data were collected on all patients admitted to the intensivist-run surgical ICU of a university hospital. PU patients were those who developed a new stage II or greater lesion during or after a surgical ICU stay as identified in Project Impact, ICD9 discharge, or ICU complications databases. Patients were nursed in pressure-relieving beds with nutrition initiated by 72 hours. Chi², t test, and logistic regression statistics were used. Three percent (25/820) developed PU. Age, ICU length of stay, Acute Physiology and Chronic Health Evaluation Score (APACHE), and gender were not different between those with and without PU. Patients with PU had a higher blood urea nitrogen/creatinine (30.5/2.2 mg/dL vs 22.0/1.6 mg/dL) and were more frequently vascular patients (28 vs 14.1%), diabetics (40 vs 17.2%), paraplegics (8 vs 0.2%) (all $P < 0.01$), and patients on pressors (28.0 vs 11.8%, $P < 0.02$). Multivariate analysis revealed that diabetes (odds ratio [OR] 2.7, 95% confidence

interval [CI] 1.1-6.4), spinal cord injury (OR 16.8, 95%, CI 1.5-183), age > 60 years (OR 2.9, 95%, CI 1.2-7.1), and a creatinine >3 mg/dL (OR 3.7, 95%, CI 1.2-9.3) were independent predictors of PU. Despite universal use of specialty beds and early nutrition, pressure ulcers developed in 3 per cent. Independent risk factors include age greater than 60 years, diabetes, spinal cord injury, and renal insufficiency. Additional modalities, such as aggressive early mobilization, might be warranted in this cohort.

Gajewski, B. J., S. Hart, et al. (2007). "Inter-rater reliability of pressure ulcer staging: ordinal probit Bayesian hierarchical model that allows for uncertain rater response." *Statistics in Medicine* 26(25): 4602-18.

This article describes a method for estimating the inter-rater reliability of pressure ulcer (PU) staging (stages I-IV) from raters in National Database of Nursing Quality Indicators (NDNQI) participating hospitals. The method models ordinal spanning data utilizing an ordinal probit Bayesian hierarchical model (BHM) across several hospitals in which raters monitor patient's PUs. An ulcer that cannot be accurately assessed because the base of the wound cannot be seen is defined as unstageable. Our novel approach allows for an unstageable PU rating to be included in the analysis. We compare the ordinal probit BHM to an approximate random-effects (standard approach in the literature) model that assumes that the raw ordinal data are continuous. Copyright 2007 John Wiley & Sons, Ltd.

Gefen, A., L. H. Cornelissen, et al. (2008). "The free diffusion of macromolecules in tissue-engineered skeletal muscle subjected to large compression strains." *Journal of Biomechanics* 41(4): 845-53.

Pressure-related deep tissue injury (DTI) represents a severe pressure ulcer, which initiates in compressed muscle tissue overlying a bony prominence and progresses to more superficial tissues until penetrating the skin. Individual subjects with impaired motor and/or sensory capacities are at high risk of developing DTI. Impaired diffusion of critical metabolites in compressed muscle tissue may contribute to DTI, and impaired diffusion of tissue damage biomarkers may further impose a problem in developing early detection blood tests. We hypothesize that compression of muscle tissue between a bony prominence and a supporting surface locally influences the diffusion capacity of muscle. The objective of this study was therefore, to determine the effects of large compression strains on free diffusion in a tissue-engineered skeletal muscle model. Diffusion was measured with a range of fluorescently labeled dextran molecules (10, 20, 150kDa) whose sizes were representative of both hormones and damage biomarkers. We used fluorescence recovery after photobleaching (FRAP) to compare diffusion coefficients (D) of the different dextrans between the uncompressed and compressed (48-60% strain) states. In a separate experiment, we simulated the effects of local partial muscle ischemia in vivo, by reducing the temperature of compressed specimens from 37 to 34 degrees C. Compared to the D in the uncompressed model system, values in the compressed state were significantly reduced by $47 \pm 22\%$ ($p < 0.02$). A 3 degrees C temperature decrease further reduced D in the compressed specimens by $10 \pm 6\%$ ($p < 0.05$). In vivo, the effects of large strains and ischemia are likely to be summative, and hence, the present findings suggest an important role of impaired diffusion in the

etiology of DTI, and should also be considered when developing biochemical screening methods for early detection of DTI.

Gehin, C., E. Brusseau, et al. (2006). "Which techniques to improve the early detection and prevention of pressure ulcers?" Conference Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine & Biology Society 1: 6057-60.

Pressure ulcers are a serious health problem for people with mobility disorders, like elders in acute care, long-term care, and home care settings. It also concerns paraplegics, tetraplegics or persons with burned injuries. Pressure ulcers result in significant morbidity and mortality. Consequences are a high human suffering, with high cost in terms of treatment. Several risk factors have been identified for the development of pressure ulcers: they are classified into extrinsic and intrinsic factors. Extrinsic factors include interface pressure, shear forces, friction. Intrinsic factors are the nutritional state of the patient, its age, diseases. There is little information about the mechanism of the formation of pressure sores but it is agreed that it is a complex process. The difficulty of the prevention lies in the evaluation of these factors. It is an essential stage to optimize the preventative measures. Actually, no quantifiable parameters exist to predict the formation of a pressure ulcer. This article is aimed to propose new techniques developed for the early detection of pressure ulcers. First, extrinsic parameters as the interface pressure and its consequences on the mobility are investigated. A new actimeter is presented to monitor the movements of the patient. The second part is dedicated to the presentation of a new imaging technique which can help the physician to control

tissue elasticity of the patient. The technique is called elastography, it is a 3D strain estimation of soft biological tissues. Finally, the last way of investigation is the combination of extrinsic and intrinsic factors evaluation for a most relevant earlier diagnosis. Before the description of these techniques, it is essential to understand the phenomenology associated to the development of pressure sores. Only in this way, new techniques can be developed.

Goldsworthy, R. C. (2008). "Home health aides' beliefs regarding pressure ulcer preventive care." *Home Healthcare Nurse* 26(2): 113-20.

Gray, M. (2007). "Incontinence-related skin damage: essential knowledge." *Ostomy Wound Management* 53(12): 28-32.

Incontinence-associated dermatitis, a clinical manifestation of moisture-associated skin damage, is a common consideration in patients with fecal and/or urinary incontinence. Among hospitalized patients, the prevalence rate has been found to be as high as 27%. Exposure to skin surface irritants may be a predictor and the condition, in turn, may be a factor in pressure ulcer risk because skin integrity is compromised. Differential diagnosis, usually based on visual examination, can help determine whether incontinence-associated dermatitis or a pressure ulcer is present. Prevention comprises following a structured skin care regimen that includes gentle cleansing, moisturization, and application of a skin protectant or moisture barrier. Treatment goals include protecting the skin from further exposure to irritants, establishing a healing environment, and eradicating any cutaneous infection. This

concise review of relevant literature underscores the scant amount of evidence-based information available and highlights the need for further studies that involve comparing protocol and product efficacy to determine best practice for this oft-encountered condition.

Gunes, U. Y. (2008). "A descriptive study of pressure ulcer pain." *Ostomy Wound Management* 54(2): 56-61.

Despite increased emphasis on addressing patient pain, knowledge and information about pressure ulcer pain remains limited. To describe the quantitative and qualitative characteristics of pain related to pressure ulcers, a study was conducted among 47 hospitalized patients with pressure ulcers using the McGill Pain Questionnaire and Revised Faces Rating Scale. Volunteer participants, admitted for neurological disorders, ranged in age from 38 to 72 years (mean age 60.1 years +/- 8.23; 29 men, 18 women), six with Stage II, 32 with Stage III, and nine with Stage IV pressure ulcers. All but three (44, 94.6%) reported pressure ulcer pain; of those, 28 (59.5%) reported constant pressure ulcer pain and 41 (87.2%) did not specify when pain occurred. Dressing change, movement of the afflicted area, and pain at rest were reported by 32 (68.1%), nine (19.1%), and three (6.4%) patients, respectively. "Hot-burning" was the sensory descriptor most frequently used to describe the pain in 52%, 56%, and 67% of Stage II, Stage III, and Stage IV patients, respectively. Three out of six patients with Stage II ulcers rated their pain "discomforting," 32 of 32 with Stage III ulcers rated pain as "distressing," and nine out of nine with a Stage IV ulcer rated their pain as "horrible". Based on the Revised Faces Rating Scale, mean pain intensity was 6.04 +/- 2.78 (range 1 to 10), corresponding to moderate pain. For

overall pain intensity, Patient Pain Index and Faces Rating Scale-Revised scores were highly correlated ($r = 0.90$, $P < 0.001$). Pressure ulcers are painful, most patients report pain as "constant", and pain assessment should be included in all patient care plans.

