THE UNIVERSITY OF HULL

PREVENTION OF PRESSURE SORES IN HOSPITAL AND COMMUNITY WITH SPECIAL REFERENCE TO THE TIME SPENT FOR CARE

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ABSTRACT

The main purpose of this study was to evaluate the amount of time which was spent in giving preventive pressure area care in both a sample of hospital patients and a sample of community patients. A pilot study was carried out to test the methodology, which was subsequently used with only minor modifications, for the main study. Bedfast or chairfast patients were studied from admission to the selected hospital wards or community nursing areas for a period of six weeks or until they were discharged from care, developed pressure sores, died, or became mobile. Data was collected by means of interviews and observations made of patients, nurses and relatives. A diary sheet was designed for use by nurses in hospital and by nurses and relatives in the community, on which they were asked to record pressure area care as it was given. Information collected by this means included the time spent in care, the method used and observation of the skin areas. The researcher also collected data about the patient's appetite, Norton Score, age, sex and diagnosis. The outcome measure used was whether or not the patient developed a pressure sore which was defined for this study as a break in the skin due to pressure. Due to geographical dispersion of patients within the community in the health district used for that part of the study, fewer community patients (n = 30) were included in the study than the number of hospital patients studied (n = 88). Discriminant analysis was used on the results to distinguish between groups of patients. Results of this study showed that a higher percentage (29%) of the hospital patients developed pressure sores than among the community patients studied (20%). The average total time spent on pressure area care daily was higher for the community patients than for the hospital patients. Interestingly, of the six community patients who developed pressure sores, five were dependent entirely upon the nursing service for pressure area care, whilst the usual pattern at home was that relatives and nurses shared the care. Frequency of pressure area care given showed a significant relationship with outcome for both hospital and community patients. It should be noted that whilst the number of patients who developed sores is reported here, and this is related to the total number of patients studied, this study is not an incidence or a prevalence study, and should not be considered as such. The study appears to show that nursing care devoted to the prevention of pressure sores in terms of time and frequency is significantly related to outcome and thus to effectiveness.

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ABBREVIATIONS

List of abbreviations

Ca	Cancer
C.V.A.	Cerebro vascular accident
df	Degree of freedom
F	Female
I.C.U.	Intensive care unit
M	Male
N.H.S.	National Health Service
No.	Number of patients in the study
%	Percentage of patients in the study
P.A.C.	Pressure area care
P.S.	Pressure sore
S.D.	Standard deviation
S.E.D.	Standard error deviation
S.P.S.S.	Statistical package of social science
T. No.	Total number of patients in the study

GLOSSARY

Man-hours	Total amount of time expanded by all staff involved in an activity
Elapsed-time	The amount of time from the beginning of the activity to the end, excluding the interuptions

Introductory reason for my interest in Pressure area care

I still remember my sister's accident and her subsequent development of pressure sores. She was 20 years old, and was admitted to hospital with:

1. multiple fractures of her elbow;
2. fractured neck of left femur;
3. fracture of the left arm;
4. 40% of her body burned.

The striking feature which drew my attention was the development of skin breakdown within ten days of her admission to the hospital. Because of shortage of nursing staff at that time the decision for me to be with her as a bedside nurse was officially granted. Working with her continually for 24 hours, I attempted to increase the frequency of, and the time devoted to pressure area care. The skin breakdown on her buttock disappeared and other sites of pressure remained intact and free from further sores - even after her discharge from the hospital to her home as a temporarily chairbound patient. At home she started to be independent with improvement and no further sores. From my sister's case it seemed to me that the more pressure builds up the greater the chance of developing sores; i.e. the longer the time the patient is left without care the more time the nurse needs for treating the consequent pressure sores, the longer the stay in hospital and the higher the cost of hospitalisation. Therefore the time spent in pressure area care will affect the pressure sores and will contribute as a factor relevant in reducing the length of hospital stay.

CHAPTER ONE

General Review

1.1 Introduction

Few nursing activities occupy such a large amount of time, and cause so much controversy, as the care of pressure areas. It is a source of vast clinical expense in terms of manpower and finance, yet, for all that it remains one of the most common subjects of debate in professional nursing practice, and has been an important problem of concern in patient care for all generations of nurses. Continued interest in the subject of pressure sores can be assumed by the number of studies which have appeared in the nursing press over recent years (Kenedi, Cowden, and Scales, 1976). We seem, however, to be little nearer to a solution to the problem, and pressure sores still exist. It is not known why some patients develop pressure sores whilst others of the same age, with the same diagnosis, in a similar state of general health, nursed under similar conditions, do not; and the number of those patients developing sores in relation to the routine preventive methods used is not known. Hunt (1981), drew attention to the growing body of nursing research, suggesting that poor communication of the findings had prevented them from becoming incorporated into clinical practice. The following five main results of this communication failure are cited below:

1. Nurses do not know about research findings.
2. They do not understand them.
3. They do not believe them.
4. They do not know how to apply them.
5. They are not allowed to use them.

Therefore more knowledge is required to find out about the susceptible patient. Elderly patients particularly are more liable to pressure sores (Norton et al., 1962, 1975). Whilst better medical care is increasing the expectation of life, it may also be indirectly increasing the incidence of pressure sores, since the pathology of the ageing process is associated with the formation of pressure sores. Furthermore, the increasing numbers of medical and surgical techniques which have become available may, in themselves, lead to pressure sores. Examples include total hip replacement, and repairs to the upper shaft of the femur. However, the proportion of the elderly in the UK population is predicted to continue to increase until at least the year 2000. Many workers (Barton and Barton, 1981) feel that pressure sores reflect preventable morbidity, and provide a sensitive indicator which might be used for the allocation of funds at district and regional levels.

1.2 How much do pressure sores cost?

Treatment of pressure sores is both costly and time-consuming. In economic terms, it has been estimated that each pressure sore increases the cost of medical care for the unfortunate individual on whom it occurs. Moreover, it is reported to cost the NHS £60 million per annum (Fernie, 1973); but, this figure is considered an under-estimate. A figure of "£200 millions a year" seems more likely as the incidence of pressure sores in hospital increases (Hibbs, 1987). Meanwhile, Kenedi et al. (1976) noted that it is difficult to measure the cost of treatment in both hospital and the community because of equipment cost variation; e.g. in the community the cost of a bed ranges from £10-100, as opposed to £150-300 per patient in hospital. So more detailed investigation will be required to give more reliable figures. However, even with the provision of sophisticated and expensive equipment and facilities for home treatment, the latter will work out cheaper than hospitalisation of the patient.

As far as cost effectiveness of the treatment is concerned, in certain cases it is difficult to separate methods of prevention from methods of treatment, because many methods are used both as prevention and as treatment. Most of the measures for treatment depend on the idea of reducing pressure by using relieving devices in addition to therapy. So the cost of prevention should be taken into consideration and seems to be related to the cost of treatment. This will cover:

1. the cost of training patients to be pressure-sore conscious;
2. cost of monitoring equipment;
3. expenses of travelling for the community nurse, especially when she is calling just to bring pressure-relieving devices to the patient at risk.

1.3 Pressure sores' time consumption

Pressure sores and their prevention is still one of the most time-consuming problems faced by the nursing team. Although the time factor related to pressure area care seems to have received little attention in research to date. Scales (1971) reported that it was estimated that by instituting a particular type of nursing procedure such as using an air bed to prevent sores forming, a total of 21 hours of nursing time for one patient per week is saved compared with the use of a normal bed. Scales also reported that all nursing procedures can be carried out without lifting the patient. This is not sufficient to keep the bed-ridden patient in good health. However, Barton and Barton (1981) stated that

> Once pressure sores have become established a 50% increase in nursing time is necessary and an added burden is thrown on to the staff.

(i.e. the patient with pressure sore lesions is said to require one and a half times as much nursing time as patients in a similar condition without lesions). For this reason it is obvious that pressure sores are real problems and it is important to focus attention on factors that are responsible for the occurrence of pressure sores and their prevention. A pressure sore problem often has a major impact on the patient. To an already disabled person the occurrence of sores imposes further difficulties both for him and for those who care for him. To those patients otherwise recovering from illness, a pressure sore may retard their recovery and prolong their hospitalisation. It has an influence on the families of the patient and other citizens requiring hospitalisation as well as delaying a potential tax payer's return to his job. Relatives may be unemployed and the cost of time and travel involved in coming to visit the patient in hospital may prove to be (costly), particularly if he is in hospital for a long period of time. In addition, emotional problems arise from pressure sores as the patients sometimes suffer from one or more of the following:

1. depression
2. anxiety
3. psychosis
4. body image changes
5. sexuality problems

Family often feel unreasonable guilt about the injury or illness itself or about their inner reluctance to face the problems. The family may need significant education and emotional support from the hospital staff (Constantian, 1980).

The best method of treatment is prevention. But up to now, and although the weekly nursing journals frequently print articles about the prevention of pressure sores, still there is little knowledge of the relative effectiveness of different methods of pressure sore care. The subject therefore needs further investigation.

The prevention of pressure sores is usually seen as a nursing rather than a medical task. It extends from the level of senior nurse management who plan and allocate resources, to nurses at the bedside directly involved in patient care. Whoever is responsible, the continuity of nursing care is the most important part of prevention of pressure sores and it is likely that almost any method of prevention will work if it is followed consistently around the clock.

It is interesting to note the difference between patients nursed at home and those in hospital regarding the development of pressure sores (The Hospital Advisory

Services, 1973). A number of major studies which have been done with different groups of people at different times e.g. namely Petersen and Bittman (1971), Barbenal *et al*. (1977) and Lowthian (1979a) show that there was a higher percentage of patients with skin breakdown in hospital, although various methods of prevention had been used. In spite of this, it appears from the literature that there has been little investigation up to the present date which shows the methods of prevention of pressure sores in the community. There is a percentage of the patients who are admitted from the community to the hospital who already have skin breakdown. From these studies it seems to be possible that a relationship exists between preventive care and pressure sores development in both hospital and community. For this reason investigation of pressure sores prevention will need to include community as well as hospital patients. However, there have been no previous studies in which this relationship is explained. One previous survey (Barbenel *et al*., 1977) showed only the incidence of this problem within the community, without any indication of the method of prevention which had been used. For this reason the community could be a useful starting point for further investigation. A second reason for studying community patients has been to test the validity of community nursing. There is an impression that the number of patients with pressure sores referred to the community from the hospital has increased. This may be surprising, bearing in mind that in the hospital there are more facilities and more trained nursing staff, who should be well versed in the method of prevention of pressure sores. However, there are no baseline data which might confirm this impression.

This present practical research was undertaken to study the influence of nursing time directed to the prevention of pressure sores in order to provide more knowledge in an area in which there has been relatively little investigation to the present date. It is hoped that it will add to the information already available and that its result will encourage a higher standard of nursing practice.

1.4 The initial sign of pressure sores

The first sign of a pressure sore is the appearance of erythema (redness of the skin), which will blanche on pressure. Later the redness of the skin progresses to a dusky cyanotic blue-grey appearance which results from skin capillary occlusion due to pressure on the skin and subcutaneous tissue. Then, blistering and breakdown in the skin occur, so that by three to five days a well-circumscribed focus of necrosis results, appearing initially as a reddish grey area that progresses to waxy, yellowish grey scar and then becomes a grey-to-black area of necrosis. Bleeding may occur at the margins of the red skin. Then bacterial infection may lead to abscess formation. This process in turn initiates thrombosis of adjacent and deeper vessels involving muscles, tendons, and even bones and/or joints, causing further necrosis. Moreover, if the ulceration is allowed to continue, a large deep area of destruction results, which may ultimately include osteomyelitis or septic arthritis. The largest part of the lesion is not at the skin surface, but at the level of the bony prominences.

1.5 Definition of the terms used in relation to pressure sores

By definition, a pressure sore is a breakdown of the skin leading to ulceration of an area due to pressure on the skin, usually the skin overlying bony prominences. A variety of definitions have been used to describe the condition, all having the same underlying pathology and including bed sores, decubitus ulcers, trophic ulcers, stasis ulcers, ischaemic ulcers and more recently distortion sores. Grammatically, decubitus is a fourth-declension noun derived from the past participle of a late-Latin verb, 'decumbere' meaning 'to lie down, to recline'. The word itself would mean lying down or 'reclining' as an adjective; but like these expressions it could be a noun meaning 'the reclining position'. The word does not seem to have been used in the 19th Century to mean pressure sores caused by lying in bed. These were called 'bed sores' (Nightingale, 1866). Today the term still survives in the sixth edition of Andrews's Diseases of the Skin (1973). Domenkes changed the term to 'decubitus ulcer' or 'bed sores', so in the seventh edition the same term is used. Dorland's illustrated Medical Dictionary (1974) gives the plural of dicubitus as 'decubiti' and this plural form is seen quite often still. Since this looks and sounds like a mistake to most readers, it may be best avoided, by writing pressure sores (Synonym, dicubitus ulcer, bed sore), (Rook *et al*., 1979). However, the lesion is not always caused by pressure of a bed: an operating table, a too tight head band, a floor beneath a patient who has attempted suicide, or any prolonged pressure can produce the same lesion (Arnold, 1983).

Merlino (1969) writes that his personal conception is that decubitis ulcers are localised areas of tissue necrosis between underlying bony prominences and overlying bed, chair, cast, brace or other external compressing surfaces. Although 'decubitis ulcer' describes the problem of lying down, a large percentage of these sores develop while the patient is in a sitting position. Therefore the term 'pressure sores' is an excellent name and should be used because it is a reminder that pressure on soft tissue is the most important cause of a pressure sore and the term has an additional advantage in that it places the emphasis on prevention applying equally to all patients at risk.

The term does not, however, stress the importance of the temporal factor. Though pressure is a vital, initiating component in tissue necrosis, it has been pointed out by many observers that this occurs only as a result of a prolonged pressure insult. Consequently, the time factor must be considered as equally important. Husain (1953) suggested that the temporal factor in sore etiology was more important than intensity of pressure. Paget (1873) defined pressure sores as "the sloughing or mortification or death of a part produced by pressure". Barton and Barton (1981) defined pressure sores as

> localised areas of dead skin where necrosis is due to complete or partial occlusion of blood supply by pressure between an internal bony prominence and an outside resistant surface.

In some cases a sore has been regarded as an area of persistent erythema. However, Groth (1942) has shown two forms of pressure sores. Firstly, there is the superficial ulcer which begins on the skin surface as skin breakdown, and normally the pressure force is distributed over a wide area of the skin but tends to be concentrated over a small area where muscle or subcutaneous tissue overlies a bony prominence. Secondly, a more serious type of pressure sore starts in the deep tissues and spreads outwards to involve the skin; thus, at a time when the skin shows only erythema, extensive tissue damage is occurring in the deep layers of the damaged tissues.

The definition of pressure sores used throughout the present study is that of Barton and Barton (1981), as this definition describes the lesion of pressure sores when they first appear, especially over bony prominences. It is important to remember that not all patients at risk develop sores at the same rate. In the present study, only those patients who showed a break in the skin surface of the 'pressure areas', occurring over the bony prominences, were considered to have pressure sores. Thus, patients showing skin erythema alone, without further evidence of tissue damage and which condition did not progress to actual ulceration, were not classified as having sores.

