

Prediction and Prevention of Pressure Ulcers in Adults



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MOH NURSING CLINICAL PRACTICE GUIDELINES 1/2001

Prediction and Prevention of Pressure Ulcers in Adults

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STATEMENT OF INTENT

This set of guidelines aims to serve as a guide for practitioners who are involved in caring or treating patients at risk of pressure ulcer development. Recommendations made are based on best available evidence at the time of guideline development.

Every practitioner is accountable and responsible for the management of patients at risk of pressure ulcer development. It is recommended that individual practitioners assess the appropriateness of the recommendations with regards to individual patient condition, overall treatment goal, resource availability, institutional policies and treatment options available before adopting any recommendation in clinical practice.

FOREWORD

Pressure ulcers constitute an important cause of morbidity particularly amongst frail elderly and physically disabled patients. The presence of pressure ulcers often makes the patient's medical care more complicated and reduces the patient's quality of life.

Most pressure ulcers can be prevented. Hence, active measures must be adopted to address this challenge. The Ministry of Health established a nursing workgroup to prepare clinical practice guidelines on the prediction and prevention of pressure ulcers. These guidelines were adapted from the "Pressure ulcers in adults: prediction and prevention" guidelines by Agency for Healthcare Research and Quality.

We are pleased to present these guidelines to all healthcare professionals involved in the care of adults at risk of pressure ulcer development and urge that they be applied systematically for the benefit of our patients.

PROFESSOR TAN CHORH CHUAN
DIRECTOR OF MEDICAL SERVICES



AHCPR version can be viewed at <http://www.ahcpr.gov/clinic/cpgonline.htm>

CONTENTS

1. Introduction	7
2. Development of Guidelines	12
3. Executive Summary of Recommendations	15
4. Assessment and Identification of Patients at Risk	19
5. Skin Care and Nutrition	27
6. Management of Tissue Loading	32
7. Education Programmes	41
8. Clinical Audit	44
9. Implementation of Guidelines	45
10. Workgroup Members	46
11. References	47
Annex 1 - Key Outcome Indicators	57

1. INTRODUCTION

1.1 Background

Pressure ulcers have significant impact on the health status of patients and a country's health care costs. It is estimated that the treatment of pressure ulcers cost the US healthcare system about \$8.5 billion annually (Kuhn and Coulter 1992). Studies have indicated that older age is a potential risk factor for the development of pressure ulcers (Berlowitz and Wilking 1989; Ministry of Health (MOH) Nursing Department 1998). There is a four-fold increase in the risk of death among elderly with pressure ulcers (Burd et al 1992).

In Singapore, the population is aging rapidly. It is projected that by 2030, the proportion of elderly (age 65 years and above) in the population will increase to 18.4% (MOH 1999). An increase in lifespan due to advances in medical technology and treatment modalities may also cause an increase in the number of elderly developing pressure ulcers.

Literature reviewed indicated that most pressure ulcers can be prevented (Bergstorm et al 1992). However, even the most vigilant nursing care may not prevent the development and worsening of ulcers in some very high-risk individuals. In these cases, intensive therapy must be aimed at reducing risk factors, implementing preventive measures and treating pressure ulcers (Bergstrom et al 1992).

1.2 Definition of Pressure Ulcers

Pressure ulcers are also known as bedsores and decubitus ulcers. Literature that were reviewed indicated that most definitions of pressure ulcers include the cause and location of pressure ulcers. Therefore, the MOH Nursing Clinical Practice Guidelines Workgroup for Prediction and Prevention of Pressure Ulcers define a pressure ulcer as:

'an area of localised damage to the skin, muscle and underlying tissue, caused by shear, friction or unrelieved pressure, usually over bony prominences'.

1.2.1 Staging of Pressure Ulcers

The workgroup has adopted the pressure ulcer staging definitions by the National Pressure Ulcer Advisory Panel (NPUAP 1989):

Stage I : Non-blanchable erythema of intact skin; the heralding lesion of skin ulceration. Note: Reactive hyperaemia can normally be expected to be present for one-half to three-fourths as long as the pressure occluded blood flow to the area; it should not be confused with a Stage I pressure ulcer.

Stage II : Partial thickness skin loss involving epidermis and/or dermis. the ulcer is superficial and presents clinically as an abrasion, blister, or shallow crater.

Stage III : Full thickness skin loss involving damage or necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia. the ulcer presents clinically as a deep crater with or without undermining of adjacent tissue.

Stage IV: Full thickness skin loss with extensive destruction, tissue necrosis, or damage to muscle, bone or supporting structures. Undermining and sinus tracts also may be associated with Stage IV pressure ulcers.

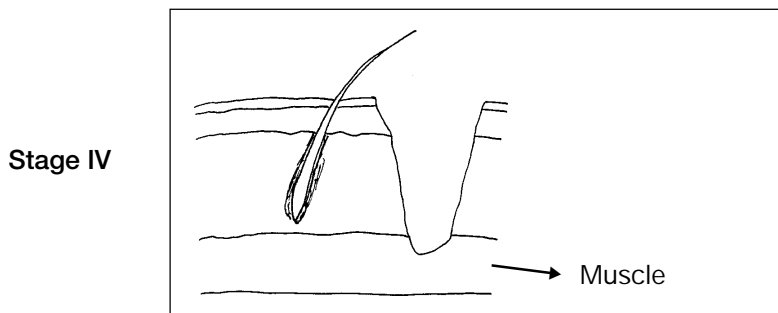
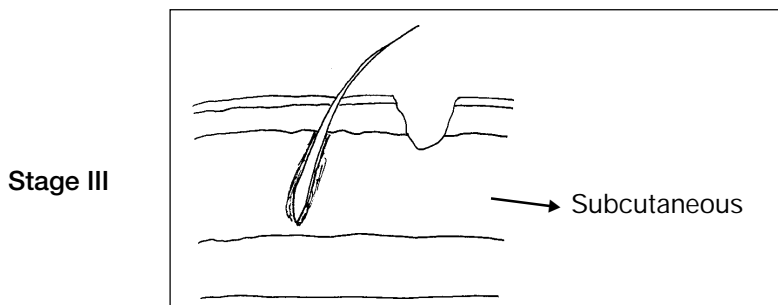
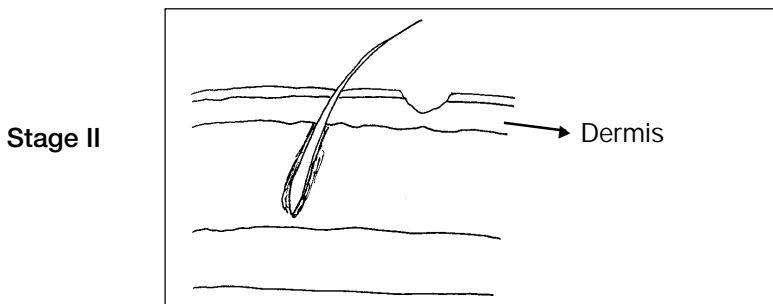
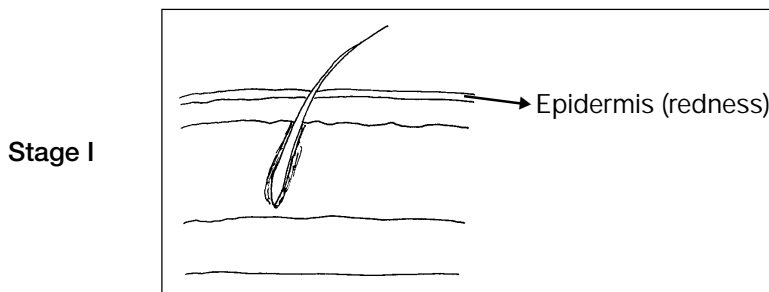
NB: When eschar is present, accurate staging of pressure ulcer is not possible until the eschar has sloughed or the wound has been debrided.

Figure 1 provides a diagrammatic presentation of pressure ulcers at various stages.

1.3 Incidence and Prevalence

Incidence reflects the number of new cases detected during a specified period and prevalence indicates a cross-sectional count of the number of cases at a specific point in time. However, incidence and prevalence of pressure ulcers are difficult to determine because of methodological barriers that prevent generalisation from available data (Bergstrom et al 1992).

Figure 1 Provides a diagrammatic presentation of pressure ulcer at various stages.



The NPUAP (1989) Consensus Development Conference has identified these methodological limitations to the interpretation of incidence and prevalence studies. These limitations are:

- i) difficulty in comparing various populations (i.e. data collected in tertiary care hospitals are not likely to reflect community hospital populations)
- ii) different data sources which can range from direct observation of patients by trained research personnel to retrieval of data from patient records
- iii) confounding methods of analysing incidence and prevalence of pressure ulcers and
- iv) exclusion of Stage I pressure ulcers in the population.

In the USA, the reported incidence of pressure ulcers amongst hospital patients varies from a low of 2% to a high of 40% (Allman et al 1986; Shannon and Skorga 1989; Goodrich and March 1992).