Hammett, L., T. A. Harvath, et al. (2007). "Remote wound care consultation for nursing homes: using a web-based assessment and care planning tool." *Journal of Gerontological Nursing* 33(11): 27-35; quiz 36-7.

Pressure ulcers represent a particular challenge in long-term care (LTC) facilities, where many frail older adults with reduced mobility reside. Guidelines for preventing and treating pressure ulcers have existed for many years; however, nurses in LTC facilities do not always use best practices in pressure ulcer care. In this article, the authors report on the development and pilot testing of a Web-based pressure ulcer management tool used for remote consultation in LTC.

Heule, E. J. C., R. H. M. Goossens, et al. (2007). "Using an indentation measurement device to assess foam mattress quality." *Ostomy Wound Management* 53(11): 56-62.

Foam mattress quality affects pressure ulcer risk but no reliable method to assess mattress fatigue and indentation is available. To ascertain Indentation Quality values of standard 14-cm (5-inch) foam mattresses after 15 years of use, a convenience sample of 50 visco-elastic foam mattresses from a total of 1,000 same-brand mattresses used in a Dutch University hospital was tested using a durometer.

Indentation Quality values were obtained on the mattress cover at a relatively unloaded zone (corner), at the head and heel zones, the knee and shoulder areas, and in the middle (buttocks area). Indentation Quality values ranged from a mean of -11.91 mm (+/-2.58) in the unloaded zone to a mean of -26.96 mm (+/-4.31) in the middle zone (buttocks area, $P < 0.001$ compared to all other mattress areas). The value at the relatively unloaded zone was significantly and positively related to the values at the head and the heel zones ($r = .70$, $P < .01$) and the knee and the shoulder zones ($r = .33$, $P < .05$). The value at the buttocks zone was positively related to the value at the knee and the shoulder zones ($r = .35$, $P < .05$). The study showed that mattresses that appeared similar had a wide range of indentation values (indicating a need for individual assessments to monitor their quality) and that Indentation Quality values, determined using the durometer, facilitate objective and quantifiable mattress assessments. Consideration of the consequences of foam mattress life span on quality of care, hospital management practices, and cost analysis is justified.

Hommel, A., K. B. Bjorkelund, et al. (2007). "Nutritional status among patients with hip fracture in relation to pressure ulcers." *Clinical Nutrition* 26(5): 589-96.

BACKGROUND & AIMS: Patients with a hip fracture often have a poor nutritional status that is associated with increased risk of complications, morbidity and mortality. The aim of this study was to investigate the effects of an improved care intervention in relation to nutritional status and pressure ulcers. An intervention of best practices for patients with hip fracture was introduced, using the available resources effectively and efficiently with a not too complicated or expensive

intervention. METHODS: A quasi-experimental study of 478 patients consecutively included between April 1, 2003 and March 31, 2004. A new evidence-based clinical pathway was introduced on October 1, 2003. The results from the first 210 patients in the control group and the last 210 patients in the intervention group are presented in this article. RESULTS: The total number of patients with a hospital-acquired pressure ulcer was in the intervention group, 19 patients, and in the control group, 39 patients ($p = 0.007$). No patient younger than 65 years developed a pressure ulcer. There were no statistical significant differences between the groups with respect to blood biochemical variables at inclusion. Patients in the control group had higher arm muscle circumference (AMC) ($p = 0.05$), calf circumference (CC) ($p = 0.038$) and body mass index (BMI) ($p = 0.043$) values. Abnormal anthropometrical tests of BMI, triceps skin fold (TSF) <10th percentile and AMC <10th percentile were found in 12 patients in the control group and in 4 patients in the intervention group. None of the 4 patients in the intervention group developed pressure ulcers. However, 2 of the 12 patients in the control group were affected. CONCLUSIONS: It is possible to reduce the development of hospital-acquired pressure ulcers among elderly patients with a hip fracture even though they have poor prefracture nutritional status. Results in this study indicate the value of the new clinical pathway, as number of patients who have developed pressure ulcers during their stay in hospital has been reduced by 50%.

Hoppe, C., A. Pohler, et al. (2008). "[Pressure ulcers: new data about risk, prevalence and places of development. Results of a study in German nursing homes and hospitals]." *Pflege Zeitschrift* 61(2): 90-3.

In the spring of 2007 the "Institut für Medizin-/Pflegepädagogik und Pflegewissenschaft der Charite-Universitätsmedizin Berlin" conducted a nationwide prevalence study. Data were collected concerning pressure ulcer risk and pressure ulcer prevalence. In addition, data were gathered about place of development, prevalence rates for various clinical specialties within hospitals, and pressure ulcer location. Altogether, data from 6473 patients and residents were collected and analysed. In nursing homes the percentage of persons at risk for pressure ulcer development was 61.4 percent, in hospitals 38.0 percent. The prevalence of pressure ulcers grade 1 to 4 was 8.4 percent in nursing homes and 15.7 percent in hospitals. In nursing homes as well as in hospitals more than half of the pressure ulcers emerged within the same facilities. For 22.6 percent of pressure ulcers in hospitals the place of development remained unknown. In nursing homes this proportion was 5.6 percent.

Huber, J., R. Reddy, et al. (2008). "Increasing heel skin perfusion by elevation." *Advances in Skin & Wound Care* 21(1): 37-41.

OBJECTIVE: To 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. **DESIGN:** A prospective study was used to compare different preventative devices with an elevating prosthesis. **SETTING::** Wollongong Hospital Wollongong, New South Wales, Australia. **PARTICIPANTS:** Normal subjects and subjects with vasculopathy were tested with their heel resting on a hospital bed, medical-grade lamb's wool, or a viscoelastic gel overlay, with or without the test prosthesis. Skin perfusion was measured throughout using a laser Doppler monitor. **INTERVENTION:**

A device designed to elevate the heel off the bed and distribute the weight of the leg and foot on the calf. MAIN OUTCOME MEASURE: Heel capillary blood perfusion. MAIN RESULTS: Perfusion in the heel was significantly greater when elevated than when using the other devices tested. The differences in mean red blood cell flux were significant, with $P < .0001$ for bed-normals, ie, subjects with no peripheral vascular disease on an alpha Xcell mattress overlay as the control with flux increasing from 7.6 to 163.1 arbitrary units (AU); $P < .005$ bed-vasculopathy, ie, subjects with peripheral vascular disease on an alpha Xcell mattress overlay as the control with flux increasing from 31.6 to 224.7 AU; $P < .0001$ viscoelastic overlay subjects where the viscoelastic overlay was the control with flux increasing from 26.6 to 291.4 AU; and $P < .01$ lamb's wool subjects where the lamb's wool was the control with flux increasing from 27.7 AU to 169.2 AU. CONCLUSION: In this study, when the heels were elevated, tissue perfusion to that area was substantially increased. When the heel was transferred to the elevating splint, the heel capillary bed underwent reactive hyperemia, indicating the alleviation of tissue hypoxia. Elevation is therefore an important technique in pressure ulcer prevention and treatment and should be incorporated into health care practice.

Hulsenboom, M. A., G. J. J. W. Bours, et al. (2007). "Knowledge of pressure ulcer prevention: a cross-sectional and comparative study among nurses." *BMC Nursing* 6: 2.

BACKGROUND: Pressure ulcers are a common, painful and costly condition. Results of a 1991 study into the knowledge among Dutch hospital nurses on the usefulness of measures to prevent pressure ulcers showed moderate knowledge.