1.6 Superficial sores

Pressure sores may develop in any patient who is immobile. Basically, there are two types of superficial sore, one of which is indeed initially superficial but if left unattended will progress and destroy the underlying tissue, forming a deep wound (Fig 1.1).

Superficial sores begin at the skin, especially the epidermis, due to the force between the skin of the patient and the contact with bed clothes, particularly if the skin is moist, or in any other way which increases the maceration of the skin. Superficial sores are often found in dry skin and when there is creased dirty linen that will exert pressure.

In some cases superficial sores develop by movement rather than by lack of movement, causing trauma of the skin due to a cumulative effect of friction on the same area of tissue. This is one reason why patients in sliding traction are particularly prone to superficial sores. Superficial sores can be inter-related to deep sores (Bliss, et al., 1966) and some further harmful effects of friction itself and friction augumented by direct pressure, are discussed. Included in these is the phenomenon of stretched surface membrane spasmodic movement and frequent movement, if superficial sores begin in the skin and progress to the dermis and then penetrate the deep layers, depending on the level of causative insult. Groth (1942) describes 'deep sores' as sores originating from deep tissues and spreading to the surface, whilst Husain (1953) associates all types of pressure sore with an initial deep lesion within the muscles close to the bony surface.

1.7 Classification of pressure sores

Several classifications have been applied to pressure sores. Some are based on the causes and appearance or size of the sores. Others are based on the

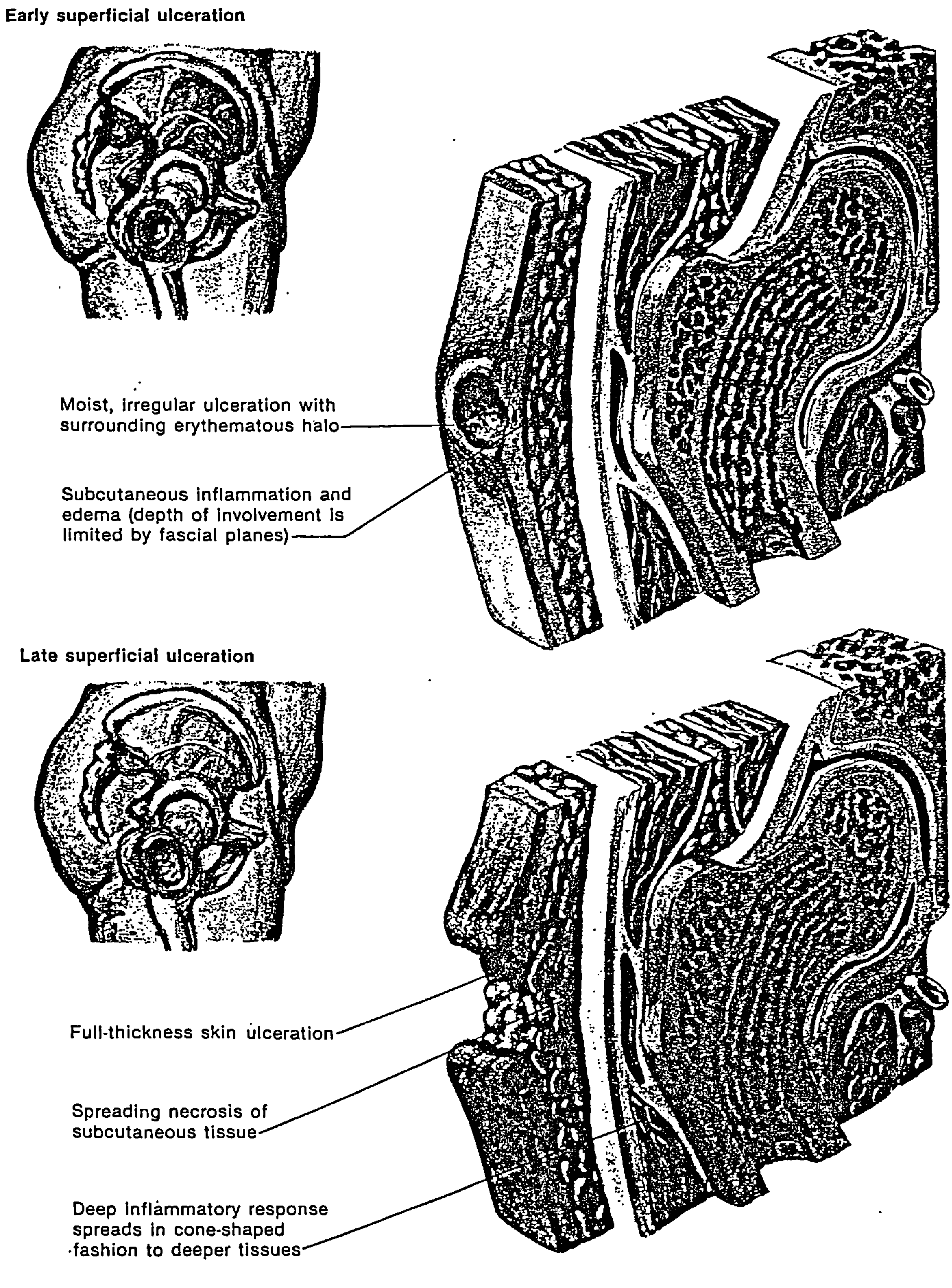


Fig 1.1 Evolution of a Pressure Sore
After Agris and Spira (1979).

shape and size and this is thought to give an indication of the likely cause. Sores caused by pressure alone are usually circular and have vertical sides, whilst those caused by shearing forces often have sloping side walls and are triangular in shape. However, some types of sores have a combination of both characteristics, indicating that both direct pressure and shearing force contributed to the formation of these sores. Meanwhile, some sores are classified by the processes involved in pressure sore formation (Shea, 1975; David et al., 1983). Pathological studies have demonstrated muscular lesions long before superficial bed sores appear. Experimental investigation into the mode of action of pressure has shown the susceptibility of muscles to physical disturbance as contrasted with the relative resistance of the skin and to a lesser extent of the fat (Husain, 1953).

1.8 What are the most common sites on the body for pressure sores?

Pressure sores occur anywhere on the body, but the most likely areas are over bony prominences, those bony prominences of the skeleton where the skin and subcutaneous tissues are thin and where the surface is highly curved; for example, sacrum, trochanters, ischial tuberosities, knees, fibula, malleali, heels and fifth metatarsals (Fig 1.2). The occiput and elbows are also at risk in patients with cervical cord lesions. When a patient is placed in a plaster cast, sores may also develop over the ribs, spinous processes and anterior and posterior superior iliac spines. Pressure sores might occur under splints, plasters, calipers

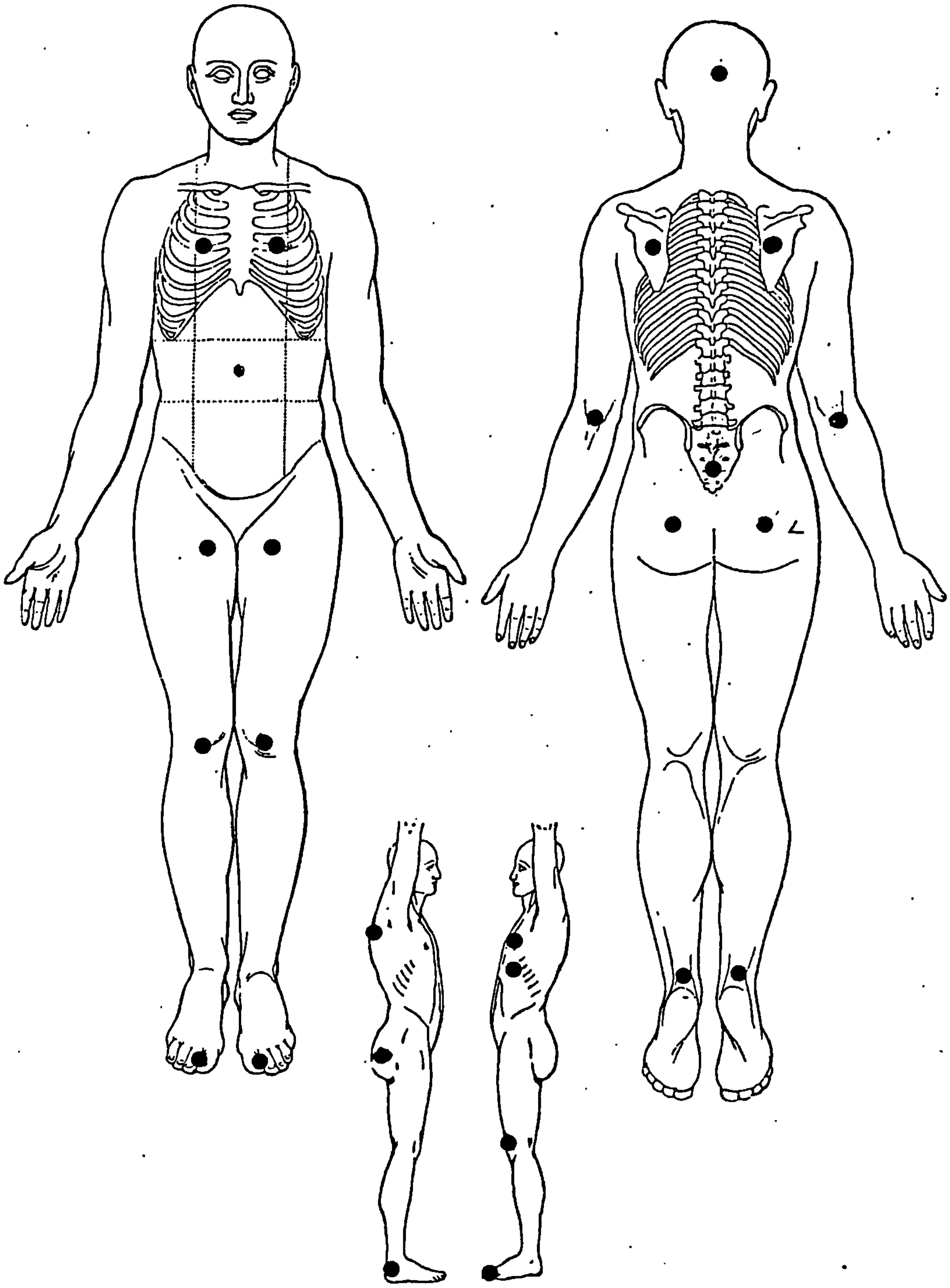


Fig. 1.2 Sites of pressure sores.

and braces, applied over a paralysed area, or due to ill-fitting shoes, especially if there is oedema in the feet. However, even the genitalia are more likely to develop sores when there is tight clothing at the site of genitalia and when there is dampness due to high temperature accompanied by little ventilation or sometimes (due to) incontinence. Bardsely (1977) shows the distribution of sores related to the posture of a patient who is susceptible. Chairfast patients mostly develop sores over ischial areas and at the post-trochanteric areas of their hips, whilst in the bedfast patient they are mainly developed on the sacrum, the trochanter, the head of the fibula, the ankle, the heel and the outside of the feet. Meanwhile, both bedfast and chairfast patients show a high prevalence of sacral sores.

A high percentage of pressure sores (96%) occur in positions below the waistline, i.e. below the level of the umbilicus (Petersen and Bittman, 1971). Of these, 58% occur in the pelvic area and 26% on the lower limbs (David et al., 1983).

1.9 Incidence and prevalence of pressure sores

Pressure sores are a common problem and have a major effect on patient morbidity, mortality, rehabilitation and health care expenditure. At present no precise figures on the incidence of pressure sores are available, but Barton and Barton (1981) quote a figure for prevalence of 30,000 patients with pressure sores at any one time in the UK. Major surveys have been carried out in Aarhus in Denmark (Petersen and Bittman, 1971) and in the Borders Glasgow Health Board area (Jordan and Nicol, 1977).

Furthermore, a recent prevalence survey took place in Surrey (Clark and Crow, 1986). These surveys, currently available, indicate a prevalence rate of pressure sores among patients in hospital and in the community ranging from 3% (Petersen and Bittman, 1971) to 6.7% (Clark and Crow, 1986) to 11.7% (Jordan and Nicol, 1977) in hospital. In contrast, the prevalence rate of patients with pressure sores in the community ranges from 0.01% (Petersen and Bittman, 1971) to 1.1% (Clark and Crow, 1986) to 4.8% (Jordan and Nicol, 1977). These studies strongly suggest that hospital patients have a higher prevalence of sores than do those nursed at home. All these figures are alarmingly high, possibly because of a high proportion of bedfast and immobile individuals in the population sampled. However, Barbenel et al. (1977) reported that the differences in sore prevalence between the hospital and home groups disappear if patients of similar degree of disability are compared.

The difference in percentage between hospital and community may be real or due to the type of population, especially the type of group surveyed. Alternatively, there is a difference in terms of gradings of pressure sores. In the Danish survey, Petersen and Bittman's (1971) definition was

at least an epithelial defect present.

This appears to be closely comparable with the criteria for a sore of "grade 2" or worse. However, in Glasgow and Border surveys they grade a pressure sore as listed below:

Grade of sore	Description
1	Erythema and redness of skin.

2	Superficial pressure sore.
3	Destruction of the skin, no cavity.
4	Destruction of skin with cavity.

The percentage of patients who developed pressure sores in both surveys was higher in hospitalised bedfast or immobile patients, in particular patients with spinal cord injury.

Furthermore, the majority of patients who developed pressure sores were found in the geriatric, orthopaedic, general medical and surgical wards as well as the GP Units, of which "more than 91%" were over 60 years of age (Crow, 1986).

1.9.1 Incidence of pressure sores in relation to elderly patients

Incidence of pressure sores has been shown to increase with age (Norton et al., 1962, 1975). In both surveys (Glasgow and Denmark) age seemed to be significantly associated with the incidence of pressure sores in both hospital and community. Barbenel et al. (1977) found 70% of both hospital and home patients with sores were 70 years of age or over and 71% of all patients with sores were over retirement age. Bliss et al. (1967) stated that

> 35% of the geriatric patients in nursing homes have pressure sores.

The principal etiological factors are immobility, incontinence of urine, faeces, or both; and wasting and debilitating diseases. It is this group of patients who must be identified early and treated with aggressive nursing care, including local skin care, frequent inspection, correction of incontinence, and avoidance of pressure. Further, from the Glasgow survey it appears that the elderly are less likely to develop pressure sores at home.

In Britain, 16% of the population is over 65 years of age. This percentage is likely to increase to nearly 20% by the end of the century, and according to Redfern (1986) it is estimated that by the year 2000 the number of people aged 75 or over, will have increased by 42%, Norton et al. (1962, 1975) suggesting that the number of pressure sores will rise dramatically. Thus, if the same level of care is to be maintained, the resources required for treatment of pressure sores will have to increase correspondingly. The increasing percentage of elderly patients in the overall population suggests that health services will need to spend proportionately more on the problem of pressure sores in the future. In a comparison of some of the Glasgow surveys, David (1981) considered that their result would be of use in the numerical estimation of those patients who will have pressure sores in the future and as an indication as to which group of patients is prone to pressure sores. Table (1.1) gives a summary of the pressure sores prevalence.

In the late nineteenth and early twentieth centuries, pressure sores were not frequently seen in young persons who had a variety of wasting diseases. At the present time, the most common setting for pressure sores in young groups of patients is among those with spinal cord injury.