In Singapore, a small scale research study (evidence level III) conducted within the acute care and rehabilitative settings of three hospitals indicated that the prevalence of pressure ulcers range from 9% to 14% and incidence of 5% to 16% (MOH Nursing Department 1998). This study did not examine the incidence and prevalence among patients in nursing homes and those nursed at home. Currently, there is a lack of research on the prevalence or incidence of pressure ulcers in Singapore.

1.4 Scope of the Guidelines

The overall purpose of these guidelines is to prevent pressure ulcer development in adult patients who are at risk and to manage Stage I pressure ulcers.

The guidelines are not applicable to adults who are fully active or mobile, patients with existing Stage II or greater pressure ulcers, and neonates and children.

The guidelines aim to:

- (a) identify patients at risk of pressure ulcer development;
- (b) specify nursing interventions that promote tissue tolerance to pressure;
- (c) specify interventions that protect patients against external pressure, shear and frictional forces and;
- (d) improve patient outcomes through educational programmes for practitioners and carers.

The guidelines are intended for nurses and other health care personnel who provide care and treatment for adults at risk of developing pressure ulcers. It is applicable to patients in the acute care setting and rehabilitative care setting (institution/home).

2 DEVELOPMENT OF GUIDELINES

2.1 Literature Review

The recommendations are based mainly on the Agency for Healthcare Research and Quality (AHRQ, formerly Agency for Health Care Policy and Research, AHCPR) guidelines “Pressure Ulcers in Adults: Prediction and Prevention” (Bergstrom et al 1992). As the AHRQ guidelines were based on a comprehensive review of available evidence up to 1991, the workgroup reviewed relevant published literature and evidence relating to the prevention of pressure ulcers from 1991 onwards. The online resources used included: MEDLINE, CINAHL, AHRQ website, NPUAP website, the Joanna Briggs Institute for Evidence Based Nursing and Midwifery website and the National Health Service (NHS) Centre for Reviews and Dissemination website.

The workgroup also conducted a review of prevailing clinical practice in Singapore by studying the various guidelines and documents used by local hospitals and institutions.

In areas where available evidence was inconsistent or inconclusive, recommendations were made based on the clinical experience and judgement of the workgroup members or expert committee reports.

2.2 Evaluation of Evidence

The workgroup adopted a structured process in the evaluation of evidence. Factors such as research design (include sampling methods, measurement methods, internal validity, external validity, conclusion validity), consistency of results from different studies, resource limitations, feasibility of implementation and patient preferences were reviewed.

2.3 Evidence Criteria

For the definition of the strength of evidence and the grading of recommendations in the guidelines, the workgroup adopted the criteria used by the Scottish Intercollegiate Guidelines Network (SIGN).

2.3.1 Levels of Evidence

Level	Type of Evidence
Ia	Evidence obtained from meta-analysis of randomised controlled trials.
Ib	Evidence obtained from at least one randomised controlled trial.
IIa	Evidence obtained from at least one well-designed controlled study without randomisation.
IIb	Evidence obtained from at least one other type of well-designed quasi-experimental study.
III	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.
IV	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

2.3.2 Grades of Recommendation

Grade	Recommendation
A (evidence levels Ia, Ib)	Requires at least one randomised controlled trial as part of the body of literature of overall good quality and consistency addressing the specific recommendation.
B (evidence levels IIa, IIb, III)	Requires availability of well conducted clinical studies but no randomised clinical trials on the topic of recommendation.
C (evidence level IV)	Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates absence of directly applicable clinical studies of good quality.
GPP (good practice points)	Recommended best practice based on the clinical experience of the guideline development group.

2.4 Guidelines Review

The set of guidelines was circulated to hospitals and institutions for peer review and evaluation of the recommendations in clinical practice.

These guidelines will be revised and updated periodically to incorporate the latest relevant research evidence and expert clinical opinions.

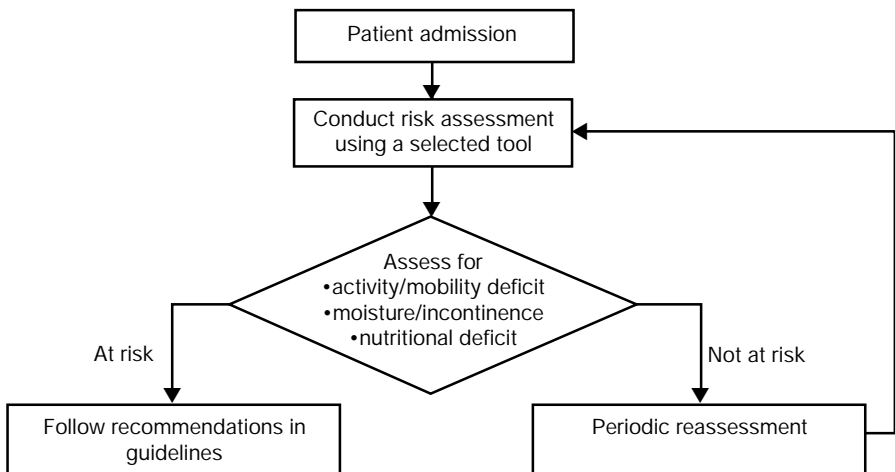
2.5 Limitations

The workgroup recommends that individual practitioners assess the appropriateness of the recommendations with regards to patient's condition, overall treatment goal, resource availability, institutional policies, available treatment options and any recent research findings before adopting any recommendation in clinical practice.

2.6 Decision and Management Flowchart

The flowchart below illustrates the procedure flow, decision points and recommended practices discussed in the guidelines.

Figure 2 Pressure ulcer prediction and prevention flowchart.



3 EXECUTIVE SUMMARY OF RECOMMENDATIONS

Nursing Assessment

On admission, patients with mobility deficit and impaired ability to reposition should be assessed for additional contributing factors such as incontinence and impaired nutritional status that increase their risk of developing pressure ulcers.

Grade A, Level Ib

Risk Assessment Tools

During assessment, use a reliable and validated risk assessment tool such as the Braden Scale to complement good clinical judgement and observation.

Grade A, Level Ib

If the Braden Scale is selected, institutions should establish a risk assessment threshold score (e.g. 16), that is sensitive and specific to their clinical settings.

Grade A, Level Ib

Conduct risk assessment for patients with mobility deficit within two hours of admission to any health care facility.

Grade A, Level Ib

Assessment should also be implemented at 72-hour intervals, following a change in clinical condition or a significant clinical event, such as post-surgery, prolonged procedures, and at regular intervals for chronically ill patients.

Grade A, Level Ib

Skin Assessment and Cleansing

Individuals at risk of pressure ulcer development should have a systematic skin assessment at least once a day. Particular attention should be given to bony prominences. The assessment should be documented.

Grade C, Level IV

The skin should be cleansed routinely and at time of soiling. During cleansing, use warm water and a mild cleansing agent that minimises irritation and skin dryness.

Grade C, Level IV

Application of Topical Agents

Minimise environmental factors that lead to skin dryness (e.g. exposure to cold). Apply moisturiser to dry skin.

Grade C, Level IV

Moisture Control

Minimise skin exposure to moisture due to perspiration, incontinence or wound drainage.

Grade C, Level IV

Underpads may be used where skin exposure to moisture cannot be controlled.

Grade C, Level IV

Topical agents can be applied to areas frequently exposed to moisture.

Grade C, Level IV

Massage

Do not massage areas at risk of pressure ulcer development.

Grade B, Level III

Nutrition

Determine patient's nutritional status by assessing the nutritional risk factors.

Grade C, Level IV

Give dietary support and advice.

Grade A, Level Ib

Consult the physician and dietician where dietary intake remains inadequate and interventions such as enteral or parenteral feedings should be considered.

Grade GPP

Positioning

For bed-ridden patients who are at risk, reposition them at least 2-hourly if there are no contraindications. Draw up an individual written positioning schedule.

Grade C, Level IV

Use positioning devices such as pillows or foam wedges to keep bony prominences from direct contact with one another.

Grade C, Level IV

When in lateral position, avoid positioning directly on bony prominences (e.g. trochanter).

Grade C, Level IV

Keep the head of the bed at the lowest angle (about 30 degree) unless contraindicated.

Grade C, Level IV

Use lifting devices and correct lifting techniques during transfer and repositioning.

Grade C, Level IV

Pressure-Relieving Devices

Place at risk patients on pressure-relieving devices whilst they are in bed (foam, gel, static air or alternating air mattress or overlay).

Grade B, Level III

For patients who are completely immobile, raise their heels off the bed or use pressure-relieving devices.

Grade C, Level IV

For patients who are chair-bound, use pressure-relieving devices such as foam, air or gel cushions.

Grade C, Level IV

Individuals at risk should avoid sitting for prolonged period on a chair or wheelchair. Patients who are able should be taught to shift their weight every 15 minutes. Those who need assistance should be repositioned at least hourly or be put back to bed.