Results were confirmed by subsequent studies. In recent years, Dutch guidelines have been updated and the attention given to pressure ulcer care has been increased. This was expected to improve pressure ulcer care and to increase nurses' knowledge. The aims of the current study were to investigate (1) how much nurses employed in Dutch hospitals know about the usefulness of 28 preventive measures considered in the most recent national pressure ulcer guideline; (2) whether differences in knowledge exist between nurses working in hospitals that audit pressure ulcers and those employed in hospitals that do not; and (3) to study whether knowledge among Dutch hospital nurses regarding the usefulness of preventive measures had changed between 1991 and 2003. **METHODS:** A cross-sectional study design among nurses employed in Dutch hospitals in 2003 was used to investigate their knowledge and differences in knowledge between nurses employed in different types of institution. A comparative design was used to assess whether knowledge differed between this population and that of Dutch hospital nurses in 1991. The nurses' knowledge was assessed by a written questionnaire. Data of 522 respondents meeting the inclusion criteria were analyzed and compared with the results of the 351 nurses included in the 1991 study. **RESULTS:** Knowledge in 2003 was slightly better than that in 1991. The nurses were moderately aware of the usefulness of preventive measures. Nurses employed in organizations that monitored pressure ulcers did not display greater knowledge than those employed in organizations that did not do so. **CONCLUSION:** Knowledge among Dutch hospital nurses about the usefulness of measures to prevent pressure ulcers seems to be moderate. Being employed in an institution that monitors pressure ulcer care hardly affects the knowledge level. Knowledge about prevention has improved little since 1991.

Karatas, G. K., A. K. Tosun, et al. (2008). "Center-of-pressure displacement during postural changes in relation to pressure ulcers in spinal cord-injured patients." *American Journal of Physical Medicine & Rehabilitation* 87(3): 177-82.

OBJECTIVE: To evaluate the center-of-pressure displacement in spinal cord-injured patients, to investigate dynamic sitting stability and its relationship with pressure ulcers. **DESIGN:** Sixteen spinal cord-injured patients and 18 healthy volunteers were included in the study. For the assessment of dynamic sitting stability, center-of-pressure displacement during maximum unsupported forward, backward, and right- and left-sided trunk leaning were measured with a seat sensor system, which was placed between the subject's buttocks and chair. **RESULTS:** Center-of-pressure displacements in all directions in spinal-injured patients were smaller than healthy volunteers ($P < 0.05$). Center-of-pressure displacements for high- and low-thoracic spinal cord-injured patients were not significantly different. History of previous pressure ulcer was not different between high- and low-thoracic spinal cord-injured patients ($\chi^2 = 0.90$, $P = 0.62$). Mean center-of-pressure displacement during forward and backward leaning were smaller in patients with pressure ulcer history ($P = 0.04$ and 0.03 , respectively). **CONCLUSIONS:** The results of this study suggest that impaired dynamic sitting stability is associated with pressure ulcer development.

Latham, C. L., M. Hogan, et al. (2008). "Nurses supporting nurses: creating a mentoring program for staff nurses to improve the workforce environment." *Nursing Administration Quarterly* 32(1): 27-39.

BACKGROUND: The hospital workforce environment has been recognized as an important factor for nurse retention and patient safety, yet there is ongoing evidence that inadequate communication, intraprofessional oppression, and lack of collaboration and conflict resolution continue to disempower nurses and hinder improvement of workforce conditions. **PURPOSE:** A 3-year academic-hospital partnership developed and used a registered nurse (RN) mentor and advocacy program to improve the RN work environment and selected patient outcomes. **METHOD:** The partnership initiated mentor-mentee teams and a Workforce Environment Governance Board, and obtained preliminary data on outcomes related to mentor-mentee teamwork, changes in the level of support within each unit, and the impact of improved working conditions on nurse and patient satisfaction, nurse vacancy and turnover rates, and 3 patient safety outcomes related to fall and pressure ulcer prevention and use of restraints. **DISCUSSION:** Dedicated mentors not only engaged in supporting fellow nurses but also assisted with enhancing the overall work environment for RNs. The partnership enhanced mutual respect between frontline RNs and managers, and allowed frontline RNs to improve the culture of support. **CONCLUSIONS:** The comprehensive approach to incorporating mentor-mentee teams changes the way fellow nurses and others perceive nurses, augments support by managers and coworkers, and improves patient care outcomes.

Lee, Y.-H., I.-S. Jeong, et al. (2003). "[A comparative study on the predictive validity among pressure ulcer risk assessment scales]." *Daehan Ganho Haghoeji* 33(2): 162-9.

PURPOSE: This study was to compare the predictive validity of Norton Scale(1962), Cubbin & Jackson Scale(1991), and Song & Choi Scale(1991). **METHOD:** Data were collected three times per week from 48-72 hours after admission based on the four pressure sore risk assessment scales and a skin assessment tool for pressure sore on 112 intensive care unit(ICU) patients in a educational hospital Ulsan during Dec, 11, 2000 to Feb, 10, 2001. Four indices of validity and area under the curve(AUC) of receiver operating characteristic(ROC) were calculated. **RESULT:** Based on the cut off point presented by the developer, sensitivity, specificity, positive predictive value, negative predictive value were as follows : Norton Scale : 97%, 18%, 35%, 93% respectively; Cubbin & Jackson Scale : 89%, 61%, 51%, 92%, respectively; and Song & Choi Scale : 100%, 18%, 36%, 100% respectively. Area under the curves(AUC) of receiver operating characteristic(ROC) were Norton Scale.737, Cubbin & Jackson Scale.826, Song & Choi Scale.683. **CONCLUSION:** The Cubbin & Jackson Scale was found to be the most valid pressure sore risk assessment tool. Further studies on patients with chronic conditions may be helpful to validate this finding.

Li, Z., E. C Tam, et al. (2005). "Effect of prolonged pressure on flowmotion: An Investigation Using an in vivo Rat Model." Conference Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine & Biology Society 1: 597-600.

The objectives of this study is to assess the effect of prolonged loading on the skin blood flowmotion in rats as measured by Laser Doppler flowmetry (LDF) using wavelets transform and power spectral in the rat skin microcirculation. External

pressure of 13.3kPa (100 mmHg) was applied to the trochanter area and the distal lateral tibia of Sprague-Dawley rats via two specifically designed pneumatic indentors. The loading duration was 6 hours/day for 4 consecutive days. The results showed that 1) spontaneous rhythmic activities were present in skin blood flow of anesthetized rats, 2) significant decrease of flowmotion power ($p=0.023$ for trochanter and $p=0.043$ for tibia) was found in the frequency range of 0.01-0.04Hz after prolonged loading. Our results suggested that reduced vasomotion in the frequency of 0.01-0.04 Hz might be involved in the mechanisms leading to pressure ulcer formation.

Lim, D., F. Lin, et al. (2007). "Evaluation of a new sitting concept designed for prevention of pressure ulcer on the buttock using finite element analysis." *Medical & Biological Engineering & Computing* 45(11): 1079-84.

Excessive compressive load induces pressure related soft tissue damage, i.e. pressure ulcer (PU), in buttock area in wheelchair users. In solving this problem, our previous study has introduced a concept of Off-Loading sitting, which partially removes the ischial support to reduce pressure under buttocks. However, the effect of this sitting concept has only been evaluated using the interface pressure and tissue perfusion measurements. The objective of this investigation was to evaluate the Off-Loading posture for its ability to reduce internal pressure and stress in deep buttock tissues. This evaluation was performed on a 3D finite element (FE) model which was established and validated in a sitting posture and has realistic material properties and boundary conditions. FE analysis in this study confirmed that the pressure relief provided by Off-Loading posture created profound effect in reducing

the mechanical stress within deep tissues. It was concluded that Off-Loading posture may prove beneficial in preventing sitting related PU.

Linder-Ganz, E., N. Shabshin, et al. (2008). "Strains and stresses in sub-dermal tissues of the buttocks are greater in paraplegics than in healthy during sitting." *Journal of Biomechanics* 41(3): 567-80.