STUDY	POPULATION	NUMBER with SORES	NUMBER of SORES	% WITH SORES	% 70 YEARS+
Petersen & Bittman (1971)	517,000 (hospital-ised) 4,437	223 (131)	318 (188)	0.43 (3.0)	15.5
Jordan & Clark (1977)	(10,751)	946	1,394	8.8	50
Stapleton (1978)	2,218	135	211	6.0	45.6
Ek and Boman (1982)	1,776	71	109	4.0	mean ave73.8
Jordan & Nicol (1977)	999	94	-----	9.4	70
Gerson (1975)	5,648	152	-----	2.69	average age 49.5
Rubin <u>et al</u>. (1974)	18,000	262	-----	1.45	----
Lowthian (1979a)	186	13	28	7.0	15.6
Woodbine (1979)					
Survey A	51	48	83	94	94
Survey B	49	12	-----	24	45
David <u>et al</u>. (1983)	14,448	961		6.7	
Nyquist & Hawthorn (1987)	2,513	132	233	5.3	80.3 male over 65 76.5 female

Table 1.1 Summary of pressure sore prevalence survey results.

1.9.2 The problem in relation to orthopaedics

Recent data from the United States regional spinal cord injury system for the years 1975 to 1980 showed that 40% of spinal cord-injured individuals developed pressure sores during the period from the onset of the injury to initial rehabilitation discharge. The Greater Glasgow health board Study (1977) and the Danish one (1971) showed orthopaedics as another specialisation where the incidence of pressure sores is higher. In the Royal National Orthopaedic Hospital 7% of 186 patients surveyed had sores (Lowthian, 1979a).

General indications are that about two-thirds of patients in most orthopaedic wards are over the age of sixty and the majority of them are admitted with fractured femurs. (Table 1.2) shows a one-day prevalence rate of pressure sores cases in orthopaedic patients (Jordan and Nicol, 1977; Jordan and Clark, 1977).

Title	% of orthopaedic patients with sores	% of all patients in study with sores
Jordan and Nicol (1977)	19.2	9.4
Jordan and Clark (1977)	11.9	8.8

Table 1.2 One-day prevalence rate of pressure sores cases in orthopaedic patients.

1.9.3 Incidence of pressure sores in relation to bedfast, chairfast patients

Jordan et al. (1977) and Barbenel et al. (1983) pointed out that there was a striking difference between the sore prevalence of patients who used a wheelchair, and to those who did not. There was also a significant difference between wheelchair users in hospital and in the community ($P = < 0.01$). But it was found that for patients with a similar degree of incapacity, the chairfast were slightly worse in sore incidence than bedfast, although the differences were small and not statistically significant. The number of patients with wheelchairs was greater than that of bedfast patients (1659 to 595); and in terms of actual numbers, but not proportionately, many more chairfast than bedfast had sores (303 to 163).

The difference found between bedfast and chairfast in terms of incontinence could not be studied in sufficient detail from the data contained in the survey and it was not possible to produce specific weightings for each of the factors associated with a high pressure-sore prevalence.

There was a strong relationship between the presence of sores and incontinence (Torrance, 1983). However, it is more likely to be other factors in association with incontinence that are responsible for a higher incidence of pressure sores. Fréquency of pressure sores in relation to the continence status of the patients was found in patients with a faecal and catheter incontinence, the proportion of those patients with sores being significantly ($P = < 0.01$) higher than with double incontinence ($P = < 0.05$). However, the reason for the very high incidence of sores in patients in the catheter and faecal incontinence group is not clear yet. It may be that the catheter is inserted in an attempt to improve the environment of a pre-existing sore.

The Glasgow survey showed that 74% of the survey population was incontinent to some degree and there was a clear association between the severity of the incontinence and the prevalence of pressure sores. Furthermore, from all the above studies, the following impressions have been confirmed:

1. The greater incidence of pressure sores was in the chronically ill, the young and the elderly (Waterlow (1988a).
2. The immobilised patients, by either spinal cord injury or infirmity, were prone to the development of sores.
3. 96% of sores were located below the level of the umbilicus. Thus, the epidemiology of pressure sores reveals at least three major at risk groups.

a. Young, chronically ill patients neurologically impaired.

b. Elderly patients.

c. Hospitalised patients.

The usefulness of these surveys in the preparation of this study has been considerable as a guide for the estimation of sample size, the type of hospital and patient to be included.

1.10 Pathophysiology of pressure sores

To facilitate a better understanding of the pressure sores etiology and prevention, a basic knowledge of the skin anatomy and physiology is necessary.

1.10.1 The skin

Most of our contacts with the environment are through the skin, which is a tough but pliable, durable, and resistant covering for the body. It is a dynamic structure in which cellular replacement and modification in response to local needs is a continuous process throughout life. The skin is one of the largest organs in the body, constituting approximately one eighth of the weight of a normal individual (Table 1.3), (Wood and Bladon 1985). Its attachment to underlying tissue varies, being loose over most of the trunk and joint flexures, but relatively tight over the palms of the hands and soles of the feet. The thickness also varies. Thus, the skin of the eye-lids is very thin, whilst that of the callus areas (palms and soles) is much thicker.

Skin receives about one third of all blood circulating through the body. The epithelium of the skin is continuous with that of the digestive, respiratory and genito-urinary system at their external orifices.

Tissue	Kg fresh weight
Skeletal muscle	30.0
Internal organs	7.3
Bone	9.0
Skin and subcutaneous tissue	7.8
Adipose tissue	4.0
Blood	5.5
Connective tissue	1.0
Tissue fluids	0.4

Table 1.3 Weight of the various tissues of a 65kg human male.

1.10.2 Functions of the skin

A) Protection

The skin has many functions. It protects from the passage of harmful physical and chemical agents and inhibits excessive loss of water and electrolytes. The acid of the skin helps protect its surface from irritants and bacteria. In some skin impairing conditions the skin is prone to bacterial invasion. Experimental evidence indicates that the normal, intact human skin is usually impermeable to water, carbohydrate, fat, and protein.

B) Temperature regulation

The thermoregulatory capacity of the skin is by virtue of the processes of conduction, convection, radiation and evaporation. These processes are regulated by nervous and chemical activation of the sweat glands and by dilation of blood vessels. If the body needs to dissipate heat, blood vessels of the skin dilate, allowing more blood to the surface, with a resulting heat loss.

C) Reception of stimuli

The skin contains sense organs or the sensory nerve fibres. The specific receptors sensitive to the four basic sensations of pain, touch, temperature, and pressure are located in the skin. Upon stimulation of a recepter, a nerve impulse is sent to the cerebral cortex of the brain. The brain must interpret between degrees of stimulation and between combinations of stimulation. By this means one becomes both physiologically and sometimes actually aware of items of the environment such as heat, cold, pain, pressure, etc.

D) Secretion

The secretory role of the skin is performed by sebum secreted by sebaceous glands. Sebum has antifungal and antibacterial properties and helps us maintain the texture of the skin. Sweat is also a secretion.

E) Absorption

Vitamin D is manufactured in the skin. Vitamin D and also some oily materials placed in contact with skin are absorbed easily through it (Jacob et al., 1978).

1.10.3 The structure of the skin

The skin is a highly specialised epithelial structure. It can never be replaced except by scar tissue. Normal skin consists of: an outer non-vascular layer, the epidermis, cutical, or scarf skin; and a deeper layer, the dermis, corium, or cutis vera, which consists of vascular connective tissue and contains the lymphatic, nerve, hair follicles and sebaceous and sweat glands. The outer skin layers (epidermis) and the lower connective tissue layer (or dermis) are easily recognised (Fig 1.3).

1.10.3.1 Epidermis

This is a cellular and vascular layer consisting of stratified squamous epithelium. In the human being, it is 0.06 - 0.1mm thick in most regions, but tending to be thicker on the back and much thicker in callus areas. The epidermis is composed of five distinct layers. From superficial to deep, they are:

A) The Stratum Corneum

This consists of dead cells completely filled with a protein called keratin. They are commonly called keratinized cells and are continuously shed, requiring replacement. The stratum corneum consists of 20 percent

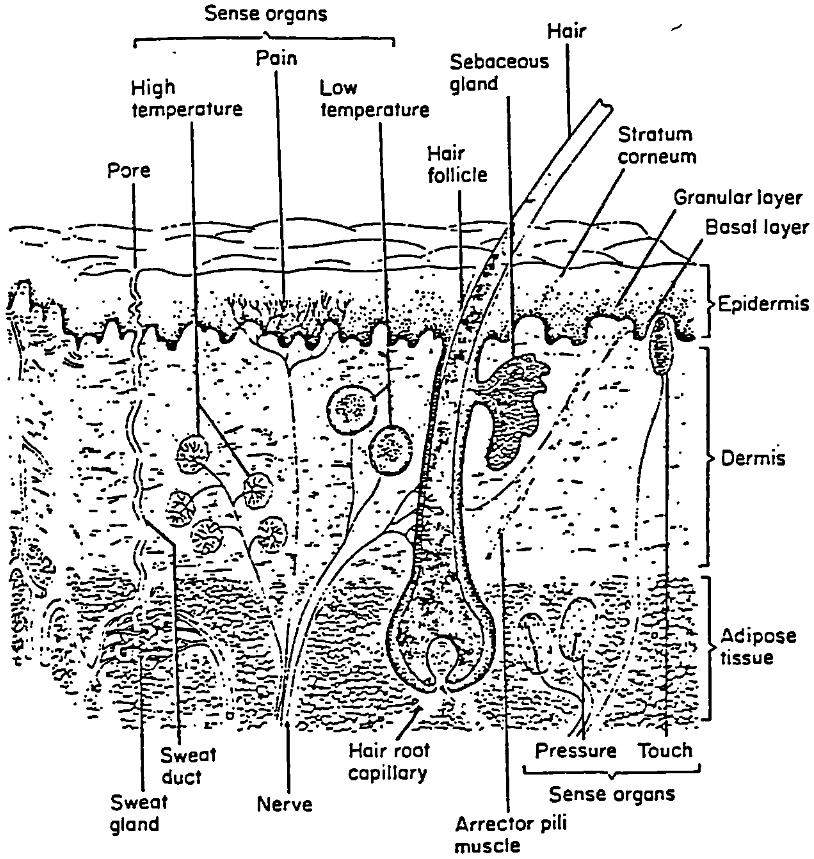


Fig 1.3 Structure of human skin.

Reproduced from Beckett, B.S. (1982).

water, as compared to 70 percent water in the stratum germinativum. It resembles scales. It serves as a physical barrier to light and heat waves, micro-organisms, and most chemicals. The thickness of this layer is determined by the amount of stimulation of the surface by abrasion and weight bearing - hence thick palms and heels.

B) The Stratum Lucidum

Lying directly beneath the stratum corneum, it is not seen in thinner skin. It is a layer of one to five cells thick, consisting of transparent, flattened, dead or dying cells, usually lacking nuclei.

C) The Stratum Granulosum

Two to five layers of flattened cells thick, it provides a transition into the subjacent layers. Granules accumulate in the cells, giving the layers its name, although the granules do not contribute to skin colour. The stratum granulosum is thought to be active in keratinization, a process in which cells manufacture keratin and lose their nuclei, becoming more compact and brittle.

D) The Stratum Spinosum

This consists of several rows of 'prickly' cells, polyhedral in shape. The cell outlines are spiny, hence the name, 'prickle' cells. In some classifications this layer is included with the stratum germinativum.

E) The Stratum Germinativum

This is the deepest and most important layer. It contains cells capable of mitotic division. When new cells are formed, they undergo morphological and nuclear changes as they move toward the superficial layer. Simultaneously these cells give rise to all outer layers of the epidermis. The epidermis will regenerate only so long as the stratum germinitivum remains intact. The basal layer of these generative cells rests on a basement membrane which offers further protection from the environment. The principal pigment of the skin is formed in the stratum germinativum by cells called melanocytes and is transferred from melanocyte processes to surrounding epithelial cells. The presence of carotene is in part responsible for the yellow colour of the skin. The darker colour of the skin is due to melanin. The strongest factor in increasing pigmentation is the sun's stimulating effect on melanocytes. A variation in melanin content is the principal factor responsible for the colour differences among races. Certain population groups have more active melanocytes in their skin. This causes black, yellow, brown, and white races. Darkly pigmented skin does not contain a greater number of melanocytes, but the melanocytes present are more active. Further, no blood vessels pass into the epidermis, but fine nerve fibres lie between the cells of the inner layer.

1.10.3.1A Functions of the epidermis

The primary functions of the epidermis are to act as a barrier against water loss, and as an important source of new cells during wound healing. The epidermal cells receive their nourishment by diffusion from fine capillaries in the dermis and also possesses the following appendages:

1. The ecrine glands
2. Sebaceous glands
3. The apocrine glands
4. The nails.

1.10.3.2 Dermis

The dermis or corium, lying directly beneath the epidermis, is often called the true skin. The dermis is much thicker than the epidermis (2-4mm) and arises from the embryonic mesoderm. It is a highly sensitive and vascular layer of connective tissue. It contains fibroblasts and collagen fibres which form a matrix in which nerve, sensory structures and blood vessels lie embedded together with fat cells and into which project the hair follicles, sebaceous and sweat glands. It consists of two layers: the papillary or superficial layer, and the reticular or deeper layer. The surface of the papillary or superficial layer is increased by protrusions in the form of small conical elevations, and it is moulded over them. The reticular part contains connective tissue bundles, below which lies the subcutaneous tissue. The dermis contains the following structures, connective tissue fibres, cellular elements, blood vessels, nerve, muscles and lymphatics.

A) Functions of the Dermis

These are to regulate the body temperature, to act as a sensory organ, and to dissipate pressure. The dermis varies in thickness over different parts of the body, so the ability to dissipate pressure varies from one area to another. Beneath the dermis there are layers of subcutaneous fat, connective tissue and muscles. Beneath all of these layers is usually either bone or a body cavity such as the peritoneum. (Fig 1.3) is a simplified diagram of the human skin.

1.10.3.3 Adipose tissue

The subcutaneous adipose fatty tissue helps to distribute the load applied to the surface of the body and provide a cushioning effect for impact loads. Also, it serves as a thermal insulating layer and as a store of energy.

1.10.4 Blood vessels in the skin

To understand the formation and the etiology of pressure sores, it is important to appreciate the anatomical and functional distribution of the blood supply to different regions of the skin. The blood supply nourishes the skin and removes its waste products, as well as playing an important role in the regulation of body temperature. The dermis has a rich blood supply; the arterioles supplying the skin form a network in the subcutaneous tissues with branches supplying the hair follicles and sweat glands. Branches from the subcutaneous network form suprapapillery plexuses from which capillary loops supply the papillae. In the larger papillae, the capillary loops can be convoluted.

The living flesh is supplied with the nutrients and oxygen necessary for cell metabolism by the arterial blood vessels. The large arteries branch out into a network of minute capillaries which run through all the peripheral tissues of the body, including the dermis and subcutaneous tissue. De-oxygenated blood is returned to the heart and lungs through the veins, which connect to the arterial system at the capillaries.

The removal of waste products from the flesh is also accomplished by the blood, with the aid of the lymphatic system. The skin is rich in lymphatic vessels in the dermis. These start at the tips of the papillae and pass between connective tissue fibres to join up eventually with the larger lymph vessels. Blood collects into venous plexuses below the arterial plexuses, but arterio-venous shunts known as 'glomus bodies' situated in various regions of the skin, allow the capillary circulation to be short-circuited. By shunting the blood in this way less heat may be lost. The blood vessels of the skin are perhaps its most vulnerable structure and are the most important structures when considering pressure sore pathophysiology.