Grade C, Level IV

Do not use donut-shaped devices as pressure-relieving devices.

Grade C, Level IV

Do not use water-filled gloves as pressure-relieving devices.

Grade B, Level IIb

Educational Programmes

Educational programmes should be structured, organised, comprehensive and directed at all levels of healthcare providers, patients and families or caregivers.

Grade A, Level Ib

Design, develop and implement educational programmes with an overall goal of reducing the incidence of pressure ulcers in the healthcare settings.

Grade A, Level Ib

Educational programmes must be conducted on a regular basis and include new techniques or technologies.

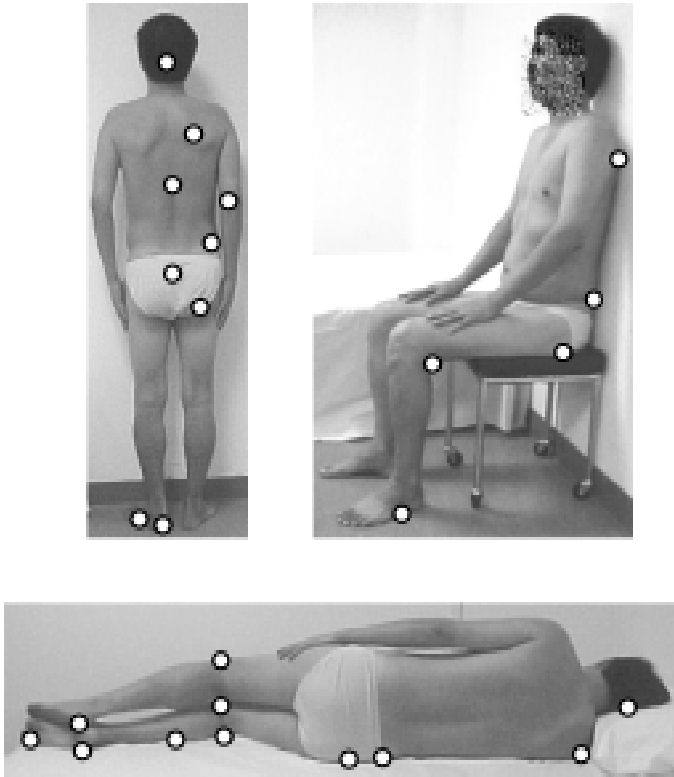
Grade C, Level IV

4 ASSESSMENT AND IDENTIFICATION OF PATIENTS AT RISK

4.1 Aetiology

The critical determinants of pressure ulcers are the intensity and duration of pressure and the tolerance of the skin and supporting structures to pressure. Tissue tolerance to pressure is influenced by both intrinsic and extrinsic factors (Bergstrom et al 1987). The risk factor categories are: immobility and inactivity, friction and shear, older age, moisture, nutrition, sensory perception, disease conditions, psychological factors and stress, and other factors (Bergstrom et al 1992). Figure 3 shows the pressure points at particular risk of ulcer development.

Figure 3 Pressure points when lying on back, when sitting and when lying on side.



4.1.1 Immobility and Inactivity

The most important risk factor for pressure ulcer is immobility (Bergstrom et al 1992; Allman et al 1995). Sustained localised pressure can lead to impairment of blood flow to compressed areas, retardation of venous return, causing oedema that further compromise the oxygen supply of the skin (Yarkony 1994). The most frequently cited measurement of 32mmHg arterioles capillary-closing pressure and the 12mmHg venules capillary-closing pressure (Landis 1930) are questioned by other findings. Ek and colleagues (1987) found that a pressure of 11mmHg caused capillary occlusion in some patients with hemiplegia. Time is also a relevant factor. Damage can occur when pressure is applied for a prolonged duration (Norton et al 1962; Knox et al 1994). Being bed or chair-bound, requiring assistance of daily living and having limb contractures are all important risk factors to pressure ulcer development (Berlowitz and Wilking 1989).

4.1.2 Friction and Shear

Skin shear occurs when the skin remains fixed and the underlying tissue shifts. This shift stretches and bends the vessels perfusing the overlying skin, leading to inhibited blood flow, skin ischaemia and tissue damage. For example, shear is exerted when the head of the bed is elevated and when the individual slides down a chair (Maklebust and Sieggreen 1996). Frictional trauma to skin occurs when skin is pulled or dragged over bed linen (Bergstrom et al 1992).

Though many authors (eg. Dinsdale 1974; Bennett and Lee 1985) have cited friction and shear forces as contributing factors for the development of pressure ulcers, few studies have attempted to assess the association between an individual's potential for exposure to friction and shear and the risk of pressure ulcers (Bergstrom et al 1992).

4.1.3 Age

Studies involving elderly patients have found significant differences in age when comparing subjects with and without pressure ulcers (Roberts and Goldstone 1979; Berlowitz and Wilking 1989). In the MOH (1998) study, 78% of the patients who developed pressure ulcers were above 60 years old.

As age increases, there is a greater likelihood for reduced capillary skin perfusion and collagen regeneration, both of which are essential for wound healing. Poor skin turgor, prolonged capillary refill and impaired mental status are also potential risk factors for pressure ulcer formation in the elderly (Young 1989).

4.1.4 Moisture

Frequent or excessive contact with moisture can reduce the tensile strength of the skin, resulting in skin breakdown (Longe 1986). Five studies, with Stage II to IV ulcers as outcomes, found that moisture in the form of faecal or urinary incontinence have been significantly associated with pressure ulcer development (Lowthian 1976; Okamoto et al 1983; Allman et al 1986; Allman 1991; Schue and Langemo 1999). However, in studies of ulcers at Stage I or greater, Lofgren and colleagues (1989) found an association between faecal incontinence and pressure ulcer development, but the association was not of statistical significance.

4.1.5 Nutrition

Essential nutrients are necessary for maximum tissue health, healing potential and immunity to infection (Holmes et al 1987; Takeda et al 1992).

Impaired nutritional status, such as poor food intake, weight loss, low triceps skinfold, low serum albumin, low haemoglobin and low total lymphocytes count can significantly predispose elderly patients to pressure ulcer (Holmes et al 1987; Bergstrom & Braden 1992; Olson et al 1996; Pieper et al 1997; Raliff and Rodeheaver 1999; Schue and Langemo 1999).

4.1.6 Sensory Perception

Three prospective studies of Stage II or greater pressure ulcers found that altered level of consciousness is associated with increased risk (Gosnell 1973; Berlowitz and Wilking 1989; Allman 1991). However, prospective studies of Stage I or greater pressure ulcers have not reported this association (Bergstrom et al 1992).

4.1.7 Disease Conditions

Several studies indicated that diseases which limit mobility, blood supply or oxygenation of tissues are associated with pressure ulcer development (Allman et al 1986; Charlson et al 1986; Berlowitz and Wilking 1989; Olson et al 1996; Schue and Langemo 1999).

4.1.8 Psychosocial Factors and Stress

Allman (1991) and Braden (1988) found that elevated serum cortisol levels are associated with pressure ulcer development. An elevated serum cortisol level suggests a higher level of stress. Weiler and colleagues (1990) found a correlation between unwelcome visitors and increased pressure ulcer risk among nursing home residents (Bergstrom et al 1992).

4.1.9 Other Factors

Some prospective studies have indicated other factors increase the risk for the development of pressure ulcer (Bergstrom et al 1992). A potential risk factor for stage I or greater pressure ulcer is smoking. Potential risk factors for stage II or greater pressure ulcer include increased glucose level or leucocyte count; severity of illness; dry skin; increased temperature and spinal deformity.

4.2 Nursing Assessment

4.2.1 Importance of Assessment

Bergstrom and Braden (1992) found a significant relationship between risk assessment scores on admission to a long-term care facility and the subsequent development of pressure ulcers. Measures for the prevention of pressure ulcers are expensive in terms of manpower and equipment costs (United Kingdom Department of Health 1993).

Assessment to accurately identify patients at risk is thus essential to ensure cost effective allocation of resources and the institution of timely and appropriate nursing interventions to promote positive patient outcomes. The use of a tool as a quantitative measure of risk can help reduce subjectivity in reporting patients' conditions and also allow easier evaluation of care.

On admission, patients with mobility deficit and impaired ability to reposition should be assessed for additional contributing factors such as incontinence and impaired nutritional status that increase their risk of developing pressure ulcers.

Grade A, Level Ib

4.3 Risk Assessment Tools

4.3.1 Review of Available Tools

The National Pressure Ulcer Advisory Panel (1989) recommended that an ideal assessment tool should:

- have a good predictive value
- have high sensitivity
- have high specificity and
- be easy to use.

Numerous risk assessment tools have been devised to predict the risk of pressure ulcer development. However, only the Norton Scale (Norton et al 1975) and Braden Scale (Bergstrom et al 1987) have been tested extensively. However, at this point, no tool can be confidently held as superior to the rest in all settings with all levels of staff, or more effective than clinical judgement in prediction of pressure ulcer development (University of York 1995).