A pressure-related deep tissue injury (DTI) is a severe pressure ulcer, which initiates in muscle tissue overlying a bony prominence (e.g. the ischial tuberosities, IT) and progresses outwards through fat and skin, unnoticed by the paralyzed patient. We recently showed that internal strains and stresses in muscle and fat of individuals at anatomical sites susceptible to DTI can be evaluated by integrating Open-MRI scans with subject-specific finite element (FE) analyzes (Linder-Ganz et al., *Journal of Biomechanics*, 2007); however, sub-dermal soft tissue strains/stresses from paraplegics are still missing in literature. We hypothesize that the pathoanatomy of the buttocks in paraplegia increases the internal soft tissue loads under the IT, making these patients inherently susceptible to DTI. We hence compared the strain and stress peaks in the gluteus muscle and fat tissues under the IT of six healthy and six paraplegic patients, using the coupled MRI-FE method. Peak principal compression, principal tension, von Mises and shear strains in the gluteus were 1.2-, 3.1-, 1.4- and 1.4-fold higher in paraplegics than in healthy, respectively ($p < 0.02$). Likewise, peak principal compression, principal tension, von Mises and shear stresses in the gluteus were 1.9-, 2.5-, 2.1- and 1.7-fold higher for the paraplegics ($p < 0.05$). Peak gluteal compression and shear stresses decreased by as much as 70% when the paraplegic patients moved from a sitting to a lying

posture, indicating on the effectiveness of recommending such patients to lie down after prolonged periods of sitting. This is the first attempt to compare internal soft tissue loads between paraplegic and healthy subjects, using an objective standardized bioengineering method of analysis. The findings support our hypothesis that internal tissue loads are significantly higher in paraplegics, and that postural changes significantly affect these loads. The method of analysis is useful for quantifying the effectiveness of various interventions to alleviate sub-dermal tissue loads at sites susceptible to pressure ulcers and DTI, including cushions, mattresses, recommendations for posture and postural changes, etc.

Makhsous, M., D. Lim, et al. (2007). "Finite element analysis for evaluation of pressure ulcer on the buttock: development and validation." *IEEE Transactions on Neural Systems & Rehabilitation Engineering* 15(4): 517-25.

The interface pressure is currently the only clinical tool to estimate the risk of sitting-related pressure ulcers. However, it provides little information on the loading condition in deep tissues. We present a comprehensive 3-D finite element (FE) model for human buttocks with the consideration of the joint configuration and realistic boundary conditions in a sitting posture. Sitting induced soft tissue deformation, internal pressure, and von-Mises stress were computed. The FE model was well validated qualitatively using actual displacement obtained from magnetic resonance imaging (MRI) images. FE analysis demonstrated that the deformation induced by sitting pressure was substantially different among muscle, fat, and skin. The deformation of the muscle varied with location and the maximum was seen in the regions underneath the bony prominence of ischial tuberosity. In these regions,

the range of compressive pressure was 65-80 kPa, 50-60 kPa, and 55-65 kPa, for skin, fat, and muscle, respectively. The von-Mises stress distribution had a similar pattern. In conclusion, this study suggests a new methodology for the development and validation of FE models for investigating the risk of sitting-related soft tissue injury. The proposed model may provide researchers and therapists with a powerful technique for evaluating the effectiveness of various postural modulations in preventing deep tissue ulcers.

McElhinny, M. L. and C. Hooper (2008). "Reducing hospital-acquired heel ulcer rates in an acute care facility: an evaluation of a nurse-driven performance improvement project." *Journal of Wound, Ostomy, & Continence Nursing* 35(1): 79-83.

PURPOSE: A nurse-driven performance improvement project designed to reduce the incidence of hospital-acquired ulcers of the heel in an acute care setting was evaluated. **DESIGN:** This was a descriptive evaluative study using secondary data analysis. Data were collected in 2004, prior to implementation of the prevention project and compared to results obtained in 2006, after the project was implemented. **SUBJECTS AND SETTING:** Data were collected in a 172-bed, not-for-profit inpatient acute care facility in North Central California. All medical-surgical inpatients aged 18 years and older were included in the samples. Data were collected on 113 inpatients prior to implementation of the project in 2004. Data were also collected on a sample of 124 inpatients in 2006. **METHODS:** The prevalence and incidence of heel pressure ulcers were obtained through skin surveys prior to implementation of the prevention program and following its implementation. Results from 2004 were compared to data collected in 2006 after introduction of the Braden Scale for

Predicting Pressure Sore Risk. Heel pressure ulcers were staged using the National Pressure Ulcer Advisory Panel (NPUAP) staging system and recommendations provided by the Agency for Health Care Quality Research (AHRQ) clinical practice guidelines. RESULTS: The incidence of hospital-acquired heel pressure ulcers in 2004 was 13.5% (4 of 37 patients). After implementation of the program in 2006, the incidence of hospital-acquired heel pressure ulcers was 13.8% (5 of 36 patients). CONCLUSIONS: The intervention did not appear to receive adequate staff nurse support needed to make the project successful. Factors that influenced the lack of support may have included: (1) educational method used, (2) lack of organization approved, evidenced-based standardized protocols for prevention and treatment of heel ulcers, and (3) failure of facility management to convey the importance as well as their support for the project.

McInerney, J. A. (2008). "Reducing hospital-acquired pressure ulcer prevalence through a focused prevention program." *Advances in Skin & Wound Care* 21(2): 75-8.

OBJECTIVE: To provide health care organizations with strategies for decreasing the prevalence of hospital-acquired pressure ulcers. DESIGN: Hospital-acquired pressure ulcer prevalence was measured every 6 months for 4.5 years while multiple strategies were implemented. SETTING: The study took place in a not-for-profit, 548-bed, 2-hospital system in Southwest Florida. PATIENTS: All adult patients with the exception of those admitted for obstetric or mental health care. INTERVENTIONS: An assortment of interventions were implemented, including electronic medical records, risk assessment tied to automatic consults, pressure

relief measures including new equipment and personnel augmentation, and an interdisciplinary team to decide on protocols. MAIN RESULTS: Hospital-acquired prevalence rate for all pressure ulcers was reduced by 81%. The rate for heel ulcers alone was reduced by 90%. CONCLUSION: A pressure ulcer prevention program has been developed, which has shown a trend toward improved patient outcomes with a resultant cost savings.

Meffre, R., C. Gehin, et al. (2007). "MAPI: active interface pressure sensor integrated into a seat." Conference Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine & Biology Society 2007: 1358-61.

The purpose of MAPI project is to propose a method for interface pressure measurement. This method must be exact, easy to build, low cost, and must take into consideration viscoelastic characteristics of the skin and of human morphology. The main areas of the project is related to ergonomics of seating surfaces and prevention of pressure ulcers. An additional stage was performed by developing an electro-pneumatic interface pressure sensor directly integrated into a seat. The sensor is easy to use and presents acceptable characteristics. The average error is 2.58%, and the standard deviation is 1.66 mmHg. Spatial resolution is 3 cm. This first prototype will be improved, with better spatial resolution, and used for different pressure ulcer study and prevention tests.

Meffre, R., C. Gehin, et al. (2006). "New methodology for preventing pressure ulcers using actimetry and autonomous nervous system recording." Conference

Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine & Biology Society 1: 5563-6.

Pressure ulcers constitute an important health problem. They affect lots of people with mobility disorder and they are difficult to detect and prevent because the damage begins on the muscle. This paper proposes a new approach to study pressure ulcers. We aim at developing a methodology to analyse the probability for a patient to develop a pressure ulcer, and that can detect risky situation. The idea is to relate the mobility disorder to autonomic nervous system (ANS) trouble. More precisely, the evaluation of the consequence of the discomfort on the ANS (stress induced by discomfort) can be relevant for the early detection of the pressure ulcer. Mobility is evaluated through movement measurement. This evaluation, at the interface between soft living tissues and any support has to consider the specificity of the human environment. Soft living tissues have non-linear mechanical properties making conventional rigid sensors non suitable for interface parameters measurement. A new actimeter system has been designed in order to study movements of the human body whatever its support while seating. The device is based on elementary active cells. The number of pressure cells can be easily adapted to the application. The spatial resolution is about 4 cm². In this paper, we compare activity measurement of a seated subject with his autonomic nervous system activity, recorded by E.motion device. It has been developed in order to record six parameters: skin potential, skin resistance, skin temperature, skin blood rate, instantaneous cardiac frequency and instantaneous respiratory frequency. The design, instrumentation, and first results are presented.

Meijers, J. M. M., J. M. G. A. Schols, et al. (2008). "Differences in nutritional care in pressure ulcer patients whether or not using nutritional guidelines." *Nutrition* 24(2): 127-32.