1.10.5 Innervation of the skin

The skin is the major interface of the body with the environment and it is richly supplied with nerves which are constantly transmitting information about the environment to the brain. Cutaneous sensibility includes the ability to detect changes in temperature, a sense of touch and pressure, sensitivity to vibrations, and ultimately the ability to experience pain. Many of the sensory neurones terminate in specialised receptors but may end in unmyelinated free nerve endings in the skin. These latter tend to form plexuses from which fine branches penetrate between the cells. They probably have functions in relation to the sense of touch and of pain. The nerves of the skin terminate partly in the epidermis and partly in the dermis forming superficial and deep plexuses in the dermis. Impulses concerned with sensation of pain are carried mainly by extremely fine varicose fibres which are found in the superficial plexuses immediately below the epidermis. There are five types of these nerve receptors which are responsible for the skin sensibility. These are as follows:

1) Meissner's corpuscles are responsible for recognising exactly what point of the body is touched and also for recognising the texture of the object touched.
2) Merkel's corpuscles send a steady signal that allows the perception of the continuous touch of objects against the skin.
3) Pacinian's corpuscles are responsive to various cutaneous stimuli. They seem to be involved in sensing vibration and in the perception of pressure.
4) Tonic receptors transmit the information to the brain on the state of a particular part of the body and its relationship to the surroundings.
5) Rate or phasic receptors give information about changes.

1.10.6 Location of Micro-organisms of the skin

The skin is quite a rich habitat for micro-organis ms, including bacteria and fungi, as well as for certain small arthropods. There are four structures which bacteria can colonise: the surface of the skin, the hair follicles, the sebaceous glands and the sweat glands. It is generally accepted that micro-organisms are present in the superficial layers of the skin. Montes and Willborn, (1970) examined sections of the skin from sites all over the body with an electron microscope and found bacteria located beneath the most superficial cells of the stratum corneum. The presence of micro-organisms in hair follicles and associated sebaceous glands is a subject of debate. Price (1938) stated that

> Bacteria were common in hair follicles but did not penetrate deeply.

However, Montes and Willborn (1970) claimed that there were numerous bacteria in the opening of the hair follicles and associated with sebum in comedones. The sweat glands have also been seen as a potential site for bacteria. Meanwhile, (Price, 1938) stated that

> They are not present in sweat glands.

Pecora et al. (1968) supports this, whilst Lovell (1945) reported that there are no bacteria in any part of the sweat glands after he used incubated skin biopsies. He suggested that the absence of bacteria in the sweat glands is because sweat is secreted continuously and that mouth of the duct is so small that they can not gain an entrance.

1.10.6.1 The nature of the micro-organism of the skin

A variety of anaerobic and aerobic bacteria live in the skin. Price (1938) distinguished between the "resident flora" which are more or less constant and live and multiply on the skin, and "transient flora" which are deposited on the skin.

The resident flora are thought to exist in the crevices and deeper layers of the skin, whilst the transient flora are present in superficial layers of the epidermis. However, the resident flora have been considered as non-pathogenic and the transient flora as potential pathogens. This distinction is questionable since a number of the resident bacteria become pathogenic when they are not in their usual location; for example, staphylococcus aureus lives and multiplies on the skin where it acts like a commensal. However, if it gains access to the tissue it can cause septicaemia and wound infections. However, the idea of non-pathogenic and pathogenic bacteria is being re-examined in the light of the possibility that all bacteria are potentially pathogenic.

1.10.6.2 The ecology of the flora of the skin

The presence of microbial flora must be regarded as normal, and the organisms are prevented from invading deeper into the body by chemical factors such as lysozyme in the tears and saliva and by gastric acidity. Many bacteria live on the skin surface. Some are obligate anaerobes, and many live in the sebaceous glands and hair follicles. Presumably these commonly play some part in denying pathogens the opportunity to colonize. However, the delicate ecological balance is easily upset by some types of anti-microbial therapy as well as by the use of steroids and immune-suppressive agents. For example, it is a common finding that the yeast-like fungus Candida, normally present on the skin and mucus membranes, and which is resistant to most antibiotics, will tend to undergo explosive growth and infect the oral, oesophageal and vaginal tracts leading to candidiasis, or thrush, if broad spectrum antibiotics therapy is instituted. Moreover, damp skin folds favour the growth of organisms, e.g. the axillae, the skin between the toes, skin beneath bandages. These are typical sites for the growth of micro-organisms, such as Candida and other fungi.

Removing staphlococcus albus from the skin either by repeated washing with hexachlorophene or with antibiotic drugs is often followed by a proliferation of the gram negative flora. This may be because the production of the fatty acids has decreased, or because the removal of the gram positive flora makes available a more spacious environment for other species. As yet there is no direct evidence of this.

1.11 Pressure

Pressure is defined as

The force exerted perpendicularly over a given area, divided by that area.

1.11.1 Types of pressure   Source : Crow *et al*., 1981.

A) Compressions

Gravitational forces cause the skin on areas of the body which are in contact with hard surfaces to become compressed by the body's weight. Normal mean capillary pressure is 25mm Hg. It is seen that normal compressive pressure of 100mm Hg during sitting or lying are sufficient to temporarily occlude capillary circulation. The pressure to which human skin is subjected while sitting and lying has been determined (Lindan, 1961; Kosiak *et al*., 1958).

B) Shear pressure (drag)

Gravitational forces exert shear pressure when the body is in an inclined position, as in Fig 1.4. The weight of the trunk causes the body to continuously slide down the bed. The skin surface adheres to the under-sheet, causing shear forces in less superficial layers. Inflammatory reactions to damage thus incurred may promote coagulation of the peripheral micro-circulation, resulting in occlusion and further tissue damage due to anoxia (Warner, 1982).

The wounding of the skin results from shearing pressure (or shearing force), which damages blood vessels and causes platelet thrombosis of the micro-circulation (Barton, 1976). When pressure is applied at an angle to the skin, tissue layers move over one another, causing tissue distortion; this force pulls the tissues rather than pressing on them, moving one

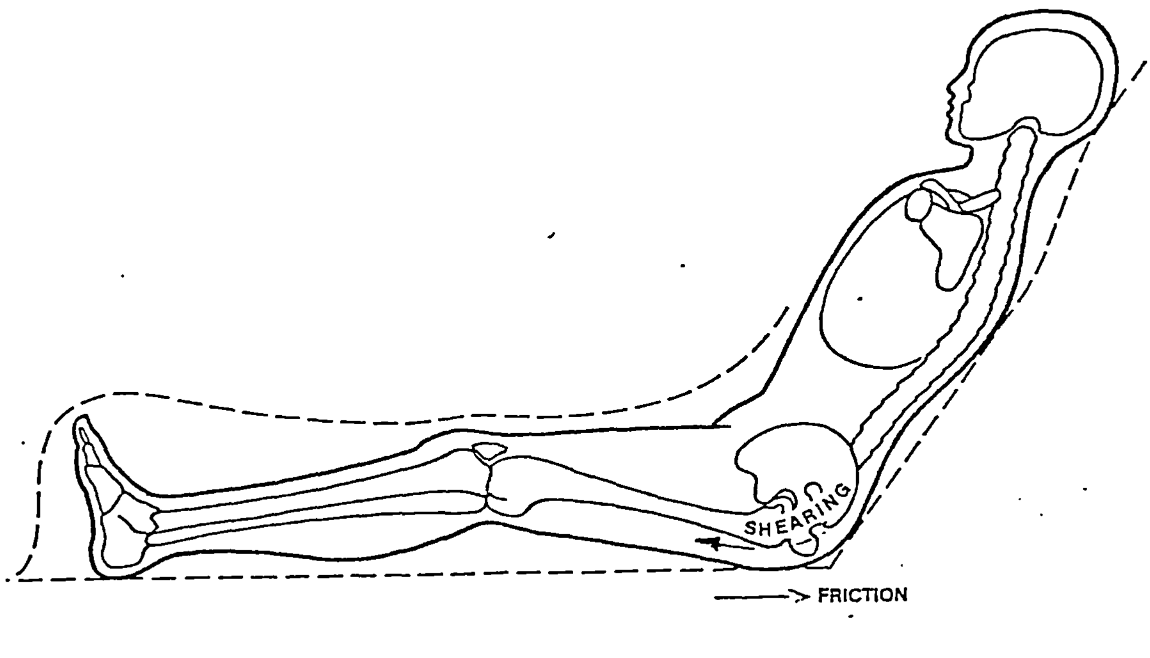


Fig 1.4 Semi-recumbent patients are at risk from shearing and friction.

layer of tissue over another. Shearing pressure stretches the soft tissues between the bone and the skin which has cohered to some external material, and some blood vessels caught in the stretching are blocked. When this shearing force is strong enough, soft tissue, including blood vessels, may be stretched so much that they are torn apart. Either by blocking of blood vessels or by tearing tissues, shearing force can cause severe damage, and this is the important reason why pressure sores may start in the tissue under deep layers of the skin and become quite large before the skin breaks down to form an ulcer. The duration of the shear force is as important as its magnitude. Moreover, repeated shearing due to poorly executed lifts can cause considerable damages.

C) Frictional pressure occurs when one surface rubs against another, for example, when a patient with limited mobility moves himself around in bed without lifting his buttocks off the bed. It represents a particularly important factor in elderly patients, where it may readily lead to skin abrasion and so open up a route for the introduction of infection. Sometimes it happens in skin folds under the breast or between the buttocks, in which the presence of warmth or moisture promotes the growth of pathogenic bacteria which cause damage to tissue.

D) <u>Direct disruptive damage</u>

Peripheral circulation to pressure areas may be directly disrupted during surgical procedures such as a hip replacement operation (Barton, 1976).

According to Groth (1942), fat and muscle resist pressure injury less well than does skin. Further, because fat and muscle are relatively closer than skin to bony prominences, pressure is concentrated in smaller areas in the deeper tissues. Thus, the greater the pressure on the skin, the more the tissues are distorted.

The duration of the pressure is more important in effect than its magnititude. Thus, for example, prolonged periods at lower pressure can be as damaging as short periods at higher pressure. Husain (1953) and Kosiak (1959) have demonstrated, that

> there is an inverse relationship between time and pressure.

The precise tolerance of the skin to prolonged pressure is unknown, although it is widely believed that sore etiology is dependent on a pressure-time relationship (Parish et al., 1983).

1.11.2 Pressure-time relationship

Kosiak (1959) has determined that the production of pressure sores depends not only upon the degree of pressure, but also upon the length of time that pressure is exerted (Fig 1.5). Brooks and Duncan (1940) concluded that the duration of pressure was of greater importance than the degree of pressure. However, Kosiak (1959) considered intense pressure of short duration to be equally as injurious as lower pressure over a longer time, due to the

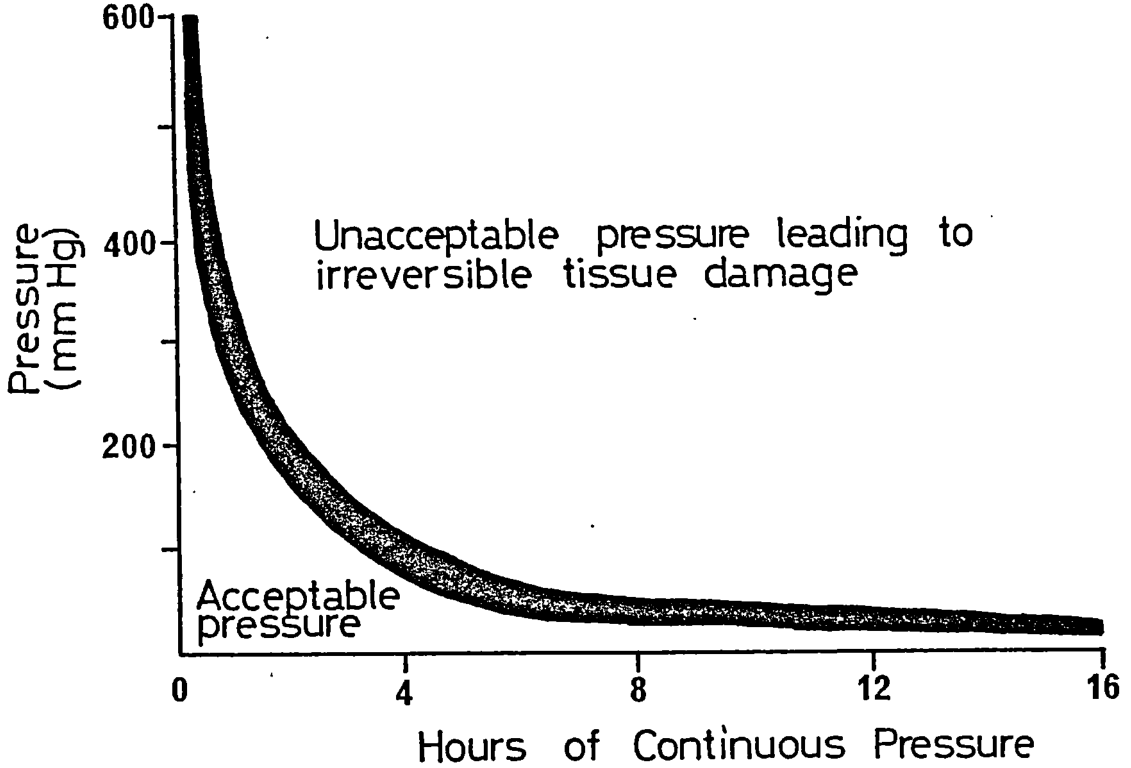


Fig 1.5 Long periods of low pressure can be as damaging to tissues as short periods of high pressure. The width of the line indicates the lack of precision in the relationship.

involvement of larger blood vessels.

Meanwhile, in a study on rats, Husain (1953) found that an external pressure of 100mm Hg applied for 2 hours to the skin produced ischaemic histological changes in the underlying muscle. But when the pressure was applied for 6 hours, complete muscle degeneration occurred. He concluded that "length of time appeared to be more critical to tissue damage than actual pressure exerted. That is, low pressure maintained for long periods of time produced more damage than high pressure maintained for short periods".

Kosiak (1959) and Husain (1953) both concluded that high pressure over a short time caused the rupture of the skin and necrosis, compared with a prolonged low pressure insult, where necrosis was the result of prolonged ischaemia. Husain further commented that long periods of pressure were more damaging than high pressure maintained for short periods, suggesting that the time factor in sore etiology was more important than the level of the pressure insult. Brand (1976) demonstrated that repetitive moderate pressure also caused pressure tissue damage. Thus, the conclusion is that on balance the length of time for which pressure is exerted is the most crucial factor in the development of pressure sores.

1.11.3 Effect of the pressure

Localised pressure does not directly harm living tissue. It is the compression of local blood vessels causing ischaemia, which results in a deprivation of nutrients, mainly oxygen, and a build-up of metabolic waste. Tissue death results from anoxia, not from mechanical disruption of cells. However, if the period of pressure-induced ischaemia is long enough, or repeated at frequent intervals, tissue necrosis will follow.