Reviewed literature indicates that the Braden Scale appears to be the most valid and reliable risk assessment tool for use with a wide age group of patients (Hamilton 1992; Pang and Wong 1998). It has been evaluated in varied clinical settings such as intensive care units, medical-surgical units and nursing homes.

The reported sensitivity and specificity of risk assessment tools vary widely. This variability probably reflects differences in study methodology, patient populations and outcome measures. Some studies have included Stage I ulcers as an outcome with inconsistent definitions of these lesions (Bergstrom et al 1992).

Several studies have found that the Braden Scale has a best balance of sensitivity and specificity. Many adopted a different threshold score (score=16) used by Bergstrom and colleagues (1987):

- (i) Langemo and colleagues (1991) reported an optimal score of 15;
- (ii) Salvadalena and colleagues (1992) reported a threshold score of 19;
- (iii) Harrison and colleagues (1996) implemented the tool on 300 adult subjects with a wide range of diagnoses, ranging from critical to long term care. A best balance of sensitivity and specificity was achieved at Braden score 19;
- (iv) Bergstrom and colleagues (1998) reported an overall critical cutoff score of 18 in their latest study.

Several researchers (Bergstrom et al 1987; Clark and Farrar 1992) have recommended that institutions establish a risk assessment threshold score that is sensitive and specific to their clinical settings.

Studies have reported a low inter-rater reliability for Norton Scale and Waterlow Scale (Lincoln et al 1986; Wardman 1991; Hamilton 1992). However, for the Braden Scale, a good inter-rater reliability (Bergstrom et al 1987), and ease of application (Pang and Wong 1998) have been reported. Bergstrom and colleagues (1987) reported a reliability between 0.90 and 1.00 for Registered Nurses (RN) and between 0.83 and 0.86 for Licensed Practical Nurses (LPN) and nursing aides who have not received training in use of the tool. The authors concluded that the Braden Scale is most appropriately used by RN and that training for LPN and nursing aides might overcome the reading and assessment difficulties inherent in the tool.

Though the Waterlow Scale (Waterlow 1985) consistently achieves a high level of sensitivity in studies, it has been found to have lower specificity and tends to over-predict those at risk of pressure ulcers (Bridel 1993; Edwards 1994). This may misdirect the use of resources to patients who are actually not at risk.

4.3.2 When to Conduct Assessment

The duration before any given pressure will begin to cause injuries to the skin and tissues cannot be concluded from the evidence reviewed. However, it is generally assumed that any pressure exerted for longer than two hours is likely to cause trauma (Versluysen 1986). Currently, at clinical level, a 2-hourly turning to relieve pressure is achievable.

Assessment of pressure ulcer development on admission was noted to have high predictive validity to all setting (Bergstrom et al 1998). However, it is not as highly predictive as assessment performed in 48 and 72 hours after admission. This is probably due to lack of patient information, such as the nutritional status, incontinence or other risk factors (Bergstrom et al 1998). Thus, ongoing assessments should be carried out at 72 hours (Bergstrom et al 1998) or following a change in clinical condition or a significant clinical event, such as prolonged surgical procedures (Aronovitch 1999) and at regular intervals for long term patients (Bergstrom et al 1992).

During assessment, use a reliable and validated risk assessment tool such as the Braden Scale to complement good clinical judgement and observation.

Grade A, Level Ib

If the Braden Scale is selected, institutions should establish a risk assessment threshold score (e.g. 16), that is sensitive and specific to their clinical settings.

Grade A, Level Ib

Conduct risk assessment for patients with mobility deficit within two hours of admission to any health care facility.

Grade A, Level Ib

Assessment should also be implemented at 72-hour intervals, following a change in clinical condition or a significant clinical event, such as post-surgery, prolonged procedures, and at regular intervals for chronically ill patients.

Grade A, level Ib

5 SKIN CARE AND NUTRITION

5.1 Skin Assessment and Cleansing

5.1.1 Skin Assessment

Skin assessment provides health professionals with the information essential for developing preventive interventions and evaluating outcomes.

It should be carried out on admission and routinely on patients identified to be at risk. Inspection should be conducted systematically, involving the whole body, with special attention given to high risk areas such as bony prominences. It is recommended that patients at risk should be examined at least daily, if not during every shift or every 8-hourly. In addition, every time such a patient is repositioned, the newly exposed skin surfaces should be examined (Bergstrom et al 1992).

Institutions/hospitals should utilise a skin assessment checklist to facilitate systematic and comprehensive skin assessment. Factors to be incorporated in the checklist should include:

- frequency of inspection
- areas to be inspected and
- skin characteristics (e.g. skin integrity, colour, temperature, texture and turgor).

5.1.2 Skin Cleansing

Comprehensive skin care includes skin cleansing to remove contaminants and skin secretions. As there is less sebum and perspiration in the elderly, the frequency of cleansing put the elderly at risk for dry skin. Use of harsh soaps, especially alkaline soaps and cleansers can alter the pH of the skin, disrupt the acid-mantle and interfere with the ability of the skin to retain moisture and a decrease in bacterial resistance. Although the change of skin pH values after cleansing is transient, it takes few hours to return to normal (Bergstrom et al 1992; SpringNet 1999).

When materials such as cloth, sponge or brush is used during cleansing, they should be as soft as possible to maintain skin integrity. Care should be taken to minimise force and friction to the skin (Bergstrom et al 1992).

Individuals at risk of pressure ulcer development should have a systematic skin assessment at least once a day. Particular attention should be given to bony prominences. The assessment should be documented.

Grade C, Level IV

The skin should be cleansed routinely and at time of soiling. During cleansing, use warm water and a mild cleansing agent that minimises irritation and skin dryness.

Grade C, Level IV

5.2 Application of Topical Agents

5.2.1 Skin Hydration

Reviewed evidence suggest that decreased skin hydration is correlated to reduced skin pliability and flexibility (Spencer 1988), and decreasing ambient humidity limits the ability of the stratum corneum to maintain adequate hydration (eg. Fulmer and Kramer 1986). The evidence also implies that adequate hydration of the stratum corneum helps protect it against mechanical trauma (eg. friction).

A number of studies (eg. Kantor et al 1982; Wehr et al 1986) have indicated that both the clinical picture of dry skin and measures of stratum corneum hydration generally improve with application of various topical moisturising agents. However, the efficacy of specific moisturising agents has not been established and there is no direct evidence that treating dry skin will prevent pressure ulcer development. Nevertheless, applying topical moisturiser on skin with clinical signs of dryness and maintaining environmental conditions (relative humidity, temperature) appear to facilitate stratum corneum hydration and enhance its resistance to mechanical trauma (Bergstrom et al 1992).

Minimise environmental factors leading to skin drying (eg. exposure to cold). Apply moisturiser to dry skin.

Grade C, Level IV

5.3 Moisture Control

5.3.1 Exposure to Moisture

The common sources of moisture are urine, stool, wound drainage and perspiration. Various studies (eg. Leyden 1984; Zimmerer et al 1986) have indicated that moist skin is more susceptible to injury from friction, more easily abraded and promote high microbial growth (Bergstrom et al 1992).

5.3.2 Protection from Moisture

Underpads and incontinent briefs are frequently used to protect the skin of individuals who are incontinent of urine or stool, and have excessive wound drainage. Bergstrom and colleagues (1992) reviewed 22 studies that examined the effects of underpads on the skin condition of incontinent adults and infants. Their results indicated that the use of absorbent products (compared with cloth products) was associated with fewer episodes of skin irritation or less severe skin irritation. Other advantages were: less odour, lower costs, reduced work load, increased mobility and improved quality of life. The only adverse outcome was that some patients objected to wearing an incontinent brief. They highlighted that the key feature evaluated was not whether the product was disposable but whether the product was specifically designed to absorb moisture and present a quick-drying surface to the skin.

Many studies (eg. Kramer and Honig 1988) which examined the use of topical moisture barrier agents found that application of such agents protects the skin from the detrimental effects of moisture. However, due to the lack of replication studies on specific categories of products, the diversity of products tested and a variety of methodological problems, the extent to which the studies can be considered as evidence based is limited (Bergstrom et al 1992).

Minimise skin exposure to moisture due to perspiration, incontinence or wound drainage.

Grade C, Level IV

Underpads may be used where skin exposure to moisture cannot be controlled.

Grade C, Level IV

Topical agents can be applied to areas frequently exposed to moisture.

Grade C, Level IV

5.4 Massage

5.4.1 Review of Evidences

Traditionally, massage has been used to stimulate circulation and was thought to assist in pressure ulcer prevention. However, reviewed evidence suggests that massage over bony prominences may cause harm to patients. Studies (eg. Ek et al 1985; Olson 1989) found that subjects had a significant decrease in skin temperature at the areas that were massaged. The findings suggest that circulation was not improved by massage and the blood supply to the massaged areas may have been compromised.