OBJECTIVE: Malnutrition, characterized by a loss of lean body mass, enhances the risk of pressure ulcers (PUs). Because the intrinsic risk factor nutritional status in PU development can be influenced by practitioners' interventions, the use of clinical guidelines might be a satisfactory management approach. This study investigated the influence of using nutritional guidelines in daily practice on the actual nutritional care that PU (prone) patients receive, and barriers with regard to providing nutritional support were also explored. **METHODS:** A cross-sectional study was carried out in 1087 hospitals, nursing homes, and home care organizations in the Netherlands, Germany, and the United Kingdom. Because this study focused on comparing nutritional care in daily practice in PU (prone) patients using and not using nutritional guidelines, for the analyses two groups (health care organizations with and without guidelines) were identified. Differences between groups were tested using chi-square test and by analysis of variance. **RESULTS:** Respondents from 363 organizations participated in the study, of which 66.1% used nutritional guidelines for PU care in practice. Significant differences between organizations with nutritional guidelines versus organizations without guidelines were mostly on nutritional screening ($P = 0.001$) and the extent of nutritional assessments that included significantly more weight history recalls, weight measurements, and body mass index measurements (all $P < 0.05$). The most important barrier to providing nutritional support for PU (prone) patients in both groups was knowledge and skills. **CONCLUSION:** Using a nutritional guideline in PU care contributes to the amount of

nutritional screening conducted in daily practice and to the content and extent of the assessment.

Mistiaen, P., W. Achterberg, et al. (2008). "Cost-effectiveness of the Australian Medical Sheepskin for the prevention of pressure ulcers in somatic nursing home patients: study protocol for a prospective multi-centre randomised controlled trial (ISRCTN17553857)." *BMC Health Services Research* 8: 4.

BACKGROUND: Pressure ulcers are a major problem, especially in nursing home patients, although they are regarded as preventable and there are many pressure relieving methods and materials. One such pressure relieving material is the recently developed Australian Medical Sheepskin, which has been shown in two randomized controlled trials 12 to be an effective intervention in the prevention of sacral pressure ulcers in hospital patients. However, the use of sheepskins has been debated and in general discouraged by most pressure ulcer working groups and pressure ulcer guidelines, but these debates were based on old forms of sheepskins. Furthermore, nothing is yet known about the (cost-)effectiveness of the Australian Medical sheepskin in nursing home patients. The objective of this study is to assess the effects and costs of the use of the Australian Medical Sheepskin combined with usual care with regard to the prevention of sacral pressure ulcers in somatic nursing home patients, versus usual care only. **METHODS/DESIGN:** In a multi-centre randomised controlled trial 750 patients admitted for a primarily somatic reason to one of the five participating nursing homes, and not having pressure ulcers on the sacrum at admission, will be randomized to either usual care only or usual care plus the use of the Australian Medical Sheepskin as an overlay on the mattress. Outcome

measures are: incidence of sacral pressure ulcers in the first month after admission; sacrum pressure ulcer free days; costs; patient comfort; and ease of use. The skin of all the patients will be observed once a day from admission on for 30 days. Patient characteristics and pressure risk scores are assessed at admission and at day 30 after it. Additional to the empirical phase, systematic reviews will be performed in order to obtain data for economic weighting and modelling. The protocol is registered in the Controlled Trial Register as ISRCTN17553857.

Morse, L. R., K. Stolzmann, et al. (2008). "Association between mobility mode and C-reactive protein levels in men with chronic spinal cord injury." *Archives of Physical Medicine & Rehabilitation* 89(4): 726-31.

OBJECTIVE: To assess clinical determinants of systemic inflammation in persons with chronic spinal cord injury (SCI). **DESIGN:** Cross-sectional survey. **SETTING:** Veterans Affairs medical center. **PARTICIPANTS:** As part of an epidemiologic study assessing SCI-related health conditions, 63 men with chronic SCI provided a blood sample and information regarding locomotive mode and personal habits. **INTERVENTIONS:** Not applicable. **MAIN OUTCOME MEASURE:** Plasma high-sensitivity C-reactive protein (CRP). **RESULTS:** The mean +/- standard deviation age was 56+/-14y, and participants were assessed 21+/-13y after injury. Adjusting for heart disease, hypertension, and body mass index (BMI), the mean CRP in 12 motorized wheelchair users (5.11mg/L) was not significantly greater than 23 participants who used a manual wheelchair (2.19mg/L) (P=.085) but was significantly greater than the 17 who walked with an assistive device (1.41mg/L) (P=.005) and the 12 who walked independently (1.63mg/L) (P=.027). CRP was

significantly greater in participants with obesity but was not related to age, smoking, or SCI level and severity. CRP was elevated in participants reporting a urinary tract infection (UTI) or pressure ulcer within a year, but adjustment for this did not account for the elevated CRP in motorized wheelchair users. CONCLUSIONS: These results suggest that CRP in chronic SCI is independently related to locomotive mode, BMI, and a history of pressure ulcers and UTI. It is suggested that future studies in SCI investigate whether modifying these factors influence systemic inflammation and cardiovascular health.

Olshansky, K. (2008). "Assessing pressure ulcer risk is different than predicting development of a pressure ulcer." *Journal of Wound, Ostomy, & Continence Nursing* 35(1): 22; author reply 22.

Pagnamenta, F. (2007). "Is fluid filled mattress technology compatible with NICE guidance?" *British Journal of Community Nursing* 12(12): S35-8.

The NICE pressure ulcer guidelines the management of pressure ulcers in primary and secondary care (2005) recommend 'as a minimum provision a high specification foam mattress'. With this statement NICE infers that if quality of care is to be offered, an alternating pressure mattress should be used. In the Newcastle upon Tyne Hospitals NHS Foundation Trust, a new approach to pressure ulcer management has been pioneered, with the introduction of fluid-filled mattresses instead of alternating pressure technology. The Trust has moved to a 98.4% static approach, in effect questioning the NICE guidelines and its recommendations on the

selection of appropriate pressure relieving surfaces. Quarterly studies demonstrate a reduction in the prevalence of pressure ulcers as well as significant savings being made, despite an initial financial outlay. The radical move from alternating pressure technology to fluid-filled static technology has been a success: will the same apply to primary care?

Palacios, A., J. Soares, et al. (2007). "[Pressure ulcer secondary to penile prostheses]." *Archivos Espanoles de Urologia* 60(9): 1.143.

Paquay, L., R. Wouters, et al. (2008). "Adherence to pressure ulcer prevention guidelines in home care: a survey of current practice." *Journal of Clinical Nursing* 17(5): 627-36.

AIMS AND OBJECTIVES: To investigate the pressure ulcer prevalence in home nursing patients and to evaluate guideline adherence of measures for the prevention of pressure ulcers and the participation of informal carers in pressure ulcer prevention. **BACKGROUND:** Since 2002, the Belgian Guideline for the Prevention of Pressure Ulcers was published on the Internet, but no information was available on guideline adherence in home care. **METHODS:** A cross-sectional survey of pressure ulcer prevalence and guideline adherence was performed in a cluster randomized sample of 2779 clients of nine regional nursing departments in Flanders, Belgium. The Belgian Guideline for the Prevention of Pressure Ulcers was the reference standard for the evaluation of the guideline adherence. **RESULTS:** There were 744 subjects at risk for developing pressure ulcers. The overall

prevalence of pressure ulcers for the total sample population was 6.8%. The age-, sex- and risk-standardized prevalence per regional department varied between 4.9% and 9.1%. Of the 744 subjects at risk, 33 (4.4%) received preventive measures, which were in adherence to the Belgian Guideline for Prevention of Pressure Ulcers, 482 persons (64.8%) were administered measures, which did not adhere to the Belgian Guideline for Prevention of Pressure Ulcers and in 229 subjects (30.8%) at risk for developing pressure ulcers, prevention was lacking. For subjects with at least one pressure ulcer, the proportions were: 4.8% adherence, 76.6% no adherence and 18.6% no prevention. A proportion of 22.2% of the patients at risk and their informal carers were informed and motivated by the home care nurse to participate in the pressure ulcer prevention and their actual participation in the prevention was 21.4% of all risk cases. CONCLUSIONS: The adherence of nurses and clients to the guideline for pressure ulcer prevention was low. RELEVANCE TO THE CLINICAL PRACTICE: The study demonstrates a detailed evaluation of guideline adherence to pressure ulcer prevention in an individual patient situation, with special attention for materials and measures, which are not adequate and not recommended by the Belgian Guideline for the Prevention of Pressure Ulcers.