Husain (1953) found that point pressure obliterated more vessels in muscles than in skin and subcutaneous tissue. Husain concluded that point pressure caused tissue injury by:

1) Increased capillary permeability (particularly after the release of pressure), interstitial oedema and blockage of lymphatic and venous channels.
2) Ischaemia and its aftermath.
3) Changes in muscles, loss of cross striations, fragmentation, and eventual necrosis.

He also showed that effects on tissue can induce pathological changes in the muscles, which in turn impair its functional capacity. It is important to realise in this connection that the value of the threshold of pressure above which damage is caused, is reduced even by partial interruption of the arterial supply of the affected part. When the vascular supply of nutrients and oxygen is interrupted by continuous pressure for too long, this will lead to cellular death or can start the development of pressure sores, though it may not be immediately apparent as a surface ulcer. In addition, pressure can occlude lymphatic vessels and the resultant build up of toxic waste may contribute to cellular damage. Krouskop et al. (1978) found that the major contributing factor to pressure sore development is the tissue necrosis that is caused by the accumulation of anaerobic metabolic waste products due to occlusion of the lymph vessels.

A number of skin areas in sitting, prone, and supine subjects develop pressure sufficient to cause tissue ischaemia; for example, pressure over occipit, spine, sacrum, and heels, when the subject is supine, and over the costal margins and knees when subjects are prone.

Bush (1979) measured the pressure under the ischial tuberosities when the normal subjects sat in a wheelchair fitted with hard seats and found an excess pressure of 30lb/inch^2 in case of feet were supported. He also observed that the pressure under ischial tuberosities did not differ significantly whether the subjects sat with their feet hanging free or extended and supported at the calves.

1.11.4 The stress factor

This could be either
- A. Mechanical stress
- B. Emotional stress

Pressure sore development increases especially during the first two weeks of hospitalisation for bed-ridden patients (Exton-Smith, 1976). However, Brand (1976) reported that a repetitive moderate mechanical stress such as pressure in bed, may produce tissue necrosis. Also, Harman (1947) and Stock and Majno (1969) have demonstrated the pathological changes which instigate the effect of pressure on soft tissues, including skin and muscle.

Kosiak (1959) were in agreement with Husain (1953) in showing the histological changes in the skin and muscle after application of pressure (Table 1.4).

The skin may survive periods of ischaemia as long as "six hours", in spite of underlying tissues which are more vulnerable than skin to pressure injury (Wilms and Majno, 1969). However, Cotran and Majno (1964) showed electron microscopic pressure damage to the vessels after a moderate trauma; even though endothelial cells in the superficial dermis may not appear damaged, the cell-to-cell barrier to the diffusion from the vessels lumen to the vascular space is affected as endothelial cell-separation occurs. Barton and Barton (1968, 1969, 1973) have presented evidence that endothelial cell-separation is the critical step in the occlusion of vessels by pressure and leads to tissue damage.

Admission of 'ACTH' (which presumably stabilises the protein polysaccharide material at the endothelial cell interface), significantly lowers the incidence of pressure sores (Barton and Barton, 1981).

Further, emotional stress makes the tissue more susceptible to pressure sores (Krouskop, 1983).

The stress acting on the body tissue produces strains, as the relationship between stress and strain depends on the mechanical properties of the tissue. However, owing to the difficulty of deriving a quantitative description of the properties of the intact living skin, most available data refer to excised tissue. Meanwhile, in *in vivo* studies it has been demonstrated that skin can stand periods of ischaemia of up to 9 hours at normothermic conditions before irreversible damage takes place. Selye (1967) found that the resistance of rats' skin to ischaemia

Investigation	Animal	Technique	Lesion Produced	Minimum Time	Minimum Pressure
Groth 1942	Rabbit	(A) local application of pressure. 15mm metal spheres gluteal muscles	Waxy degeneration of voluntary muscles	--- ---	24 mm Hg
Kosiak 1959	Dog	Piston Femur Trochanter Ischial tuberosits	Skin ulcer	2 hours (x 500 mm Hg)	150 mm Hg (x 9 hours)
Lindon 1961	Rabbit	Clip - ear	Skin necrosis	13 hours (x 100 mm Hg)	--- ---
Brooks 1940	Rat	(13) general pressure to appendage plethysmograph - tail	Massive necrosis	17 hours (x 130 mm Hg)	100 mm Hg (x48 hours)
Husain 1953	Rat Guinea Pig	Pressure cuff - leg	Skin congestion muscles degeneration	1 hour (x 60 mm Hg)	100 mm Hg (x 2 hours)

Table 1.4 A review of previous pressure experiments.

After Dinsdale (1970)

could be increased if the animals were subjected to a form of stress before occluding the blood supply.

1.11.5 The physical damage and the microcirculatory changes at increased tissue pressures

The areas of the body where the bony prominences of the skeleton are covered by only a thin layer of tissue are those most likely to be subjected to harmful pressure. Therefore, these areas are most at risk of developing pressure sores.

The function of the skin and the underlying tissues is to dissipate pressure where tissues are relatively thin; but over bony prominences the capacity to dissipate pressure is reduced, and the pressure on the skin can distort the blood vessels in the dermis to such an extent that the blood supply is interrupted. The critical pressure needed to seriously impair cutaneous blood-flow in humans has not been established; however, the pressure in a small vein within muscle tissue is as low as 11mm Hg, and it would appear that any prolonged pressure above this level can cause irreversible microcirculatory damage (Constantian, 1980).

Dinsdale (1970) provided an outline of criteria for assessing specimens of swine skin subjected to pressure. The reactive hyperaemia that follows tissue ischaemia is detected as a "hot spot" that lasts a variable period of time depending on the severity of the injury. Tissue necrosis is seen as a "cold spot" surrounded by a "hot ring" of inflammatory damage (Barton and Barton 1981).

A set of criteria for evaluating histological sections of skin and muscles has been developed by Daniel *et al*. (1981) and is shown below:

Criteria

A **Skin**

Epidermis		Dermis	
1.	Inflammation, infiltration with polymorphonucleocytes and monocytes.	1.	Oedema.
2.	Oedema of the skin basement membrane.	2.	Haemorrhage - red blood cells and vessels.
3.	Blistering separation of layers in the epidermis.	3.	Thrombosis of vessels, arterioles and veins.
4.	Ulceration - loss of epithelium.	4.	Inflammation.
5.	Necrosic focal changes.	5.	Necrosis.

B **Muscle**

1. Loss of longitudinal striations.
2. Infiltration by white blood cells, giant cells.
3. Vessels thrombosis and inflammation.
4. Widespread individualisation and separation.
5. Necrosis.

1.12 The elderly and the aging process

All people, animals, plants, as well as non-living matter become older and undergo changes with the passage of time.

The biological term 'aging' is a word that when applied to living organisms, includes changes that take place gradually and end with death. Such changes may be observed as a decline in body efficiency, as maladaptive changes in structure and as stoppage or reversal of growth.

Growth and development represent biological processes which are the opposite of aging, and are moving towards maximum functional efficiency and often size.

(i) Primary aging

Refers to numerous biological processes that are inherent in the organism and are inevitably detrimental, and although time-related, are to varying degrees influenced by the social and physical environment.

(ii) Secondary aging

"Senile changes" or "senility" refers to disabilities resulting from trauma and diseases. In fact, age is not a disease. It is a part of life which must be accepted as ever changing. It was found to be significantly connected with survival. (That is, the longer one survives, the older one gets.) Observing the bodily appearance of people makes it possible for us to judge the chronological age of an individual. However, age changes vary widely from one person to another; there is no standardised criterion for assessing biological age. Older persons were graded chronologically into three groups by Linn (1975). These are: (55-64), (65-74) and 75 years old and over.

However, the Department of Health and Social Security and most local authorities define the elderly as those of pensionable age (65 for men and 60 for women). Planning of services is based on this definition (Central Office of Information in Britain, 1974).

However, aging is associated with some decline in organ and tissue function. There appear to be changes both in the network of fibres and gel which support the functional cells of tissues. Such changes occur particularly in the walls of the larger arteries and arterioles. These changes in the circulatory system were once believed to be an intrinsic part of the aging process, but most authorities now regard vascular changes - at least these which are most definitive and disastrous in their effect - as consequences of a less than optimal environment and/or diet.

1.12.1 Skin changes

One of the most generally reliable and widespread clues we have to the age of an individual is the appearance of the skin during the aging process. It is be clear that the condition of a person's skin reflects his age. The familiar changes in the appearance and structure of skin with time are the cumulative results of three principle factors: genetic, endocrine, and environmental. The main visible changes that occur are a general increase in irregularities such as scars, wrinkles, roughness and pigmented areas. These visible signs are accompanied by changes in the texture of the skin due to a loss of cells and of subcutaneous fat, and to the decrease in elasticity as the connective tissue elements are altered. The epidermis, dermis, hair follicles, melanocytes and exocrine and sebaceous glands are all affected by the passage of time.

A decline in the epithelial cell reproduction rate causes thinning of the epidermis and a reduction of the number of sweat glands and the amount of sweat secretion. There is a shortage of water in the tissue and subcutaneous fat.

Local changes in the skin and general reduction in immunological mechanisms increase the susceptibility of old people to skin infection. Healing powers are diminished and absorption of medicines through the skin is reduced. Therefore, the changes in the skin which occur in aging increases the susceptibility to pressure sores as well as leading to delay in healing if they occur.

1.12.2 Muscle changes

Muscles weaken and deteriorate with age, but exercise and use can retard the aging process in voluntary muscles. The cells that make up voluntary muscle diminish in number with age, so this decline in muscle power may be due to this major factor which is in turn due to the death of progressive numbers of the nerves in the spinal cord which activate muscles. Muscle strength is reduced as the person gets older. Besides, the loss of muscle mass, in particular in the sacral/ischeal tuberosity area in the elderly, has significance in the development of pressure sores.

Blood vessels lose their elasticity and become rigid. Blood supply to the brain is diminished. Falls and confusion may result. Joints move less readily and there is a tendency for the spine to bend. The head bends forward, making falls more likely on movement.

Bone is deposited by cells which are called osteoblasts, and the exact mechanism by which they extract calcium, phospherons, and carbonate under appropriate conditions at their borders and lay down layers of the bone, is not understood. During the process of aging a gradual decrease in the activity of osteoblasts occurs and results in a gradual thinning of the individual layers (lamina) of bone which make up a large bone. The thinning process gives rise to a disease or abnormality called 'osteoporosis'. The bones, which are no longer as strong as they were during youth, are susceptible to breakage and this is one of the reasons that elderly persons, particularly women, have fractures, including very serious fractures, such as those of the hip, even as a result of a very slight fall. Occasionally a spontaneous fracture of the neck of the femur causes the fall.

Fractures of the hip and other bones are much less frequent among older men than among older women, this being one of the few age-related diseases which are not more frequent among men than women.

The mass of bone in both men and women decreases as a function of age (Adams et al., 1970). The thickness of bone and its strength is influenced, to a considerable extent, by the amount of use 'stress' that is put on the bone. Because so much of the lengthy hospitalisation which occurs among the elderly is due to slow recovery from bone fracture, this is a very important area for basic studies.

1.12.3 Mobility

Many old people complain of decreased mobility with increasing age. Examination often reveals muscle wasting and weakness which is due in part to the progressive death of nerve cells controlling skeletal muscular movement. Unlike simpler cells, neurones can not reproduce themselves, and when cells die they are not replaced and function inevitably declines. There is a reduction in the speed with which nerves conduct stimuli, and because nerves relaying position sense are involved, old people often experience difficulty in maintaining their balance. Although aging does interfere with muscle power and balance, neurological diseases should be taken into consideration.

Diet is important. Sick old people may not eat sufficient protein to meet muscle requirements and this leads to further muscle wasting. The message, then, is that aging does produce a decline in strength, but this can be minimised by indulging in regular exercises and taking a well-balanced diet, which is important in maintaining activity; which in turn is the key to continued health in the elderly, for when activity declines, muscles and joints lose their power, and this will result in the patient becoming increasingly less mobile. This has been demonstrated graphically in industrial workers who within a few months of retirement showed a dramatic decline in thigh muscle mass. Aging has already stripped the elderly of family, companions, vocation, recreation, finances, belongings, prestige, social roles, as well as physical health; so that some experience difficulty in supporting themselves at home, although they are not yet suffering from old age, but perhaps from undiagnosed disease. This is sometimes curable, often treatable and always alleviable (Steger, 1979). In the life-cycle of the elderly person, chronic health problems are likely to be an additional major concern. Early identification of the problem is possible if all members of the health-care team, including relatives, exercise a high degree of vigilance and suspicion.

Relatives and friends at home must be educated and told that valuable exercise includes all normal household tasks, such as washing, walking or dressing, and encourage the elderly to be independent. It is helpful to note and indicate on the care plan the patient's ability to perform specific tasks, such as fastening buttons or combing hair or getting up from a chair frequently. Inactivity not only leads to deformity of joints and contractures, but also to diseases of the circulatory, respiratory, and digestive systems.

1.13 Why do women live longer than men?

There has been a clear reversal in life expectancy trends for men and women. However, women tend to live longer than men do; thus, they outnumber men by 2:1 in the 75 years and over age group (Redfern, 1986). In fact, the life-expectancy for women is still increasing faster than for men, and by the year 2000 the ratio of elderly women to men will be increased still further.

At the present time the mortality of males as compared to females appears to be a complex interaction between genetically determined physiological difference, socioeconomic factors and cultural values, as well as environmental conditions that may be more dangerous to the man than to the woman.

Waldron and Johnson (1976) indicated that 40% of the excess male mortality is due to heart diseases, accident, carcinoma of the lungs, and emphysemas. Also, it is clear that cultural behavioural patterns which are more prevalent among men than women contribute to arterio-sclerotic heart diseases, as well as habits of excess smoking and drinking and higher risk behaviour found more often in men as compared to women.

1.14 Demography and population statistics

An increase in the proportion of the old people in society seems to be a relatively recent phenomenon. The full impact has only become apparent in the present century. The so-called developed nations have the highest proportion of old people, but it is important to realise that the elderly in Africa, Latin America and South-East Asia will be the fastest-growing of any age group, including children, between 1985 and the year 2000 (Hall *et al*., 1986). Thus, in these regions, the number of people over the age of 60 years will increase during those 15 years by more than 100%. This change in population structure is not due to the old living longer, but rather to fewer young and middle-aged people dying.

Modern medicine, public health, better nutrition, social improvements, and so on, have reduced the premature mortality rate. Thus, life expectancy at birth for a boy is now nearly 70 years in the UK. This represents an increase of more than 21 years or 45% over the course of this century. Over the same period the remaining life expectancy for the elderly increased by approximately one year or 8%, to 12.2 years. By the end of this century, the world population of people over the age of 60 years will have reached 580 million, a 60% increase over 25 years, and two thirds of these individuals will live in the less-developed regions of the world. Thus, by the year 2000, very nearly one in ten individuals world-wide will be over 60 years of age. With increasing numbers of elderly people, the number of pressure sores rises dramatically (Norton et al., 1962, 1975).

1.15 Summary

The population of elderly patients over the age of 70 years is increasing, due to the increases in expectation of life. One major problem of the elderly is pressure sores. Moreover, pressure-sore incidence increases with advancing patient age. Thus, the increasing percentage of elderly patients in the overall population suggests that health services will need to spend proportionately more on the problem of pressure sores in the future. The number of elderly patients, who are the largest at-risk group, is expected to grow until the end of the century. Hence, pressure sores are a large scale problem which costs the

National Health Service a great deal of money and causes the patient additional suffering and extended hospitalisation.