Dyson (1978) documented the potentially deleterious effects of massage on human tissues. Dyson designated half the patients (100) in a geriatric hospital to receive routine massage of bony prominences whereas the other half did not receive any massage. Subjects were followed up for 6 months. The findings indicated a 38% reduction in the incidence of pressure ulcers in the non-massaged group compared to the massaged group. On postmortem biopsies, the non-massaged individuals showed no evidence of tissue tearing whereas the massaged tissue appeared macerated and degenerated.

Do not massage areas at risk of pressure ulcer development.

Grade B, Level III

5.5 Nutrition

5.5.1 Nutritional Status and Risk

Many studies indicated that nutritional status is related to pressure ulcer development and the healing of ulcers (refer section 4.1.5). Most of the experts found an increased risk of pressure ulcer development when serum albumin levels were below 30g/L, total lymphocyte counts less than 1500mm², the right triceps skinfolds less than 2.5mm for men and less than 3.0mm for women, poor food intake and weight loss (Allman et al 1995).

Clinical experts (eg. Lidowski 1988; Goode and Allman 1989) also recommend supplementing or supporting intake of high protein, high calories, vitamin C and zinc (Holmes et al 1987; Bergstrom et al 1992; Dugan 1992; Bourdel-Marchasson et al 2000).

Determine patient's nutritional status by assessing the nutritional risk factors.

Grade C, Level IV

Give dietary support and advice.

Grade A, Level Ib

Consult the physician and dietician where dietary intake remains inadequate and interventions such as enteral or parenteral feedings should be considered.

Grade GPP

6 MANAGEMENT OF TISSUE LOADING

6.1 Positioning

6.1.1 Positioning and Repositioning Schedule

Although manual repositioning of patient is an established means of reducing the duration of pressure to pressure prone areas, it is unclear what is the effective optimum frequency of repositioning (University of York 1995). A study by Knox and colleagues (1994) demonstrated that subjects developed redness and skin temperature increases over their trochanters and sacral areas after one hour and two hours of being immobile respectively. It was concluded that a period of one and a half hours between turning may be more appropriate than the traditional 2-hourly turning period. Further study to explore this area is necessary. Norton and colleagues (1975) found in their clinical trial that patients who developed fewer pressure ulcers were those who were turned every two to three hours.

It is recommended that practitioners assess individual patient's risk, level of tissue tolerance, medical and physical conditions, and comfort level before deciding on the repositioning schedule. Turning schedules can be based on time or event. If the schedules are time-based, the interval of turning is usually every two hours. However, patient who is at risk of developing pressure ulcer should be repositioned at less than 2-hourly intervals (Bergstrom et al 1992). If the schedules are event-based, the nurse or the caregiver will then have to work out a list of events of the day such as bathing, eating and others. Repositioning is then implemented to the events.

Whilst the patient is in bed, use positioning devices such as pillows or foam wedges to keep bony prominences from direct contact with one another, such as knees or ankles. Clinicians also advocate using devices to help individuals maintain a comfortable position in bed or chair.

6.1.2 Lifting Devices

Friction is common in individuals who cannot lift sufficiently during a position change or transfer to avoid dragging their skin over rough surfaces of bed linen (Bergstrom et al 1992). Lifting devices such as trapeze, extra linen sheet should be used to minimise friction when moving patient.

6.1.3 Bed Positioning

Shearing forces occur when the head of bed is elevated at 50 to 60 degree (Braden and Bryant 1990; Sparks 1993). For a patient whose medical condition requires constant head elevation, the head elevation should not be more than 30 degree to prevent shearing forces. Frequent assessment of the sacral region is necessary (Bergstrom et al 1992).

Two studies (Garber et al 1982; Seiler et al 1986) measured the effect of various side-lying positions on tissue interface pressure and transcutaneous oxygen tension. They reported that positioning subjects so they were not lying directly on the trochanters resulted in either lower interface pressure or increased transcutaneous oxygen tension. Hence, avoid positioning patients at 90 degree laterally at the greater trochanters in bed. Instead, use the 30-degree body positioning. Studies (e.g. Preston 1988, Colin et al 1996) have indicated that when the 30-degree tilt positioning method is used, the contact pressure is transferred to a low risk area, such as gluteal muscles, which can tolerate pressure up to 3.5 times higher than those tolerated over bony prominences. The 30-degree laterally inclined position has very high transcutaneous oxygen tension value on either standard hospital mattress or support surface (84.1 and 80.9mmHg) (Seiler et al 1986). The 30-degree tilt can be achieved by rolling the patient 30 degree to a slightly tilted position with pillow support at the back. Figure 4 illustrates the 30-degree tilt.

Figure 4 : 30-degree tilt.



For bed-ridden patients who are at risk, reposition them at least 2-hourly if there are no contraindications. Draw up a individual written positioning schedule.

Grade C, Level IV

Use positioning devices such as pillows or foam wedge to keep bony prominences from direct contact with one another.

Grade C, Level IV

When in lateral position, avoid positioning on bony prominences (e.g. trochanter).

Grade C, Level IV

Keep the head of the bed at the lowest angle (about 30 degree) unless contraindicated.

Grade C, Level IV

Use lifting devices and correct lifting techniques during transfer and repositioning.

Grade C, Level IV

6.2 Pressure-Relieving Devices

6.2.1 Devices for Heels

Literature consistently revealed that heels have substantially higher interface pressure when compared with other bony prominences. This is due to difficulty in redistributing pressure under the heels. The interface pressure measured over the heels is at 40 to 100mmHg in several studies (Counsell et al 1990; Thompson-Bishop & Mottola 1992; Whittemore et al 1993). This suggests that heels need extra protection. This is especially likely in individuals who are not able to reposition their lower extremities (Bergstrom et al 1992).

Tymec and colleagues (1997) recommended the use of pillows under calves to maintain heels off the bed, thus effectively reducing heel interface pressure. Though there are many heel products on the market, none has shown superiority in preventing pressure ulcer development over another product (Ratliff and Rodeheaver 1999).

6.2.2 Devices for Chairs

Although this position promotes awareness of surroundings, facilitate cardiovascular, respiratory and gastrointestinal functions, it has been reported that chair-bound patients are vulnerable to pressure ulcers over the ischial tuberosities because approximately 75% of the body weight is exerted on the seating surface (Malloy 1995).

Proper posture alignment and distribution of weight while sitting is important as balance and stability influence mobility, energy expenditure and function performance (Bergstrom et al 1992). Shearing force is avoided if the patient maintains a good posture and is not sliding down the chair (Bergstrom et al 1992). The patient should be upright on the chair with the feet resting on the ground and knees bent at a 90 degree angle. Use of pressure-relieving devices and frequent repositioning by shifting every 15 minutes if feasible, to relieve pressure on the ischial tuberosities, are recommended (Ratliff and Rodeheaver 1999).

When selecting the device to be used, practitioners must ensure that the device is effective for the individual patient and does not interfere with other aspects of mobility and personal autonomy (Bergstrom et al 1992).

6.2.3 Devices for Beds

Dealey (1995) identified as many as 75 different types of pressure-relieving mattresses. A variety of materials are used to construct these support surfaces. These include air, fibre, foam, gel and water. Numerous researchers have measured the characteristics and properties of these support surfaces. Though the majority of researchers used tissue interface pressure as the basis for comparing the products, a few also compared changes in transcutaneous oxygen tension and capillary blood flow (Bergstrom et al 1992).

Andersen and colleagues (1983) found in their randomised controlled trial that the incidence of pressure ulcers in patients on hospital standard mattress was significantly greater than patients on either an air or a water mattress. Collier (1996) compared eight pressure-relieving mattresses with standard hospital mattress and found that they provide more comfort and better tissue interface pressure. The National health Service (NHS) Centre for Reviews and Dissemination (University of York 1995) made the following recommendations after conducting a systematic review and synthesis of randomised controlled trial studies,

- most of the equipment available for the prevention of pressure ulcers have not been reliably evaluated and no 'best buy' can be recommended;
- patients at risk should be provided either with an evaluated low pressure foam mattress, or if at higher risk, with a large-celled alternating pressure mattress or a proven low-air loss or air-fluidised bed.