Parish, L. C., M. Dryjski, et al. (2008). "Prospective clinical study of a new adhesive gelling foam dressing in pressure ulcers." *International Wound Journal* 5(1): 60-7.

This prospective, non comparative study evaluated the safety and effectiveness of an adhesive gelling foam dressing in pressure ulcer management. Twenty-three subjects with exuding pressure ulcers were recruited from seven centres in the USA and Canada. Study treatment included an adhesive gelling foam

dressing, optional tape/roll bandaging and mandatory pressure-reducing/relieving devices. Subjects were followed until ulcer healing, for up to 28 days, or on patient withdrawal from the study, whichever came first. Dressings were changed at least once every 7 days. Mean percentage change in ulcer area from baseline to final measurement was -13%. Investigators reported healing or subjective improvement of ulcer condition in 61% of patients. Mean dressing wear time was 4.2 days. Subjects found the dressing was comfortable, soothing and cushioning in situ at 80%, 64% and 70% of dressing changes, respectively. Subjects reported pain severity of none or mild for every dressing change. Fourteen subjects experienced adverse events, including seven subjects with study-related maceration, erythema, wound enlargement, blister or infection. A regimen including an adhesive gelling foam dressing proved to be safe and effective for managing exudate, protecting the surrounding skin, minimising pain and supporting healing of pressure ulcers with exudate.

Rajendran, P. J., J. Leachtenauer, et al. (2006). "Improving the detection of stage I pressure ulcers by enhancing digital color images." Conference Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine & Biology Society 1: 5206-9.

It has been observed in previous studies that the detection of stage I pressure ulcers becomes more difficult by unaided visual inspection and/or by using currently available techniques with darker skin subjects, due to increased melanin content. This difficulty is indicated by the elevated proportion of black and hispanic patients developing more serious stage III and IV pressure ulcers compared to white patients.

The ultimate goal of this project, undertaken by MARC at the University of Virginia, is to develop a low-cost, non-contact imaging-based stage I pressure ulcer detection system for use by support staff in assisted living and skilled nursing facilities to increase the ulcer detection rate over a wide range of skin colors. This paper describes an image enhancement procedure that improves the detection of pressure ulcers when applied to the color images of ulcer sites. Preliminary results clearly indicate that the enhanced images exhibit higher contrast and make the pressure ulcer site more conspicuous to the examiner. The experiments show promising results even for subjects with black and dark brown skin colors.

Rasero, L., C. Fabbri, et al. (2007). "[Prevention of pressure ulcers: retrospective study regarding the effectiveness of an alternate pressure device.]" *Professioni Infermieristiche* 60(4): 237-41.

Pressure ulcers are a significant problem in Public Health. A pressure ulcer is a tissutal lesion caused by different mechanisms such as local pressure, rubbing and dampness. Their frequency increases with age, in hypo-mobile patients, both in hospital and domestic environments. The preminent role of prevention in reducing the incidence and severity of pressure ulcers is supported by many studies; prevention measures are based on frequent changes in the person's posture and/or on the use of alternating pressure mattresses Study objectives : to evaluate the use of alternating pressure mattresses in such patients in terms of : 1- risk factors for ulcer development (Braden); 2- duration (days) of mattress usage; 3- description and incidence of skin lesions at the beginning of the study; 4- any possible changes (improvement/progression) in such lesions when mattress use was suspended.

Appropriate data forms were filled in by nurses at the beginning and at the end of mattress usage. A total of 1,959 persons used the alternating pressure mattresses: of these, 83.62% had a Braden scale rating from 6 to 12, and 43.62% suffered from ulcers. The ulcers improved in 54.62% of the patients, progressed in 7.6%

Resnick, H. E., J. Heineman, et al. (2008). "Diabetes in U.S. nursing homes, 2004." *Diabetes Care* 31(2): 287-8.

The 2004 National Nursing Home Survey collected cross-sectional data for 11,939 nursing home residents aged ≥ 65 years representing approximately 1.32 million individuals. That year, 24.6% of nursing home residents had diabetes as a primary admission and/or current diagnosis. Diabetes was present in 22.5 and 35.6% of white and nonwhite residents, respectively. Diabetic residents were admitted more often from acute care hospitals (42.5 vs. 35.3%), were more likely to have a length of stay ≤ 100 days (22.6 vs. 20.1%), and took more medications (10.3 vs. 8.4). Diabetic residents had 39% higher odds of having emergency department visits in the previous 90 days and 56% higher odds of having a pressure ulcer at the time of the survey. In the U.S. in 2004, one in four nursing home residents aged ≥ 65 years had diabetes, and diabetic residents had increased odds of several unfavorable outcomes that are important for care planning.

Rogers, A. A., S. Burnett, et al. (1995). "Involvement of proteolytic enzymes--plasminogen activators and matrix metalloproteinases--in the pathophysiology of pressure ulcers." *Wound Repair & Regeneration* 3(3): 273-83.

The role of matrix-degrading enzymes, particularly plasminogen activators and matrix metalloproteinases, in the acute wound healing response has been the focus of many scientific studies. Only recently have these classes of endogenously produced proteinases been studied with regard to their involvement in the chronic wound environment. Using both in situ histologic zymography and immunohistochemical techniques, we examined the distribution of plasminogen activators and matrix metalloproteinase in the granulation tissue of pressure ulcers. Using in situ histologic zymography, urokinase was found to be the predominant plasminogen activator activity in the chronic wound granulation tissue, with little or no tissue-type plasminogen activator activity. These results were confirmed with the use of immunohistochemical techniques. In contrast, tissue-type plasminogen activator was found to be constitutively expressed in normal skin. Levels of matrix metalloproteinases were also found to be elevated in the granulation tissue of pressure ulcers. Immunohistochemical localization of leukocyte-associated proteinases (PMN elastase and cathepsin G) suggested a highly inflamed environment within the pressure ulcer granulation tissue. These results suggest a highly proteolytic environment within the chronic wound.

Shahin, E. S. M., T. Dassen, et al. (2008). "Pressure ulcer prevalence and incidence in intensive care patients: a literature review." *Nursing in Critical Care* 13(2): 71-9.

BACKGROUND: Pressure ulcers remain a common health problem worldwide within the different health-care settings, especially in intensive care settings. **AIMS:** The aims of this were to systematically assess the recent prevalence and incidence of pressure ulcers in intensive care patients (2000-2005), the factors related to

pressure ulcer prevalence and incidence and the methodological rigour of studies about pressure ulcer prevalence and incidence in intensive care patients. METHODS: The research design involved a review of literature for the period of 2000 to 2005, focused on the prevalence and incidence of pressure ulcers in intensive care patients. RESULTS: The analysis of published papers revealed variations in pressure ulcer prevalence in intensive care settings ranging from 4% in Denmark to 49% in Germany, while incidence ranged from 38% to 124%. There was a wide variation in the prevalence and incidence of pressure ulcers in intensive care patients as evidenced in the studies examined. There is also a gap between theory and practice in the prevention and treatment of pressure ulcers which needs to be addressed. CONCLUSION: Further research is needed regarding the effectiveness of nursing care on pressure ulcer development and into treatments that may successfully prevent their occurrence in intensive care patients.

Sham, E., W.-T. Choi, et al. (2008). "Lateral supramalleolar flap in reconstruction of pressure ulcers in patients with spinal cord injury." ANZ Journal of Surgery 78(3): 167-71.