The initial sign of pressure sores is the appearance of erythema (redness of the skin) which progresses on the skin and in the subcutaneous tissue; then blistering; and the third stage is the developing of skin breakdown. However, in the present study, only those patients who showed a break in the skin surface of the 'pressure areas' occuring over the bony prominences were considered to have pressure sores. Further, there are two types of pressure sores: superficial pressure sores and deep sores which cause damage to the deep tissue, i.e. muscle, which is close to the bony surface.

Pressure sores are classified according to their appearance, shape and size. The common site of pressure sores are the sacrum, trochanters, ischial tuberosities, knees, fibula, heels, occiput and elbows. However, a high percentage of sores occur in positions below the level of the umbilicus. Incidence of pressure sores seem higher in hospital than in the community (Jordan and Nicol, 1977; Petersen and Bittman, 1971; Clark and Crow, 1986).

The skin receives one third of the blood circulating through the body. The skin consists of three layers: the epidermis, the dermis, and the subcutanuce layers. the epidermis is the outer layer, easily visualised by the naked eye. It contains keratin-forming and melanin-forming cells, and changes periodically. The dermis lies below the epidermis and is firm and fibrous in nature. It _is composed of elastic connective tissue and contains lymphatics, blood vessels and glands. The third layer (subcutaneous) lies below the dermis and has a looser type of connective tissue, providing storage of fat, blood vessels and nerves. According to Montagna (1974), the skin has four physiological functions. These are:

1) Protection of underlying parts from mechanical and radiation injuries, and from invasion by foreign substances and organisms
2) As a sense organ
3) As a temperature regulator
4) As a metabolic organ in the metabolism and storage of fat, and in water and salt metabolism by perspiration.

The tissue is perfused with oxygen and nutrients through the function of the blood capillaries. Crucial to this perfusion is the maintenance of blood pressure within the tissue and the prevention of compression.

<u>Appendages of the skin are</u>:

1. Hair
2. Nails
3. Glands
   a. sebaceous gland
   b. sweat gland
      ecrine apocrine

Pressure is the most important factor in pressure sore formation. The types of pressure are compression pressure, shear force, friction pressure and direct disruptive damage pressure. However, there is an inverse relationship between the time and the pressure (Husain, 1953; Kosiak, 1959).

The aging process in the elderly will cause changes in the skin, muscle and joints, which will have effect on patient mobility.

Women now are outliving men, and the life expectancy for women is still increasing, so that in the near future the ratio of elderly women to men will be increased still further.

CHAPTER TWO

Current Concept of the Aetiology of the Pressure Sore

Where there is any danger of bed sores, a blanket should never be placed under the patient.

Florence Nightingale

1859

2.1 Introduction

The aetiology of pressure sores is multifactoral. Therefore, to achieve pressure sore prevention, the causative factors must be identified. The major fundamental factor is pressure transmitted through the tissues at the site of the bony prominences. The pressure can be directly affecting the tissue or exerted in a parallel direction and called 'shearing-force'. Both types of pressure are responsible for the formation of pressure sores. These forces alone are unlikely to lead to the pressure sores in normal individuals. Meanwhile, the susceptibility of the individual patients varies considerably and a combination of a number of predisposing factors will increase the risk of developing pressure sores. These can be considered as secondary factors, as they perform a supplementary role in the causation of pressure sores. Thus, the factors that predispose to pressure sores can be divided into:

First: Extrinsic factors (derived from the patient's environment and which include many predisposing factors set below):

1. Pressure. This might be:
   A. Direct or in perpendicular direction.
   B. Parallel direction. Shearing force and friction.

2. Poor skin integrity. This might occur when the

skin is damaged by, incontinence, rubbing, scratching, heat, humidity and body support surface, (Bailey, 1971; Bell et al., 1974; Bereck, 1975a; Norton et al., 1962, 1975).

Second: Intrinsic factors (to do with the patient's general condition):

1. Health and nutritional status, diet, muscle-wasting.
2. Body type: obese, thin.
3. Immobility, lack of spontaneous movements.
4. Incontinence: faecal or urine.
5. Neurological factors: e.g. lack of sensitivity to pressure or pain.
6. Vascular factors: diseases such as diabetes, arteriosclerosis.

Furthermore, the physical status of the patient is important, and the aging process affecting the skin and subcutaneous tissue reduces skin elasticity and reliability, and causes both a loss of subcutaneous fat, and a change in collagen synthesis that results in tissue with lower mechanical strength and increased stiffness that may also offer decreased resistance to interstitial fluid flow; hence, the skin becomes dry and fragile (Krouskop, 1983). Further, activity and mobility will be reduced with advancing age, as well as a loss of physical and mental reserves for responding in times of stress. Therefore, age is a considerable factor associated with pressure sores formation (Norton et al., 1962, 1975).

2.1.1 Nutritional status

A balanced diet is necessary to achieve good health. Moreover, malnutrition contributes to tissue damage and increases the susceptibility to pressure sores. The more specific nutritional deficiences are hypoproteinemia and ascorbic acid deficiency, which interfere with normal tissue integrity. Muholland et al. (1943) indicated that protein malnutrition is important as it results in tissues of a "changed character" that are more vulnerable to tissue necrosis with smaller amounts of pressure for shorter periods of time. This having been confirmed by Moolten (1972) in describing the relationship between hypoproteinemia and pressure sores formation. Furthermore, negative nitrogen balance is a contributory factor in developing pressure sores, because protein deficiency predisposes to oedema of the dependent parts of the body. Oedema decreases the vitality and elasticity of the skin, making skin more vulnerable to pressure sore injury. It also slows the diffusion rate of oxygen and metabolites from the capillaries to the cells. The rate of diffusion decreases in proportion to the distance from the capillary to the cell in the case of oedema (Rushmer, 1970).

Rapid healing of the skin can happen when both protein and carbohydrate intake are increased (Abbot and Mellors, 1943), whilst experiments on rats have shown that protein depletion retards wound healing. The studies on patients with lesions shows that protein levels are considerably less at the site of the lesion than their respective plasma protein levels. A reduction in ascorbic acid appears to increase the sensitivity of surface tissue to localised pressure and it delays wound healing when tissue damage results (Husain, 1953).

Furthermore, the patient's appetite seems to be an important factor in pressure sores formation (Clarke and Kadhom, 1988). Hence, assessing at-risk patients and their nutritional status on admission is crucial in pressure sores prevention as it indicates the early signs of patient appetite which might provide good prognostic information. A high-carbohydrate, high-protein, moderately low-fat diet with adequate calories should be prescribed for all patients at risk of developing pressure sores or for ones who already have them. Moreover, adequate nutrition is essential to promote the healing of pressure sores, in addition to Vitamin C and Zinc supplements, i.e. 2,500 - 3,500 calories daily. But in the presence of infection or after-surgery the calorie intake should be increased (Constantian, 1980).

2.1.2 Anaemia

Anaemia is defined as a deficiency in quality or quantity of red blood cells. Anaemia is a factor of importance, and restoration of a normal blood picture is a first step in the prevention and treatment of all pressure sores. In addition, it is a contributory factor of great significance in determining whether cellular hypoxia and necrosis will occur, and pressure sores might result (Kosiak, 1959). If haemoglobin content and the supply of oxygen within the blood are normal, the damaged tissue may survive for longer periods because well-nourished tissue is more viable and can tolerate the damaging effect of pressure and ischemia when it occurs. Perkash and Brown (1982) observed that 83.3% of anaemic male patients with traumatic spinal cord injuries had decubitus ulcers. However, it was absent in non-anaemic patients.

Therefore, maintaining the haemoglobin level at about 12.5gm/100ml will be an important factor associated with both the prevention and treatment of pressure sores. For at-risk patients blood transfusions are recommended to maintain a haemoglobin level of at least 10-12gm/100ml. Meanwhile, for chronic patients two or three transfusions are required to be given over a space of 24 hours twice weekly, until the patient is ready for surgery (Baily, 1970).

2.1.3 Body type

Any change from ideal body weight will affect the distribution of pressure over the body's surface and leads to an increase in the risk of pressure sores. The patient who is thin has little subcutaneous fat and weak muscle to dissipate the pressure at the site of the bony prominence. Thus, they are more susceptible to pressure sores. In contrast, obese patients have much greater fatty padding to cushion underlying tissue and distribute pressure, (Fig 2.1). Obesity appears to be helpful in some respects but harmful in others. Tissue damage might happen when lifting and moving heavy patients as a result of bad lifting technique, or because of reduced patient mobility and excess of skin folds. Yet obese buttocks present a fine broad surface for weight distribution, and enough fatty padding perhaps to allow capillaries to remain patent in spite of the increased pressure. Lindan *et al*. (1965) indicate that

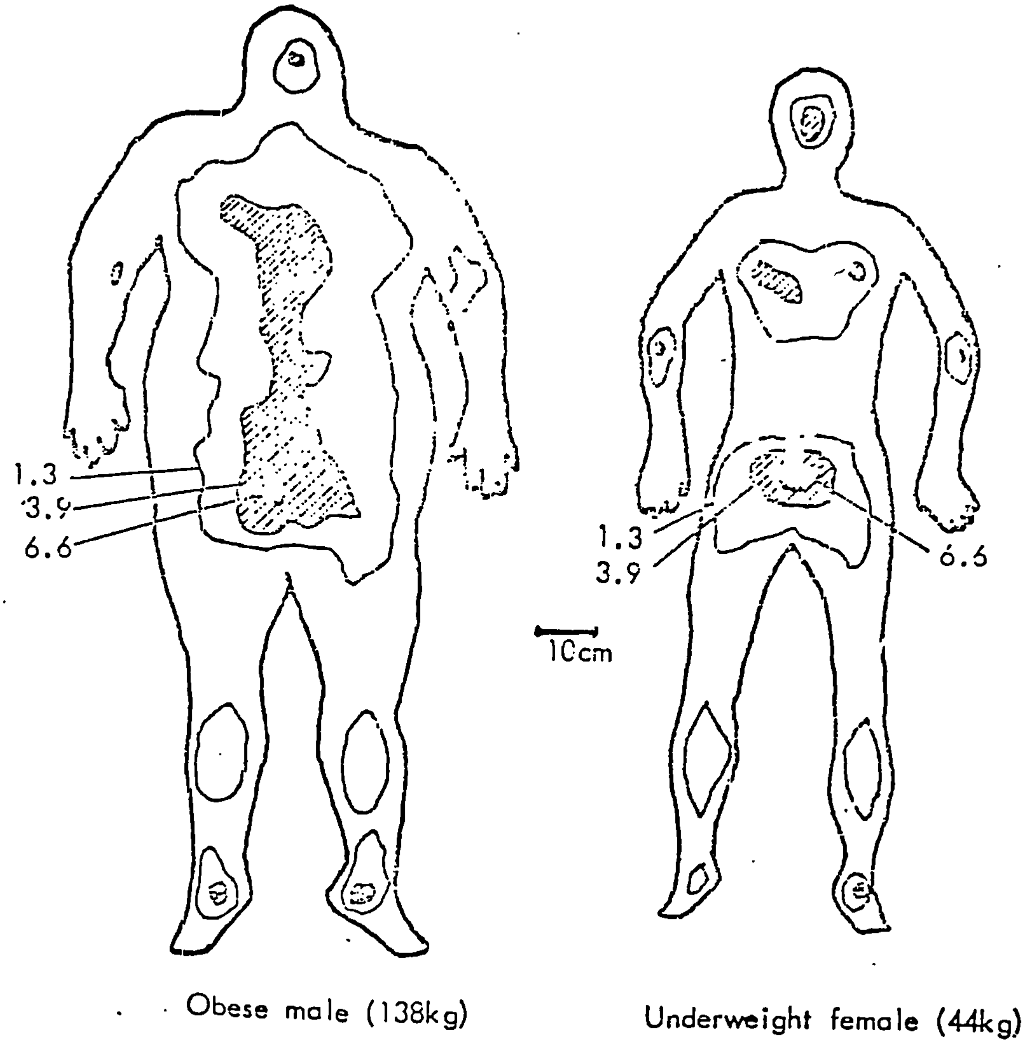


Fig 2.1 Pressure distribution over the body surface for underweight and overweight subjects lying in a supine position (kPa) after Lindan (1965).

the peak pressure points were slightly more in under-weight patients and this was later reported by Williams (1972) who studied the body weight as a factor associated with pressure sore formation. Especially thin patients are more likely to develop pressure sores.

2.1.4 Neurological factors

It appears that there is a strong association between neurological disease and pressure sore formation. The more obvious connection is the effects of neurological disease on mobility and sensation. Examples are, paraplegia, multiple sclerosis, spinal cord injury, confusion, senility, parkinsonism and dizzy spells. In stroke patients tissue damage may be a result of the uncontrolled movements in spasticity due to friction, or shearing force. Although it can be minimised by using appropriate prophylactic measures, sensory impairment such as decreased sensation and impaired pain perception increases pressure sore risk. Munro (1940) considered that spinal cord injury will cause a disturbance of the cutaneous vasculature, predisposing to pressure sore formation. A recent prevalence of pressure sores was markedly increased where Parkinson's disease and dementia coexisted (Nicholson *et al.*, 1988).

2.1.5 Vascular factors

Any condition that reduces either the quantity or quality of the blood reaching tissue exposed to pressure will potentiate pressure injury. Moreover, cardiac disorder, peripheral vascular disease, and other circulatory disorders or blood dyscrasiae, and ventilation failure, will increase the likelihood of sore development. Sufficient cardiac output to maintain a healthy perfusion of peripheral tissue is essential for prevention. Cardiac rate is increased by oedema. Stenosis or thrombosis might result from arterio-sclerotic disease which reduces the flow of blood to the tissues and induces tissue damage. Barton and Barton (1981) found that heel sores were four times more likely in male smokers than non-smokers.

2.1.6 Infection

This is an important factor contributing to increased body temperature. It may in other ways interfere with the body's ability to cope with pressure effects, such as in osteomyelitis, severe systemic infection leading to anaemia and affecting the nutrition of the patient.

Hubay (1957) observed that anaerobic *strepto-cocci* are most commonly responsible for the rapid progression of ulcers through the development of extensive gangrene which might increase body temperature.

Basically, patients with high body temperature are the most susceptible to pressure sores. In other words as Williams (1972) states, "body temperature will be a significant factor in skin breakdown". Moreover, increased ambient body temperature leads to additional perspiration, with possible maceration to the skin, increasing the growth of bacteria, all of which are factors responsible for pressure sore formation (Dyson, 1978).

2.1.7 Incontinence

Apparently a contributor to pressure sore formation, incontinence is one of the commonest nursing problems in this respect. It seems significant with community patients, in particular with lonely patients who are neither very old nor disabled. It is a problem in confused, dependent, demented and unconscious patients. Continence is not an absolute concept; we all have to pass urine and faeces, and it is very much depends on society's rules for acceptable excretion. Those who can not or will not abide by these rules are thereby defined as 'incontinent' (Norton, 1986). The same writer has given a definition of regular incontinence as "involuntary excretion or leakage of urine in an inappropriate place or at inappropriate times, twice or more, regardless of the quantity of urine lost".