Foam overlays are commonly recommended as they are inexpensive and easy to maintain. A 2-inch deep foam mattress does not significantly reduce pressure over the trochanter (Krouskop et al 1985; Maklebust & Sieggreen 1996). However, a 4-inch deep foam mattress reduces pressure by 30% (Krouskop et al 1985). Lowthian (1996) cited that dividing a planar surface to produce contiguous pillars greatly reduces hammocking and shearing forces. But Kemp and colleagues (1993) studied elderly patients in three different settings and found that 4-inch deep solid foam mattresses reduced the incidence of pressure ulcer compared with 4-inch deep convoluted foam mattresses. Krouskop and colleagues (1986) measured tissue interface pressures on 32 subjects on five different foam overlays. They observed that the density, hardness and thickness of the foam overlays had a strong correlation with tissue interface pressure. They concluded that denser, thicker and flat foam overlays were more effective in reducing tissue interface pressure. Therefore, they recommended that a foam overlay should be 4 inches thick, possesses a density of 1.3 pound per cubic foot, and an indentation load deflection (ILD) of 30 pounds. Day and Leanard (1993) found that there was no significant difference in Stage II pressure ulcer healing. Patients with Stage III and Stage IV pressure ulcers improved more rapidly on a specialty bed compared to those on a foam overlay. Therefore, it is restricted to use in low and moderate risk patients.

Factors to consider when selecting a support surface include,

- clinical condition of the patient
- characteristics of the care setting
- efficacy, portability, durability, ease of installation and use of the support surface
- maintenance/repair and ease of cleaning of the support surface;
- acceptability to patients and caregivers and
- cost effectiveness (Yong 1995).

The overlay mattress should be constantly assessed for its effectiveness. The duration of use is important in relation to its effectiveness (Harrison 1995). To check for the adequacy of the overlay mattress, place palm up, under the overlay below the patient's sacrum region. If less than an inch of support material or the bed base is felt, then the support surface has bottomed out (Ratliff and Rodeheaver 1999).

The material used for the mattress cover has great effect on the prevention of pressure ulcer. A rigid cover has a greater hammock effect. Such an effect is created when a support surface is pulled tautly (Lowthian 1996). This reduces the cushioning potential and result in increased pressure and shearing force (Defloor 1999). Hence, material for cover should be a thin loose-fitting film polyurethane (Lowthian 1996).

6.2.4 Donut-shaped Devices

Doughnut shaped devices (eg. ring cushions) are known to cause venous congestion and oedema. Crewe (1987) reported that ring cushions are more likely to cause pressure ulcers than to prevent them (Bergstrom et al 1992).

6.2.5 Water-filled Gloves

Though the use of water-filled gloves as a pressure-relieving device is practised widely, there is a lack of evidence regarding its effectiveness in preventing pressure ulcer development. The workgroup found two research articles on the use of water-filled gloves. Williams (1993) studied 40 subjects to evaluate the pressure difference between heels on a mattress and a latex glove filled with 260ml of water. The findings obtained indicated that the average interface pressure on the mattress was 126.5mmHg and the average interface pressure on the latex glove was 144.6mmHg. Hence, there was an average of 12.5% increase in pressure when the heel is placed on a water-filled glove.

Lockyer-Stevens (1993) measured the pressure on the heels of three volunteers of varying weights, using three sizes of gloves filled with varying amounts of water. He reported that the water-filled gloves provided a degree of pressure relief, but it was insufficient to achieve the therapeutic pressure of below 32mmHg. It was also easily displaced by slight movements.

6.2.6 Devices for Operating Theatre

The skin integrity of patients undergoing prolonged operations is an area of concern. It is not clear if it is the surgical experience or the patients' intrinsic factors or both that place the patients at risk. Pressure ulcers tend to occur one to three days post-surgery. They often present as 'burns' or bruise in the early stages. The common sites are the sacral region, heels, or elbows (Schultz et al 1999). Aronovitch (1999) demonstrated that the risk of pressure ulcer increases as surgical time increases. Hawkins (1997) studied the effectiveness of specialty pads and foam used intra-operatively and found that there was statistically significant difference ($p=0.0003$).

The NHS Centre for Review and Dissemination (1999) reported that pressure-relieving mattresses in the operating theatre reduced the incidence of pressure ulcers post-operatively. Schultz and colleagues (1999) suggested that patients with co-morbidity of diabetes, older age or smaller size need to have special padding to protect the skin intra-operatively.

Place at risk patients on pressure-relieving devices whilst they are in bed (foam, gel, static air or alternating air mattress or overlay).

Grade B, Level III

For patients who are completely immobile, raise their heels off the bed or use pressure-relieving devices.

Grade C, Level IV

For patients who are chair-bound, use pressure-relieving devices such as foam, air or gel cushions.

Grade C, Level IV

Individuals at risk should avoid sitting for prolonged period on a chair or wheelchair. Patients who are able should be taught to shift their weight every 15 minutes. Those who need assistance should be repositioned at least hourly or be put back to bed.

Grade C, Level IV

Do not use donut-shaped devices as pressure-relieving devices.

Grade C, Level IV

Do not use water-filled gloves as pressure-relieving devices.

Grade B, Level IIb

6.3 Protective Dressing

Protective dressing such as thin hydrocolloids is able to lower the shear and friction stress on the skin. This prevents skin from injury, shearing and friction (Bergstrom et al 1992; Flam et al 1997).

7 EDUCATION PROGRAMMES

7.1 Importance of Education

Pressure ulcer management is an important part of the basic nurse preparation programme. Pressure ulcer prevention relies on the effective management by healthcare professional and the continuing efforts by patients and their caregivers (Dimant and Francis 1988). Education is instrumental to success.

7.1.1 Objectives

Objectives include:

- increase awareness among staff
- ensure nurses are updated with changing practices
- reduce the incidence of pressure ulcer development
- improve the management of pressure ulcers.

Educational programmes should be structured, organised, comprehensive and directed at all levels of healthcare providers, patients, and families or caregivers.

Grade A, Level Ib

7.2 Programme Development, Implementation and Evaluation

7.2.1 Content

Essential information that must be included in an effective prevention programme for health professionals should include,

- aetiology
- risk factors
- risk assessment
- staging pressure ulcer
- skin care/early treatment
- support surface management
- positioning/lifting/transfer techniques
- nutrition and
- nursing documentation.

Programme for patient and/or family includes:

- causes
- risk factors
- skin care/early treatment
- positioning/lifting/transfer techniques
- support surface management and
- nutrition.

7.2.2 Strategies

Strategies to use include:

- employ different training strategies to various grades of staff to facilitate learning;
- adopt principles of adult learning through explanation, questioning, group discussion, and demonstration/return demonstration;
- use videos and patient information materials to supplement teaching for patients and their caregivers.

Key methods to use for healthcare professionals include:

- structured classroom programme;
- bedside mentoring programme - This is an active learning process where the participants and the mentors are able to validate assessment, intervention, patient-teaching and documentation (Krešević and Naylor 1995);
- workshops.

Key methods to use for caregivers include:

- public forum
- workshops
- small group teaching
- individualised home mentoring programme.

7.2.3 Evaluation

Educational programmes may be evaluated using built-in mechanisms to collect data on prevalence and incidence as performance indicators and by developing a skills checklist to audit practice and compliance (Allcock et al 1994) .

Design, develop and implement educational programmes with an overall goal of reducing the incidence of pressure ulcers in the healthcare settings.

Grade A, Level Ib

Educational programmes must be conducted on a regular basis and include new techniques or technologies.

Grade C, Level IV

8 CLINICAL AUDIT

Hospital and institution administrators should consider these guidelines in their in-house quality assurance programmes. Nurses should critically review the implications of these guidelines on their routine care, patient-teaching and education needs.

8.1 Outcome Indicators

Key outcome indicators are listed at Annex 1. Accurate nursing assessment of pressure ulcer development risk, adoption of prevention strategies and use of pressure-relieving devices are crucial to prevention of skin breakdown due to immobility.

These may best be assured through audits of randomly selected individual episodes of care and a retrospective review of cases when new skin breakdown occurs.

Audits are strongly recommended at ward level. It will be necessary to establish current baseline practice against which change may be measured.

8.2 Management Role

Hospital and institution administrators, together with quality assurance teams, should ensure that outcome indicators are met. They may benchmark against hospital or institution that perform well.

9 IMPLEMENTATION OF GUIDELINES

It is expected that these guidelines be adopted after discussion involving clinical staff and hospital and institution management. They may review how these guidelines may complement or be incorporated into their existing institution protocols.

Feedback may be directed to the Ministry of Health for consideration in future review.