Pressure ulcers are a major source of morbidity in patients with spinal cord injury. Soft tissue reconstruction of pressure ulcers around the lateral malleolar region continues to be a challenge. Numerous techniques have been described in the published reports, each with their own limitations. We review our clinical experience with the lateral supramalleolar flap for reconstruction of difficult lateral malleolar pressure ulcers in patients with spinal cord injury. This study is a retrospective review of all patients who underwent this procedure between 1991 and

2005. This fasciocutaneous flap is raised on a peroneal artery perforator as its pedicle, without compromising the three vessels supplying the foot. A split-skin graft is placed on the secondary defect. The patient remains in bed for 4-6 weeks before mobilization is allowed. Eight flaps on seven patients were carried out over the study period. Patients' age ranged from 37 to 67 years (mean 56.6 years). Three patients had procedures carried out on the right and three had on the left. One patient had bilateral procedures. All flaps survived, and there were no recurrences of the pressure areas. One patient had a small area of wound breakdown at the edge of the flap, requiring debridement and split-skin graft. Another patient developed a seroma under the split-skin graft over the secondary defect, which resolved with dressings. The lateral supramalleolar flap is a simple, safe and durable flap for lateral malleolar pressure ulcer reconstruction in patients with spinal cord injury.

Stainier, A., B. Tombal, et al. (2007). "[Fournier's gangrene on ischial pressure ulcer: use of vacuum-assisted closure and therapeutic strategy]." *Progres en Urologie* 17(5): 1000-2.

Vacuum-assisted closure (V.A.C.) was used in two paraplegic patients with Fournier's gangrene in a context of ischial pressure ulcer. This type of dressing facilitated preparation of reconstruction.

Starer, P. (1992). "Cystometric evaluation of elderly nursing home patients with indwelling urinary catheters." *Archives of Gerontology & Geriatrics* 15(1): 79-86.

Due to uncertainties concerning the use of indwelling urinary catheters in institutionalized patients, 15 catheterized nursing home patients (10 women, 5 men, mean age = 85.7 years) were evaluated with cystometric studies in order to determine bladder function. The reasons for indwelling catheter use documented in the medical records were urinary retention (n = 12), urinary incontinence (n = 1) and the promotion of pressure ulcer healing (n = 1). In one case, no reason for catheterization was recorded. Five patients had non-contractile bladders while 2 had voluntary bladder contractions of low amplitude. Three other patients had voluntary bladder contractions, although 2 of them had elevated voiding pressures, suggesting bladder outlet obstruction. All 3 of these patients had their catheters removed. (The 2 patients with elevated voiding pressures received treatment of the obstructions.) The remaining 5 patients had involuntary contractions of the bladder. It is uncertain whether the finding of involuntary bladder contractions can be used to predict the ability of the bladder to empty. Patients with voluntary bladder contractions without evidence of bladder outlet obstruction probably will not experience difficulty after the catheter is discontinued. Patients with evidence of bladder outlet obstruction will need additional intervention prior to catheter removal. Patients with a poorly contractile or a non-contractile bladder would need to be closely monitored for the development of urinary retention after discontinuation of the catheter. An evaluation of urinary function should be undertaken in any nursing home patient with unclear reasons for catheterization.

Struck, B. D. and J. E. Wright (2007). "Pressure ulcers and endothelial dysfunction: is there a link?" *Journal of Nutrition for the Elderly* 26(3-4): 105-17.

Pressure ulcers were first described in the medical literature in the mid-16th century. Today, in the 21st century, pressure ulcers continue to cause pain and suffering to patients and increase the cost of medical care. Researchers and clinicians have used significant time and money to develop prevention and treatment strategies for pressure ulcers. Accepted risk factors for pressure ulcer development include pressure, shear force, friction, moisture and malnutrition. Yet despite procedures to help minimize these risk factors, pressure ulcers are still problematic. Endothelial dysfunction, which is a well-documented cardiovascular risk factor, has been proposed as another risk factor for pressure ulcers. Yet little is known about how pressure ulcers and endothelial dysfunction are linked. In this article we explore the literature to build an argument that research into the role of endothelial function is a plausible line of translational investigation that would contribute greatly to the knowledge base that guides present-day practices in the prevention and treatment of pressure ulcers.

Subbanna, P. K., F. X. Margaret Shanti, et al. (2007). "Topical phenytoin solution for treating pressure ulcers: a prospective, randomized, double-blind clinical trial." *Spinal Cord* 45(11): 739-43.

STUDY DESIGN: Prospective, randomized, double-blind clinical trial. **Objectives:** To evaluate the efficacy of topical phenytoin solution in treating pressure ulcers among patients with spinal cord disorders and to evaluate the systemic absorption of topical phenytoin. **SETTING:** Physical Medicine and Rehabilitation Unit, Christian Medical College, Vellore, India. **METHODS:** Twenty-eight patients with stage 2 pressure ulcers were randomized to receive either

phenytoin solution (5 mg/ml) or normal saline dressing on their ulcers once daily for 15 days. Efficacy of the treatment was determined by assessing the reduction in Pressure Ulcer Scores for Healing (PUSH 3.0), ulcer volume and ulcer size as on day 16. Serum phenytoin concentrations were estimated to determine the systemic absorption of topical phenytoin. RESULTS: Statistically insignificant but marginally higher reduction in PUSH 3.0 scores and ulcer size were seen with topical phenytoin treatment. Systemic absorption of topical phenytoin was negligible. No adverse drug events were detected during the study. CONCLUSIONS: Phenytoin solution is a safe topical agent that accelerates healing of pressure ulcers. However, its efficacy is only slightly more than normal saline treatment.

Suriadi, H. Sanada, et al. (2008). "Development of a new risk assessment scale for predicting pressure ulcers in an intensive care unit." *Nursing in Critical Care* 13(1): 34-43.

AIMS AND OBJECTIVES: The study aimed to evaluate the predictive validity and accuracy of a new pressure ulcer risk assessment scale in two Indonesia intensive care units (ICUs). BACKGROUND: Several risk assessment scales have been designed to identify patients at risk of developing pressure ulcers in ICU. However, the relative weight of each variable that contributes to pressure ulcer development in these scales is not described to enable designing of a risk assessment scale. Currently, the risk factors contributing to pressure ulcer development include interface pressure, body temperature and cigarette smoking. DESIGN: A prospective cohort study was conducted in two ICUs in Pontianak, Indonesia. METHODS: A total of 253 patients were recruited to the study from both

hospitals. Data collection included new risk assessment scale [i.e. the Suriadi and Sanada (S.S.) scale] scoring, demographic, pressure ulcer severity scores (based on the National Pressure Ulcer Advisory Panel) and skin condition measures. Using the S.S. scale, trained data collectors scored patients once and assessed the body temperature daily until patients were discharged. Additionally, daily data were also collected in relation to the patient's skin condition and stage of pressure ulcer.

RESULTS: Out of the 253 patients, 72 (28.4%) developed pressure ulcers. In ICU A, the incidence was 27%; pressure ulcers developed into stage I (41.7%), stage II (45.8%), stage III (10.4%) and stage IV (2.1%). In ICU B, the incidence was 31.6%; the development of pressure ulcers was 48% in stage I and 52% in stage II. Using the predictive validity test, the S.S. scale balanced sensitivity (81%) and specificity (83%) at a cut-off score of 4. The area under the receiver-operating characteristic curve was 0.888 (confidence interval: 0.84-0.93).

CONCLUSION: The S.S. scale was found to be a valid risk assessment tool to identify the patients at risk of developing pressure ulcers in Indonesia ICU.

Theilla, M., P. Singer, et al. (2007). "A diet enriched in eicosapentanoic acid, gamma-linolenic acid and antioxidants in the prevention of new pressure ulcer formation in critically ill patients with acute lung injury: A randomized, prospective, controlled study." *Clinical Nutrition* 26(6): 752-7.

BACKGROUND & AIMS: Pressure ulcers are a significant burden in the ICU. Many factors have found to be associated with pressure ulcers including malnutrition. While it has been recognized that high protein diets decrease the incidence of pressure ulcers, the role of lipids as well as vitamins and antioxidants

remains unclear. The aim of this study was to evaluate the preventive and healing effects of an enteral diet enriched in eicosapentanoic acid (EPA) and gamma-linolenic acid (GLA) and vitamins (vitamins A, C and E) on pressure ulcers. METHODS: One hundred patients with acute lung injury were included in a larger study evaluating the effects of lipids and vitamins on respiratory function. A secondary end point, occurrence and healing of pressure ulcers was included. A diet enriched in lipids (EPA, GLA) and vitamins (vitamins A, C and E) was compared with a diet similar in macronutrient composition. The occurrence and healing of pressure ulcers was evaluated according to the National Pressure Ulcer Panel. Nutritional assessment included calorie intake, resting energy expenditure, levels of serum prealbumin, albumin, vitamins A and E, zinc and copper. C-reactive protein and procalcitonin were also measured. RESULTS: Patient's age, severity of disease and gender distribution were similar in the two groups. The study group had a higher body mass index. At baseline, the pressure ulcer score was similar in the two groups. A significantly lower rate of occurrence of new pressure ulcers was observed in the study group compared to the control group ($p < 0.05$). No difference was observed in the healing of existing pressure ulcers in the study as opposed to the control group. There was no significant difference in the nutritional parameters between the two groups. CONCLUSIONS: A diet enriched with EPA, GLA and vitamins A, C and E is associated with a significantly lower occurrence of new pressure ulcers in critically ill patients with acute lung injury.