Norton *et al*. (1962, 1975) considered continent and incontinent patients separately under the following headings:

(A) Continent patients - those with normal control of the bladder and the bowel

(B) Degree of incontinence - those who do not qualify for either A or C.

(C) Those who appear to have a persistent lack of control of both the bladder and the bowel.

Both urine and faeces can cause direct skin irritation. They also provide a damp and warm environment which is ideal for the proliferation of potentially pathogenic micro-organisms. However, it must be said that the majority of incontinent people do not have sores of the perineal skin for most of the time and only a minority develop a significant soreness, infection or pressure sore. Skin health depends to a large extent on general health, especially upon a balanced diet and an adequate fluid intake. Those who are very sick or debilitated are much more vulnerable to skin breakdown. Moisture, whether in the form of perspiration due to increased heat such as fever, or due to urine, can not in itself cause pressure sores - it can cause maceration or excoriation of the skin, so that superficial abrasion by friction becomes more likely. Bed-wetting may also enhance to some degree the adhesive component of shearing force in the semi-recumbent patient, thereby leading to sliding injury within the tissues.

It is probable that moisture also causes the skin to be more easily macerated by rubbing of the skin, and may lead to the easier introduction of infection into the region. However, even catheterised patients may not be saved from pressure sores, as some catheters without attention often leak and give rise to infection which damages the skin. The length of catheter might impede patient mobilisation, especially in the frail elderly, and so predispose to pressure sores.

2.1.8 Mobility

No one is immune to pressure sores. Thus, even a patient otherwise in good health, lying still in one position for 6-12 hours as a result of being unconscious may develop pressure sores (Freeman, 1947). Movement can be considered as one of the body's first defences against pressure injury. Both pressure degree and duration cause discomfort which stimulates a change of position even during sleep to relieve pressure. Healthy people make frequent spontaneous movements in response to stimuli received by the brain even while asleep; the compression therefore is never sufficiently prolonged to cause any tissue damage. However, interference with the ability to make these movements leads to the possibility of over-compression, with resultant tissue damage (i.e. pressure sores occur).

In illness it appears that protective mechanisms may be ineffective or even absent. Poor physical condition, apathy, unconsciousness, paralysis, or sensory disturbance may all lead to lack of response to stimuli arising from the area of the skin compressed.

A normal healthy person changes position from 50-150 times in a night. In severely ill patients this movement may be reduced to nil. Exton Smith and Sherwin (1961), studied the number of movements in the elderly during the night and its relation to the development of pressure sores. They concluded that patients who were immobile sustained the most serious tissue damage at night because localised areas of the body surface were exposed to great pressure over a long period. Thus, immobility can be considered as an important factor contributing to the formation of pressure sores. Wheatley (1982) has reported that

> the mobility of patients was assessed in terms of their ability to walk while some studies

differentiated between chair fast and bed fast patients.

There is an obvious, significant correlation between the bed fast and chair fast patients with pressure sores development compared with the mobile patients, in a study conducted by Barbenel et al. (1977). Chair fast patients showed a higher prevalence of pressure sores than bed fast patients. But this was not in agreement with Peterson and Bittman's surveys, (1971). They showed a higher pressure-sore incidence among bed fast patients than chair-fast patients.

Clearly, nurses need to be aware of the dangers of reducing patients' movement. Repeated turning of the patients in bed, day and night, is the most effective method of relieving pressure when he is unable to move freely by himself or when he is unaware of pressure owing to loss of consciousness or loss of sensation.

2.1.9 Patient position

Position itself is of importance. If the patient lies still in one position, due to deformity or contracture, poor position may increase pressure, causing tissue damage and hence, leading to pressure sore formation (Bardsley, 1977).

However, mechanical factors which also need to be considered include X-ray and operating tables where patients are required to lie absolutely still, or may be anaesthetised and kept in one position for relatively long periods. Furthermore, McClement (1984) listed the following typical causes of pressure sores:

- A hard stretcher in casualty
- An unprotected couch in the X-ray department
- Too long a wait on an anaesthetics trolley
- Insufficient pairs of hands available to lift the patient into bed on return from theatre
- Constant leakage from a catheter or overflow fluid from chronic constipation, causing maceration of the sacrum, particularly a sacrum already unpadded from hyponutrition.

However, the site of pressure sores is dictated by the way the patient lies. If a patient lies flat on his back he will develop sores of the sacrum and heels; and if he is unconscious, will develop sores of the occiput. If he is lifted up in bed or sits in a semi-reclining chair, coccygeal pressure sores will develop; while if he sits up right in a wheelchair or in calipers, he is more susceptible to ischial sores. At home, if the immobile patient is put in a chair to see out of the window or to watch television this may lead to the situation of a pressure sore.

2.2 Extrinsic factors

The most important extrinsic factors in pressure sore formation is the pressure, whether it is direct perpendicular pressure or parallel pressure which have already been explained in Chapter One. Experiments conducted on animals in the laboratory and studies of individuals prone to pressure sores have confirmed that pressure sores are generally associated with application of pressure, and show that low pressure maintained for long periods is more damaging to the tissue than high pressure for short periods (Dinsdale, 1973; Kosiak, 1959; Husain, 1953).

2.2.1 Shearing force and friction

Although direct perpendicular pressure is by far the most important factor blocking blood flow and causing pressure sores, parallel pressure (shearing force) can interfere with blood flow too. Guttman (1955) showed that shearing force was a more significant factor contributing to the formation of pressure sores than direct pressure since shearing force "cuts off larger areas from their vascular supply". This parallel force, as explained in the previous chapter, is caused by adjacent surfaces sliding against each other and is transmitted to underlying bone and deep fascia while the exterior skin is fixed. Such force can come into play when it is necessary to raise the head of the bed, and even a few inches may increase the shearing forces over the sacrum. Or sometimes this can happen if the patient is badly positioned, in a wheelchair.

Reichel (1958) has studied this phenomenon in the paraplegic. When the head of a paraplegic's bed is elevated, a greater compressive force is placed upon the posterior sacral tissues than in the flat position. Body weight from the upper part of the body is transferred to the tissue by the spinal column and sacrum and it is firmly attached to the deep fascia. If the adhesion between skin and sheet is the only force keeping the patient from sliding down in the bed, the loosely attached superficial sacral fascia will slide over the firmly attached deep fascia;

this mechanical force will disturb blood flow through vessels passing from one fascial layer to the other (Constantin, 1980). Dinsdal (1970) analysed the role of perpendicular pressure and friction in the production of pressure sores in normal and paralysed swine. Friction itself is a particularly important factor in elderly patients with vulnerable skin, where it may readily lead to the maceration of the skin, and open a route for the introduction of infection.

When the patient drags himself or is dragged and not lifted over, this dragging force across the bed-sheets removes the outer layer of protective corneum of the skin, causing tissue damage and accelerating the onset of ulceration. At the site of the friction moisture can accumulate, and infection and oedema can develop.

2.2.2 Skin integrity

Skin integrity is another important external factor which contributes in the formation of pressure sores. Patients with poor hygiene have a greater microorganism population, and bacteria tend to localise at the site of ischaemic tissue which supplies a good medium for their growth. Meanwhile, bacterial invasion of ischeamic tissue increases its destruction and the rapidity with which an ulcer develops, while there is no disagreement about the importance of frequent washing of the skin with soap and water in case of incontinence or excessive sweating. But the skin has a barrier zone of epidermis, and secretions give the skin its bacteriocidal action. Excessive washing with soap and water will remove the skin and greasy protective lipids, so that the skin becomes dry and this can increase the risk of developing pressure sores. Excessive washing with water also causes the skin to become fragile and it will easily scale, peel or crack, leaving an opening to deeper layers. Bacteria can enter those openings and multiply under the subcutaneous layer. Soap can be irritating if it is too harsh; or if it is not rinsed off completely it will effect the skin, either directly or indirectly. Indirect factors occur as when the patient's sheets are washed with irritating soap without being rinsed off completely by water.

Any medication applied directly on the skin often causes tissue damage, sometimes through a direct effect and sometimes causing an allergic reaction. Crumbs in the bed or creases in the sheet can cause skin damage. Further, hard metal bed-pans left in position for any length of time cause pressure on the skin. Wrist watches, rings, long finger nails, traction apparatus, plasters and bed cradles can cause problems. Tight splints or bandages in place for a length of time may cause tissue damage.

2.2.3 Massage

Massaging the red area to stimulate the circulation is rather dangerous. Erythema itself is a sign of reactive hyperaemia which is itself an increased blood flow into an area released from compression, Dyson (1978) and Ek, (1984) studied the effect of massage on the skin and found that the incidence of pressure sore formation increased with massage. They considered massage as a factor contributing in the formation of pressure sores, and this was in agreement with Rebell et al. (1950) in considering that rubbing the skin with spirit is rather harmful. It is likely to remove surface lipids and decrease the skin's bacteriocidal power.

2.2.4 Other causes

Different orthopaedic text books identify the pressure sore as a complication of orthopaedic operations (Apley, 1977). Moreover, new medical and surgical techniques frequently used in the older population such as total hip replacement can cause pressure sores. In one study it was estimated that 30% of the elderly patients developed pressure sores following a total hip replacement or repairs to the upper shaft of the femur (Barton, 1977); whilst Norton et al. (1962, 1975) noted that it is highly probable that tissue damage occurred on the operating table. Meanwhile, there are some factors relating to the frequency and standard of nursing care that patients receive, (Table 2.1), factors which may contribute in increasing the risk to an immobile patient of developing pressure sores. It is obvious that the nursing role is central in the prevention of pressure sores, and a perfect understanding of the mechanism of pressure sores formation and the application of this knowledge to combating the intrinsic predisposing factors identified above, and to minimising extrinsic factors - these are the nurse's main actions which allow her to implement her plans in the prevention of pressure sores formation.

Thus the nurse's role must encompass the following awareness and action:

1)	The condition of the patient.
	Physical and mental state; particular aspects.
2)	Nursing care.
	Measures used for the relief of pressure frequency and standard of care, local applications.
3)	Factors surrounding the patient.
	Manner of nursing the patient, the material of the mattress, draw sheet contact of urine and faeces, infection.

Table 2.1 Causes of pressure sores (After Barbenel *et al*., 1983)

2.3 Summary

The main causes of pressure sores have been divided into local or external causes which derive from the patient's environment, and the predisposing or internal causes, (i.e. the general health of the patient, including serious illness, old age, immobility, lowered tissue resistance to pressure, diminished ability to appreciate the sensation of the pressure, mental apathy and muscle weakness, particularly in paraplegic and quadroplegic patients). The fundamental force in the formation of pressure sores is the pressure, whether it is perpendicular pressure or parallel pressure such as shearing force and friction affecting the skin and underlying subcutaneous tissue over bony prominences, especially in the at-risk patient. Temperature and moisture over the contact area increases the patient's susceptibility to the formation of sores. However, these external factors must always be considered in the context of the person's overall physical condition. Neurological dysfunction, sensory changes and diminished physical well-being are as significant as pressure in producing tissue damage. Deformation, distortion of the tisue can be caused by a combination of both pressure and shearing force. Tension in the skin which occurs when it is stretched over the bony prominences is another factor; this is more likely to be a problem when someone is underweight or has severe muscle wasting because there will be less tissue covering the bony prominences.

High pressure is not necessarily harmful; it is sustained pressure in conjunction with relatively high pressure that produces problems (i.e. the time element is probably the more critical factor than the intensity of the pressure in the formation of pressure sores).

Most modern research into the prevention of pressure sores has been directed toward providing relief from and distribution of pressure. Meanwhile, there are many other factors which contribute to pressure sores; for example, an inadequate blood supply to the tissue already present because of anaemia, diabetes, infection, arteriosclerosis or oedema. Elderly people are the group mostly at risk of developing pressure sores, and those who are chairfast develop more pressure sores than bedfast patients (Barbenel et al., 1977). Elderly people are also more likely to remain immobile for long periods, and when neurological dysfunction is associated with old age there is a much higher risk of pressure sores (Bliss, 1981). The nursing care factors most likely to contribute in the prevention of pressure sores are frequency of pressure area care and the time spent on pressure area care. Prevention depends upon the attitude of the nurse and relatives towards patients' complaints and understanding the pressure sore aetiology and pathology in order to take action before skin breakdown appears. Materials and the equipment used for pressure relief, such as mattresses, cushions, sheepskin, water beds, and other devices for pressure relief will be explained in Chapter Four.

CHAPTER THREE

Population at Risk of Pressure Sores

3.1 When do we assess?

To prevent pressure sores, it is essential to recognise those patients who are at high risk of developing pressure sores. However, the initial step in the process of prevention of pressure sores is identifying the predisposing factors both intrinsic and extrinsic factors, which have a good correlation with the risk factor, affecting the body's ability to cope with pressure and its local effects (Torrance, 1981). Meanwhile, Edberg et al. (1973) indicated that

> Pressure sores can develop regardless of what position the patient is in, as long as pressure is applied to an area where bony prominences are present.

Bearing this in mind, pressure sores can develop under appropriate circumstances in any individual who cannot bear or resist the predisposing factor.

Some patients might develop sores due to intrinsic factors such as type of the body (i.e. increased or decreased body weight) (Torrance, 1981; Kerr et al., 1981; Gruis and Innes, 1976), incontinence (Norton et al., 1962, 1975; Torrance, 1981; Ek and Bowman, 1982), vascular diseases (Norton et al., 1962, 1975), and malnutrition (Gosnell, 1973; Torrance, 1981). Patients affected by extrinsic factors were those subjected to poor lifting technique (Reichel, 1958; Lowthian, 1970).

Thus, the most vulnerable patients to pressure sores are:

1) Elderly patients, particularly those who are immobile, incontinent, with poor appetite.

2) Patients suffering from neurological defects, as in the case of head injury and spinal cord injury, which can provide conditions conducive to skin breakdown.

Incidence of pressure sores development increases significantly with the age of the patient (Norton et al., 1962, 1975). Vitality of human tissue is mainly related to age. However, advances in general medicine show that the elderly and disabled population are surviving longer with debilitating diseases (Torrance, 1983), in spite of the fact that they are at risk of developing pressure sores. Demographic studies indicate that there will be a continuing increase in the percentage of elderly population in the future (Carstairs, 1981). Hence, there will be more patients at risk of developing pressure sores in the near future.

3.2 Why the elderly patient is at risk of pressure sores?

Elderly patients are mainly at risk of pressure sores for the reasons set out below:

1) Loss of elasticity and generalised atrophy of the skin; the outer layer of the skin becomes thinner and less well-supplied with sebaceous secretions; the amount of water in the tissue and subcutaneous fat is often reduced. Further, three quarters of elderly patients admitted to hospital are dehydrated as well as ill; and so are many of those at home (Scott, 1986).

2) Reduction of the resistance to the effect of pressure and

other predisposing factors, especially in a chronically ill patient.

Due to the aging process, the older people get the more handicaps and disabilities are acquired; as Kenedi et al. (1976) stated:

> Over the age of 85, four out of five people have at least one major disability.

Elderly people may have reduced sensation to pain, and loss of appreciation of the temperature, and reduced postural control.

Selye (1956) identified one's adaptive energy as decreasing as age increases; thus an elderly individual has less reserve energy available to be mobilised against the stresses caused by illness.