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11 REFERENCES

- Allcock N, Wharrad H, Nicolson A. 1994. Interpretation of pressure sore prevalence. *Journal of Advanced Nursing*, 26:37-45.
- Allman RM. 1991. Pressure ulcers among bedridden hospitalized elderly. *Unpublished data*. In: Bergstrom et al 1992.
- Allman RM, Goode PS, Patrick MM, Burst N, Bartolucci A.A. 1995. Pressure ulcer risk factors among hospitalized patients with activity limitation. *American Medical Association*, 273(11):865-870.
- Allman RM, Laprade CA, Noel LB, Walker JM, Moorer CA, Dear MR, Smith CR. 1986. Pressure sores among hospitalised patient. *Ann Intern Med*, 105(3): 336-342.
- Andersen KE, Jensen O, Kvorning SA, Bach E. 1983. Decubitus prophylaxis: a prospective trial on the efficiency of alternating-pressure air-mattresses and water-mattresses. *Acta Derm Venereol (Stockh)*, 63(3):227-230. In: Bergstrom et al 1992.
- Aronovitch SA. 1999. Intraoperatively acquired pressure ulcer prevalence: a national study. *J WOCN*, 26(3):130-136.
- Bennett L, Lee BY. 1985. Pressure versus shear in pressure sore causation. In: Lee BY. 1985. (Editor). *Chronic ulcers of the skin*. New York: McGraw-Hill, 39-56.
- Bergstrom N, Allman RM, Carlson CE, et al. 1992. *Pressure ulcers in adults: prediction and prevention*. Guideline Report, No. 3. Rockville, MD: US Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research. AHCPR Publication No. 93-0013.
- Bergstrom N, Braden B. 1992. A prospective study of pressure sore risk among institutionalized elderly. *J Am Geriatr Soc*, 40:747-758. In: Bergstrom et al 1992.

Bergstrom N, Braden B, Kemp M, Champagne M, Ruby E. 1998. Predicting pressure ulcer risk: a multisite study of the predictive validity of the Braden scale. *Nursing Research*, 47(5):261-269.

Bergstrom N, Braden BJ, Lagazza A, Holman V. 1987. The Braden scale for predicting pressure sore risk. *Nursing Research*, 36(4):205-210.

Berlowitz DR, Wilking SV. 1989. Risk factors for pressure sores: a comparison of cross-sectional and cohort-derived data. *J Am Geriatr Soc*, 37(11):1043-1050.

Bourdel-Marchasson I, Barateau M, Rondeau V, Dequae-Merchadou L., Salles-Montaudon N, Emeriau JP, Manciet G, Dartigues JF. 2000. A multi-center trial of the effects of oral nutritional supplementation in critically ill older inpatients. GAGE Group. Groupe Aquitain Geriatrique d' Evaluation. *Nutrition*, 16(1):1-5.

Braden BJ. 1988. The relationship between serum cortisol and pressure sore formation among the elderly recently relocated to a nursing home. *Reflection*, 14(4):11. In: Bergstrom et al 1992.

Braden BJ, Bryant R. 1990. Innovations to prevent and treat pressure ulcers. *Geriatr Nurs (New York)*, 11(4):182-186. In: Bergstrom et al 1992.

Bridel J. 1993. Assessing the risk of pressure ulcer. *Nursing Standard*, 7(25):32-35.

Burd C, Langemo D, Olson B, Hanson D, Hunter S, Sauvage T. 1992. Skin problem: epidemiology of pressure ulcers in a skilled care facility. *Journal of Gerontological Nursing*, 18(9):29-39.

Charlson ME, Sax FL, Mackenzie R, Field SD, Braham RL, Douglas RG Jr. 1986. Assessing illness severity: does clinical judgement work? *J Chron Dis*, 39:439-452. In: Bergstrom et al 1992.

Clark M, Farrar S. 1992. Comparison of pressure sore risk calculations. In: Harding KG, Leaper DL, Turner TD. (eds). 1992. *Proceedings of the first European Conference on advances in wound management*. London: MacMilliam.

Colin D, Abraham P, Preault L, Bregeon C, Saumet J. 1996. Comparison of 90 degree and 30 degree laterally inclined positions in the prevention of pressure ulcers using transcutaneous oxygen and carbon dioxide pressure. *Advances in Wound Care*, 9(3):35-38.

Collier ME. 1996. Evaluation: Pressure-reducing mattresses. *Journal of Wound Care*, 5(5):207-211.

Counsell C, Seymour S, Gurn R, Hudson A. 1990. Interface skin pressures on four pressure relieving devices. *J ET Nursing*, 17:150-153.

Crewe RA. 1987. Problems of rubber ring nursing cushions and a clinical survey of alternative cushions for ill patients. *Care Si Pract*, 5(2):9-11. In: Bergstrom et al 1992.

Day A, Leonard F. 1993. Seeking quality care for patients with pressure ulcers. *Decubitus*, 6:32-43.

Dealey C. 1995. Mattresses and beds. *Journal of Wound Care*, 4(9):409-412.

Defloor T. 1999. The risk of pressure sores: a conceptual scheme. *Journal of Clinical Nursing*, 8(2):206-216.

Dimant J, Francis ME. 1988. Pressure sore prevention and management. *J Gerontol Nurs*, 14:18-25.

Dinsdale SM. 1974. Decubitus ulcers: role of pressure and friction in causation. *Arch Phys Med Rehabil*, 55(4):147-152. In: Bergstrom et al 1992.

Dugan M. 1992. Pressure areas: Standard protocols improve care. *Nursing Management*, 23(11):78-80.

Dyson R. 1978. Bedsores – the injuries hospital staff inflict on patients. *Nursing Mirror*, 46(24):30-32.

Edwards M. 1994. The rationale for the use of risk calculation in pressure sore prevention and the evidence of the reliability and validity of published scales. *Journal of Adv Nursing*, 20(2):288-296.

Ek AC, Gustavon F, Lewis DH. 1987. Skin blood flow in relation to external pressure and temperature in the supine position on a standard mattress. *Scand J Rehabil*, 19:121-126.

Ek AC, Gustavsson G, Lewis DH. 1985. The local skin blood flow in areas at risk for pressure sores treated with massage. *Scandinavian J Rehabil Med*, 17(2):81-86. In: Bergstrom et al 1992.

Flam E, Bielat E, Raab L. 1997. *Control of friction, shear and moisture: avenue to maintenance of skin viability*. New Jersey: NTL Associates Inc.

Fulmer AW, Kramer GJ. 1986. Stratum corneum lipid abnormalities in surfactant-induced dry scaly skin. *J Invest Dermatol*, 86(5):598-602. In: Bergstrom et al 1992.

Garber SL, Krouskop TA, Carter RE. 1978. A system for clinically evaluating wheelchair pressure-relief cushions. *Am J Occup Ther*, Oct; 32(9):565-70.

Goode PS, Allman RM. 1989. The prevention and management of pressure ulcer. *Med Clin North Am*, 73(6):1511-1524. In: Bergstrom et al 1992.

Goodrich C, March K. 1992. From ED to ICU: a focus on prevention of skin breakdown. *Critical Care Nursing Quarterly*, 15(1):1-13.

Gosnell DJ. 1973. An assessment tool to identify pressure sores. *Nurs Res*, 22(1):55-59. In: Bergstrom et al 1992.

Hamilton F. 1992. Kan analysis of the literature pertaining to pressure sore risk assessment scale. *Journal of Clinical Nursing*, 185-193.

Harrison M. 1995. Pressure Sore: assessing the risk. *Nursing Standard*, 9(23):32-34.

Harrison MB, Wells G, Fisher A, Prince M. 1996. Practice guidelines for the prediction and prevention of pressure ulcers: evaluating the evidence. *Applied Nursing Research*, 9(1):9-17.

- Hawkins JE. 1997. The effectiveness of pressure-reducing table pads as an intervention to reduce the risk of intraoperatively acquired pressure sores. *Military Medicine*, 162(11):759-761.
- Holmes B, Macchiano K, Jhangiani SS, Agarwal N, Savino J. 1987. Combating Pressure-nutritionally. *AJN*, 1302-1303.
- Kantor I, Ballinger WG, Savin RC. 1982. Severely dry skin: clinical evaluation of a highly effective therapeutic lotion. *Cutis*, 30(3):410-1, 415-6, 419-24. In: Bergstrom et al 1992.
- Kemp MG, Kopanke D, Ktordeclia L, Fogg L, Shotts S, Matthiesen V, Johnson B. 1993. The role of support surfaces and patients attributes in preventing pressure ulcers in elderly patients. *Res Nurs Health*, 16:89-96.
- Knox DM, Anderson TM, Anderson PS. 1994. Effects of different turn interval on skin of healthy older adults. *Advances in wound care*, 7(1):48-52.
- Kramer KD, Honig PJ. 1988. Diaper dermatitis in the hospitalized child. *J Enterostomal Ther*, 15(4):161-170. In: Bergstrom et al 1992.
- Kresevic DM, Naylor M. 1995. Preventing pressure ulcer, through use of protocols in a mentored nursing model. *Geriatric Nursing*, 16(5):225-229.
- Krouskop TA, Noble DS, Brown J, Marburger R. 1986. Factors affecting the pressure-distributing properties of foam mattress overlay. *J Rehabil Res Dev*, Jul; 23(3):33-39. In: Bergstrom et al 1992.
- Krouskop TA, Williams R, Herszkowicz I, Garber S. 1985. Effectiveness of mattress overlays in reducing interface pressures during recumbency. *J. Rehabil Res Dev*, 22:7-10.
- Kuhn B, Coulter S. 1992. Balancing the pressure sore cost and quality education. *Nursing Economics*, 10(5):353.
- Landis EM. 1930. Micro-injection studies of capillary blood pressure in human skin. *Heart*, 15:209-228.