Thomas, D. R. (2001). "Are all pressure ulcers avoidable?" *Journal of the American Medical Directors Association* 2(6): 297-301.

A quality of care debate centers on whether pressure ulcers result from factors largely dependent on caregivers, or whether pressure ulcers result from factors associated with patient morbidity. A reduction in incidence, defined as the development of a new pressure ulcer, is the focus of prevention strategies. Yet epidemiological data demonstrates a stability in the incidence of pressure ulcers despite drastic improvements in understanding of pressure ulcers, increased regulatory oversight, and improvements in technologies available for prevention of pressure ulcers. The explanation for this stable incidence of pressure ulcers includes a failure of known effective preventive treatment to be applied or the failure of prevention strategies to be effective in spite of being applied. No intervention strategy has been reported that consistently and reproducibly reduces the incidence of pressure ulcers to zero. The published data on prevention of pressure ulcers do not support an assumption that all pressure ulcers are preventable. An effective prevention strategy demonstrated to eliminate pressure ulcers across healthcare settings is lacking.

Vangilder, C., G. D. Macfarlane, et al. (2008). "Results of nine international pressure ulcer prevalence surveys: 1989 to 2005." *Ostomy Wound Management* 54(2): 40-54.

Pressure ulcers continue to be a significant problem for patients and healthcare facilities. Since 1989, results from the International Pressure Ulcer Prevalence trade mark surveys - observational, cross-sectional cohort studies - conducted by Hill-Rom(R), Batesville, Ind, have been used to document aggregate prevalence rates and provide acute care, long-term acute care, and long-term care facilities with internal and external benchmarks of process improvement. During each

of the nine surveys conducted between 1989 and 2005, clinical teams in participating facilities predominantly in the US (some facilities in Canada, Saudi Arabia, and Australia participated after 2003) assessed admitted patients on assigned study dates. For this study, trends using all records (n = 447,930; average, 49,770 per year) were reviewed. The majority of facilities in each survey year were in the US (99% overall). Overall and nosocomial pressure ulcer prevalence rates ranged from 9.2% and 5.6% in 1989 to 15.5% and 10% in 2003 and 2004, respectively. The highest prevalence was documented in long-term acute care (27.3% overall, 8.5% nosocomial). Most commonly, ulcers were located at the sacrum (28%), heels (23.6%), and buttocks (17.2%). Ulcers were more commonly assessed as Stage I and Stage II (>70%). However, in patients with dark skin tone (2004 and 2005 data, n = 162,296), 13% of identified ulcers were Stage I compared to 32% in patients with medium and 38% in patients with light skin tone. Using the most complete data sets (2003, 2004, and 2005), more severe pressure ulcer prevalence (Stage III+) was not found to be age-related. Approximately 48% of all patients who had pressure ulcers and 48% of patients with nosocomial pressure ulcers were assessed at mild or no risk (Braden scale score >14). Prevalence within the Braden Score risk categories aligned with risk for developing pressure ulcers. Despite increased attention to the pressure ulcer problem, prevalence rates from the last five survey years are relatively unchanged.

Wang, Q., L. Kong, et al. (2006). "Portable gage for pressure ulcer detection." Conference Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine & Biology Society 1: 5997-6000.

Pressure ulcers are widely considered to be a critical problem in rehabilitation since they result in severe discomfort and high healthcare cost. The prevention of pressure ulcers is a constant preoccupation for every nursing team. This paper introduces a novel handheld instrument that can detect subtle changes in the skin biomechanical properties by measuring its biomechanical response. This could be used to detect stage-I pressure ulcers and deep tissue injury. Its high bandwidth makes it possible to load the skin under wide range of conditions. The instrument is portable, inexpensive, and intrinsically precise. Several experiments were conducted to validate the function of the device. Preliminary results show that the device could effectively measure the difference in the viscoelasticity between human skin of different sites, hence paving the way for the development of clinical protocols and trials.

Werkman, H., P. Simodejka, et al. (2008). "Partnering for prevention: a Pressure Ulcer Prevention Collaborative project." *Home Healthcare Nurse* 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.

Wong, V. K., N. A. Stotts, et al. (2007). "How heel oxygenation changes under pressure." *Wound Repair & Regeneration* 15(6): 786-94.

The mechanism of heel pressure ulcers after hip surgery is not entirely understood. The purpose of this one-group, prospective, repeated-measures design study was to examine how the external pressure of the bed surface affects heel skin oxygen tension in adults on the first 3 days after hip surgery. Transcutaneous oxygen sensors were placed on the plantar surface of each foot, close to the heels. Measures were taken on room air and with an oxygen challenge with the heels (1) suspended above the bed surface (preload), (2) on the bed surface for 15 minutes (loading), and (3) again suspended above the bed surface for 15 minutes (unloading). Eighteen hip surgery patients (mean age 58.3+/-16.1 years) from two hospitals participated. When compared with preload on room air, both loading and unloading on all 3 days resulted in a reduction in heel oxygen tension bilaterally ($p < 0.001$). Heel oxygenation decreased without the anticipated hyperemic response, raising the question of whether this is a sign of increased pressure ulcer risk. Further work is needed to understand why this short period of external pressure results in decreased oxygenation and why oxygen tension does not return to baseline when pressure is removed.

Yang, Y. and J. Wang (2005). "A design of bioimpedance spectrometer for early detection of pressure ulcer." *Conference Proceedings: ... Annual International Conference of the IEEE Engineering in Medicine & Biology Society* 6: 6602-4.

Prevention of pressure ulcer (PU) has been hampered for a long time by limitations of present risk assessment methodologies for carers. This paper

introduces a novel solution of a portable bioimpedance spectrometer (BIS), which is designed to detect in vivo subtle changes in electrical properties of tissues at the portentous onset of PU and thereby establish a reliable assessment method for early detection of PU. The principle of the modified tetrapolar method applied in BIS and system designing methodology are explained thoroughly in this paper. The BIS system can measure complex impedance of human tissues over a wide range of frequencies from 10Hz to 1MHz based on direct digital synthesis (DDS) technique. Different from conventional bioimpedance measuring systems based on phase sensitive detection, the new BIS system shows its integrity in theoretical analysis and simplicity in practical implementation. As an objective, fast, straightforward, and inexpensive technique that captures fundamentally different information than subjective assessment and optical judgment, the new BIS may bring to clinical use for risk assessment of PU in the future.

Zhong, W., A. Ahmad, et al. (2008). "Impact of textiles on formation and prevention of skin lesions and bedsores." *Cutaneous & Ocular Toxicology* 27(1): 21-8.

A bedsore or pressure ulcer is an area of localized damage to the skin and underlying tissue caused by pressure, shear, friction, or a combination of these factors. In countries with a large geriatric population like Canada, this healthcare threat presents a significant risk to hospitalized patients, imposing huge cost on both treatment and care for patients. The role textiles play in the formation and prevention of pressure ulcers is understudied. The fact remains, textiles, such as clothing and bedding, have a considerable influence on factors, such as pressure, shear/friction, and skin hydration, which contribute to skin ulceration. Our work is a pilot study to

investigate the role of textile products in the formation and prevention of bedsores. This study began with a survey study at a local long-term care facility, collecting information about incidences of bedsores and the physical conditions of residents. Information was also collected about the textile products that have been used by the residents. Correlations were established between these products and the incidence/severity of bedsores. Immobility of residents was determined to be a significant factor of causing skin lesions and pressure ulcers. Immobility of residents contributes to a prolonged interaction between skin and fabrics and might increase the chances of skin lesions or bedsores.