- Langemo DK, Olson B, Hunter S, Hanson D, Burd C, Cathcart-Silberberg T. 1991. Incidence and prediction of pressure ulcers in five patient care settings. *Decubitus*, 4(3):25-26, 28, 30. In: Bergstrom et al 1992.
- Leyden J J. 1984. Corn starch, candida albicans, and diaper rash. *Pediatr Dermatol*, 1(4):322-325. In: Bergstrom et al 1992.
- Lidowski H. 1988. NAMP: a system for preventing and managing pressure ulcers. *Decubitus*, 1(2):28-37. In: Bergstrom et al 1992.
- Lincoln R, Roberts LR, Maddox A, Levine S, Patterson C. 1986. Use of the Norton Pressure Sore Risk Assessment Scoring System with elderly patients in acute care. *J Enterostomal Ther*, 13(4):132-138. In: Bergstrom et al 1992.
- Lockyer-Stevens N. 1993. The use of water-filled gloves to prevent the formation of decubitus ulcers on heels. *Journal of Wound Care*, 2(5):282-285.
- Lofgren RP, MacPherson DS, Granieri R, Myllenbeck S, Sprafka JM. 1989. Mechanical restraints on the medical wards: are protective devices safe? *Am J Public Health*, 79(6):735-738. In: Bergstrom et al 1992.
- Longe RL. 1986. Current concepts in clinical therapeutic: pressure sores. *Clin Pharm*, 5(8):669-681. In: Bergstrom et al 1992.
- Lowthian P. 1996. The modular propad and the softform mattress. *British Journal of Nursing*, 5(9):575-580.
- Lowthian PT. 1976. Pressure sore: practical prophylaxis. *Nursing Times*, 72(8):295-8.
- Maklebust J, Sieggreen M. 1996. *Pressure ulcer: Guideline for prevention and nursing management* (2nd ed). Springhouse: Springhouse PA.
- Malloy E. 1995. *Pressure area management: a clinical evaluation of pressure reducing cushions*. HNE Clinical Report.
- Ministry of Health. 1999. *Report of the inter-ministerial committee on health care for the elderly*.

Ministry of Health Nursing Department. 1998. *Nursing research report on the prevalence and incidence of pressure sores among patients in Alexandra Hospital, Changi General Hospital and Tan Tock Seng Hospital.*

National Health Service Centre for Reviews and Dissemination. 1999. The University of York. DARE Search result documents: bed, mattress and cushion for pressure sore prevention and treatment. *The Cochrane Library*, Issue 3. Oxford: update software.

National Pressure Ulcer Advisory Panel. 1989. Pressure ulcers - incidence, economics and risk assessment. Consensus development conference statement. *Decubitus*, 2(2):24-28.

Norton D, McLaren R, Exton-Smith AN. 1962. *An investigation of geriatric nursing problems in hospital.* Edinburgh: Churchill Livingstone.

Norton LD, McLaren R, Exton-smith AN. 1975. *An investigation of geriatric nursing problems in hospital.* London: Churchill Livingstone.

Okamoto GA, Lamers JV, Shurtleff DB. 1983. Skin breakdown in patients with myelo-meningocele. *Arch Phys Med Rehabil*, 64(1):20-23. In: Bergstrom et al 1992.

Olson B. 1989. Effects of massage for prevention of pressure ulcer. *Decubitus*, 2(4):32-37.

Olson B, Langemo D, Burd C, Hanson D, Hunter LS, Cathcart-Silverberg T. 1996. Pressure ulcer incidence in an acute care setting. *JWOCN*, 23(1):15-20.

Pang SM, Wong T. 1998. Predicting pressure sore risk with the Norton, Braden and Waterlow scales in a Hong Kong rehabilitation hospital. *Nursing Research*, 47(3):147-153.

Pieper B, Sugrue M, Weiland M, Sprague K, Heimann C. 1997. Presence of pressure ulcer prevention methods used among patients considered at risk versus those considered not at risk. *JWOCN*, 24(4):191-198.

Preston KW. 1988. Positioning for comfort and pressure relief: the 30 degree alternative. *Care, Science and Practice*, 6(4):116-119.

Ratliff CR, Rodeheaver GT. 1999. Pressure ulcer assessment and management. *Lippincott's Primary Care Practice*, 3(2):242-258.

Roberts BV, Goldstone LA. 1979. A survey of pressure sores in the over sixties on two orthopaedic wards. *Int J Nurs Stud*, 16(4):355-364. In: Bergstrom et al 1992.

Salvadarena GD, Snyder ML, Brogdon KE. 1992. Clinical trial of the Braden Scale in an acute care medical unit. *J ET Nurs*, 19:160-165.

Schue RM, Langemo DK. 1999. Prevalence, incidence and prediction of pressure ulcer on a rehabilitation unit including commentary by Whitney JD. *JWOCN*, 26(3):121-129.

Schultz A, Bien M, Durnond K, Brown K, Myers A. 1999. Etiology and incidence of pressure ulcers in surgical patients. *AORN Journal*, 70(3):434, 437-440, 443-444, 446-449.

Seiler WO, Allen S, Stahelin HB. 1986. Influence of the 30 degree laterally inclined position & the 'super-soft' 3 piece mattress on skin oxygen tension on areas of maximum pressure. *Gerontology*, 32:258-166.

Shannon ML, Skorga P. 1989. Pressure ulcer prevalence in two general hospitals. *Decubitus*, 2(4):38-43

Sparks SM. 1993. Clinical validation of pressure ulcer risk factor. *Ostomy/Wound management*, 39:40-41,43.

Spencer TS. 1988. Dry skin and skin moisturizers. *Clin Dermatol*, 6(3):24-28. In: Bergstrom et al 1992.

SpringNet. 1999. Skin care: keeping the outside healthy. Nursing99.

Takeda T, Koyamma-T, Izawa-Y, Makita-T, Nkmue-N. 1992. Effects of malnutrition on development of experimental pressure sores. *J Dermatol*, 19(10): 602-609.

Thompson-Bishop JY, Mottola CM. 1992. Tissue interface pressure and estimated subcutaneous pressure of 11 different pressure-reducing support surface. *Decubitus*, 5:42-48.

Tymec A, Pieper B, Bollman K. 1997. A comparison of two pressure-relieving devices on the prevention of heel pressure ulcer. *Advances in Wound Care*, 10(1):39-44.

United Kingdom Department of Health. 1993. Pressure sores: a *quality indicator*. London: Department of Health.

University of York. 1995. The prevention and treatment of pressure sores. *Effective Health Care Bulletin*, 2(1):1-16.

Versluysen M. 1986. How elderly patients with femoral fracture develop pressure sores in hospital. *Br Med J (Clin Res Ed)*, 292(6531):1311-1313. In: Bergstrom et al 1992.

Wardman C. 1991. Norton v. Waterlow. *Nursing Times*, 87(13):74-78.

Waterlow J. 1985. Pressure sores: a risk assessment card. *Nurs Times*, 81(48):49-55.

Wehr R, Krochmal L, Whitmore C, Yarbrough C. 1986. Efficacy of Alpha Keri after showering for treatment of xerosis. *Cutis*, 37(5):384-385. In: Bergstrom et al 1992.

Weiler PG, Franzi C, Kecskes D. 1990. Pressure sores in nursing home patients. *Aging (Milano)*, 2(3):267-275. In: Bergstrom et al 1992.

Whittemore R, Bautista C, Smith C, Bruttomesso K. 1993. Interface pressure measurements of support surfaces with subjects in the supine and 45 degree fowler positions. *J ET Nursing*, 20:111-115.

Williams C. 1993. Using water-filled gloves for pressure relief on heels. *Journal of Wound Care*, 2(6):345-348.

Yarkony GM. 1994. Pressure Ulcers: a review. *Arch Phys Med Rehabil*, 75(8):908-914.

Yong H. 1995. Clinical: Home Nursing Equipment needs. *Nursing Standard*, 9(31):53-54.

Young L. 1989. Pressure ulcer prevalence and associated patient characteristics in one long-term care facility. *Decubitus*, 2(2):52. In: Bergstrom et al 1992.

Zimmerer RE, Lawson KD, Calvert CJ. 1986. The effects of wearing diapers on skin. *Pediatr Dermatol*, 3(2):95-101.

ANNEX 1 - KEY OUTCOME INDICATORS

Assessment Tool

Institutions should select a reliable and validated risk assessment tool and establish a risk assessment threshold score.

Outcome Indicators

In pressure ulcer prevention, quality of nursing care may be defined as:

- nursing assessment of pressure ulcer development risk has been accurately performed
- strategies and actions are planned and implemented to prevent skin breakdown
- education programmes are designed and conducted to staff and caregivers and
- incidence of pressure ulcer development are documented.

All the four outcome indicators may be audited at hospital and institutional levels. These require accurate and consistent documentation.