Medical records indicate that elderly persons are also more apt to be hospitalised (Bliss et al., 1967).

Healing power is diminished due to the aging process; any medicines applied to the skin are less effective as absorption through the skin is reduced (Torrance, 1983).

The Greater Glasgow Health Board Studies (Barbenel et al., 1977) indicated in their report that 70% of those patients who suffered from pressure sores were aged 70+, and Barbenel also established that chairfast patients were more likely to develop pressure sores than bedfast patients of a similar dependency.

The above studies also suggest that hospital patients and in particular immobile, incontinent patients have a higher prevalance of pressure sores than do those nursed at home.

3.3 Orthopaedic and elderly patients

The incidence of fracture of femurs and of hip replacement has shown an increase with the increase of elderly patients (Versluysen, 1985). The skin of elderly people is frail and thin and, is more likely to break down when subjected to excessive pressure due to repeated contact with traction or a prolonged stay on the theatre table during surgery. Medical and surgical advanced techniques which have become available for treatment may in themselves create the conditions in which pressure sores occur (Barton and Barton, 1981); e.g. total hip replacement and repairs to the shaft and the neck of the femur and other measures. Moreover, Shaw and Hughes (1985) were in agreement with Barton and Barton (1981) that when using the popular method of closed intra, medullary nailing for elderly patients with a fracture of the shaft of the femur, pressure sores develop at the site of the groin and overlying the hip postoperatively.

Meanwhile, the more common site for sores in orthopaedic patients are the sacral area, heels and the greater trocanter. These sores are caused by either excoriation if the pelvis is dragged along the coarse operating table when the surgeon is positioning the patient, or by the applied traction, or by the fact that the patient will lie on the table for a long time with neglect of the pressure area care during the perioperative period. Heel sores are mainly due to inadequate padding, or tight compression bandaging, or shearing forces due to the applied traction. The greater trocanter sores are usually due to inadequate padding of the perineum and excessive leg traction.

Hip fracture and hip replacement are two of the most common reasons for orthopaedic admissions and are particularly associated with secondary development of pressure sores (Norton, 1979; Barton and Barton, 1981); whilst in the United States, Kumar and Redford (1984) indicated that

> Hip fractures are a major source of mortality and morbidity among the elderly. Mortality rates for the immediate postoperative period range from 1.3 to 16 per cent, average age of patients suffering a hip fracture ranges from 70 to 78 years. Women are affected 2.4 to 4.0 times more frequently than men.

General statistics indicate that about two thirds of patients in most orthopaedic wards are over the age of sixty, with a high increase in the incidence of old people admitted with a fractured femur. This contributes to the number of pressure sores and increases the morbidity rate in these wards (Versluysen, 1985). Moreover, most orthopaedic wards contain a higher proportion of patients with pressure sores than those of other specialities. Jordan and Clark (1977) and Jordan et al. (1977) showed an 11.9% and 19.2% incidence in orthopaedic wards as against 8.8% and 9.4% overall in patients in the districts respectively.

Meanwhile, Versluysen (1983) showed a prevalance rate of 31.8% of pressure sores occurring after hip and femur fracture operations, mostly amongst females aged 70+ years.

3.4 Patients with spinal cord injury

Pressure sores are most frequently developed by patients with diminished or absent cutaneous sensation or who are restricted in their ability to move. Hence, in spinal cord injuries patients' pressure sores continue to be a major problem due to loss of sensation because of nerve damage; the patient is then unable to complain that he is lying uncomfortably, or to move his body in order to relieve the discomfort. Abnormal vascular reflexes from disturbance in the sympathetic chain exacerbate the problem of muscle tone, further reducing mobility and thus, pressure sores result.

Rudd (1962) identified four distinct factors which contribute to pressure sore formation: sustained pressure, reduction of bodily movements, devitalisation of deep tissue, and reduced general resistance. But there is still a need present for further investigation to prove whether each of these factors alone or in combination with others will contribute in pressure sore formation.

A large-scale pressure sore incidence survey in the Greater Glasgow Health Board Studies, showed that an incidence of 8.8% for all hospital patients and in the community for those patients who received care from a community nurse (Clark et al., 1978). However, the incidence was 21.6% for paraplegic patients, while for those who were quardriplegic it was 23.1% (Clark et al., 1978). The percentage of the incidence in paraplegic and quardriplegic patients was from 25% to 85%. Furthermore, in an earlier study Spence et al. (1967) revealed that

> Pressure sores occur in approximately 80% of all spinal cord injury patients and 10-15% of all other bedridden patients.

However, Edberge *et al*. (1973) indicated that "approximately 68% of patients with spinal cord injury and 35% of geriatric patients in nursing homes have pressure sores".

Patients with spinal cord injury associated with paralysis remain at risk of developing pressure sores for the rest of their lives, as the skin and subcutaneous tissues are liable to breakdown at any time; sores that develop immediately after injury delay rehabilitation and may even result in death. Over 7% of deaths among the spinal cord injured have been directly attributable to pressure sores (Freed *et al*., 1966).

A chronic pressure-sore patient might get amyloidosis, which is a major cause of death in spinal cord-injured patients (Sather *et al*., 1977).

Further, training and rehabilitation may be postponed until the area is healed, and this can prolong the hospital stay for the patient from one month to a year or longer. This will affect the family and the patient himself, as it increases his disability and emotional stress. Some patients might go home with already developing pressure sores even though they appear to have intact skin. This may later break at home and at that time the patient needs to spend a lot of money to treat the skin lesion.

3.5 Time of development of pressure sores

A striking feature which has been shown in one geriatric study (Norton *et al.*, 1962, 1975) was the length of hospital stay as a predictor of pressure sore development. 70% of pressure sores occurred during the first two weeks of patient admission to hospital. This kind of pressure sore was named an EPS -, early pressure sore - and is defined as "a pressure sore-developing in the first two weeks of patient admission to the hospital". This was in agreement with findings by Irvine *et al.* (1961). However, "up to nine hours can elapse between the application of excessive prolonged pressure and pressure sores developing" (Kosiak, 1959). Since the time of patient stay in hospital varies from one patient to another according to patients' individual need, the time patients are at risk varies as well, although the highest percentage of patients at risk were the new admissions (Norton *et al.*, 1962, 1975). Thus, the early identification of highly at-risk patients and high-risk anatomical areas is of the first priority in nursing, especially during the first two weeks, as the patient is then more likely to develop pressure sores.

3.6 Assessment of pressure sores risk

To determine whether or not a pressure sore will develop, it is essential to have some method of assessing a patient's general condition and nutrition. Efficient and rational measures for this depend mainly on identification of the predisposing factors which lead to pressure sore formation. It is obvious from the aetiology of pressure sores that some patients will be more at risk of developing pressure sores than others. Therefore, the continued dwindling resources in the National Health Service make it important for nurses to know with confidence which patients are at risk and where the resources should be focused (Redfern, 1986).

So to identify the potential pressure-sore problem it is necessary to identify patients' needs and draw a care plan accordingly, then to implement the nursing care plan and then to assess the success in doing so.

Meanwhile, good pressure area care depends not only on the quality of nursing intervention but also upon the accurate definition of the pressure-sore problem (Jones, 1986). Indeed, correct identification of the problem is the most essential phase of the nursing process, as Stevens (1975), and Macfarland and Castledine (1982) have agreed. In the words of the latter writers,

> Good assessment depends mainly on the type and method of collected patient information.

The whole sub-process of problem identification can only be effective when it is based on clinical judgement which requires not only the broad body of professional knowledge but also the nurse's ability to apply that knowledge in clinical practice. However, many nurses now in clinical practice have more experience and knowledge of the nursing process than formerly, but little experience and skills to bring out solutions to patient problems in any organised systematic and efficient manner.

Much research has been done to produce and to design a risk calculater that can be used by nurses to enable the nature and the severity of risk factors to be identified in order to implement pressure relief as soon as possible and to achieve good pressure area care according to patient needs. The initial work was designed by Norton and her colleagues (1962) and reprinted in 1975 and is widely quoted as the first risk calculator. Others have carried out some modification to the Norton Score in order to assess the most vulnerable patients (Gosnell, 1973; Pritchard, 1986; Lowthian, 1982; Waterlow, 1987; Knoll, 1982). Many hospitals and districts have their own prediction score in assessing patients at risk. However, all risk calculators are designed for many reasons:

1) To be used as a guide to enable the nurse and the carer in the community to identify those patients at risk from pressure sores.
2) To be used for research purposes.
3) To implement prophylactic measurés to prevent the occurrence of pressure sores after taking the assessment of each patient into consideration and entering it in the care plan, so as to achieve pressure relief as a preventive method according to the patient's degree of risk and his individual needs.

3.7 Assessment tools for pressure sore risk

The most famous assessment tool used for geriatric patients was the Norton scoring system (1962). This simple scoring system was developed by Miss Doreen Norton over 26 years ago, and has been used as

1) a guide for patient assessment which has recently been applied in nursing practice, leading to the critical care action of prevention;
2) a means of assisting nurses to use a process of logical inference;
3) A measure of the patient's intrinsic condition and an assessment of his risk of developing pressure sores, by means of numerical categories.

A score is given for each of five categories, namely physical condition, mental conditon, mobility, activity and incontinence, each category being rated on a scale from 1-4 as is shown in Table 3.1. A maximum score of 20 should be achieved by a really fit patient and a minimum score of 5 should be achieved by a patient in a very poor mental and physical condition. A good relationship has been found between this score and the incidence of pressure sores development (Norton et al., 1962, 1975). 24% of patients with a mean score of 12 developed pressure sores. Therefore, there is obviously a significant correlation between patient scores and the risk of tissue breakdown using this assessment tool. Meanwhile, a score of 14 for a patient is indicative of vulnerability to pressure sores, while a score of 12 is considered a special risk of pressure sores. Patients should have extra precautions taken to eliminate the predisposing factors. Whilst a score of above 14 does not necessarily mean that a patient will not get a sore, the risk is less than if the score is under 14.

The sample in Norton's Study consisted of 250 patients with a mean age of 79.9 years. The women in the sample were on average slightly older than the men. The women tended to have lower scores than men in the "at-risk" and in the pressure sores group.

Therefore, the Norton Score is quite useful when working with elderly patients, if it is taken in combination with clinical scores and recorded on the Nursing Plan (Jones, 1980). Accordingly, it has been widely concluded by nurses that they could reduce the prevalence of pressure sores by using the score to identify patients for preventive care. Though the score has been widely adopted in

Table 3.1 The Norton Score

Date of Assessment	Physical Condition	Mental State	Activity	Mobility	Incontinence	Total Score
	Good 4	Alert 4	Ambulant 4	Full 4	Not 4	
	Fair 3	Apathetic 3	Walks with help 3	Slightly limited 3	Occasionally 3	
	Poor 2	Confused 2	Chairbound 2	Very limited 2	Usually urine 2	
	Very bad 1	Stuporous 1	Bedfast 1	Immobile 1	Double 1	

Assessment of Risk

Under 14 = at Risk

practice, few subsequent investigations to verify its preventive value have been reported.

The Norton Score has been applied in nursing practice for the following reasons:

1) It is a useful teaching aid, especially for the learner, because it is quite simple and easily understood by all the carers in the hospital and at home in the community.
2) It should take no more than 5 minutes to complete.
3) We can use it as an early-warning system to help prevention of this painful, costly and time-consuming problem.
4) Re-scoring at regular intervals may indicate a need for an increased degree of vigilance or even a change in nursing management as a patient's clinical condition improves or worsens.
5) A score of 12 or less indicates that extra care must be taken, as skin breakdown is likely.
6) It can be used to estimate the work-load of the wards.
7) It shows the role of prolonged pressure in the development of pressure sores and how a simple routine of 2 hour change of position for immobile patients, indeed in virtually all patients at risk, is good preventive practice.

However, this simple scoring system has been criticised on a number of counts because it has many limitations, such as:

1. It was initially developed from research among the geriatric population, with resultant limitations as regards other groups of patients. In other words, it

has not been applied to children under six years old, since scoring children's activity and mobility are inappropriate, as a low score is likely to reflect the stage of development growth and not an underlying pathology (Hicks, 1970).

2. Categories of the scale are rather crude for use in acute nursing areas (Jones, 1980).
3. It does not show variable pain as a cause for concern.
4. Five categories may not be enough, since as it is the score tends to over-predict with the misclassifying of some patients as at risk when they are not (Goldstone and Goldstone, 1982).
5. It does not show the patients who are admitted with existing tissue damage which may progress to open sores.
6. It will not identify those at risk who have a high score but have impaired mobility at night, perhaps due to sedation.
7. It does not take into account other factors such as nutritional status, body build and certain diseases.
8. It cannot predict the severity of the sores likely to develop.
9. It does not show the site of the sores.

In spite of the limitations listed above, the Norton Score is an effective tool in assessing patients at risk from pressure sores, if the information is acted on appropriately and preventive measures applied according to individual needs. However, the Norton Score depends on nurses' judgement of assessment.

Different observers have obtained similar scores, suggesting some reliability. It has the advantage of being easily interpreted by nurses. Assessment by this system can be the first step in planning a prophylactic regime, but the assessment needs to be constantly reviewed ideally by the same person, in order to eliminate possible errors (Norton et al., 1962, 1975).

3.7.1 Modified assessment tool by Gosnell

Gosnell (1973) conducted research to determine the efficiency of a simple scoring system in determining propensity to develop pressure sores. She used a modified assessment tool which was based on Norton's scale, after she omitted the variable physical condition (Table 3.2) and substituted this with a nutrition variable. Her sample was patients with a mean age of 78-80 years who were admitted to the hospital to attend care facilities. Further, Gosnell added vital signs, skin appearance, tone, sensation, and medications as areas to assess. Results from this research show that the variables of nutrition, activity, mobility, and mental status were influential in the development of pressure sores. The variable of continence was not shown to be a significant one. This scale shows some of the variables related to the pathogenesis of pressure sores. Thus, it is considered that this scale is more comprehensive than the Norton Score. It is simple, effective, requires a minimal amount of time and can be used for all groups of patients; and a score of 11 or less shows a patient at high risk. Meissner (1980) presented the effective Gosnell method of predicting which patients will develop pressure

Table 3.2 Assessment of patient's risk potential for pressure sores

(Gosnell Rating Scale)

Mental State		Continence		Mobility		Activity		Nutrition	
Alert	5	Fully controlled	4	Full	4	Ambulatory	4	Good	3
Apathetic	4	Usually controlled	3	Slightly limited	3	Walks with assistance	3	Fair	2
Confused	3	Minimally controlled	2	Very limited	2	Chairfast	2	Poor	1
Stuporous	2	Absence of control	1	Immobile	1	Bedfast	1		
Unconscious	1								

Total score of 11 or less = high risk

sores. However, Goldstone and Goldstone (1982) concluded that the Norton Score is a more reliable guide to the incidence of pressure sores.

3.7.2 Douglas pressure sore risk calculator

Another risk assessment score which has been shown by Barratt (1987) (Table 3.3) is called the 'Douglas pressure sores risk calculator', in contrast to the Norton Score. A score of 18 or below shows a patient to be at risk. It is similar to the Norton Score except that some of the variables like pain are included in this scale as factors contributing to pressure sore formation.

3.7.3 Knoll scale

This scale was developed in the USA (1982). It takes into account oral nutritional diseases, diabetes and anaemias, as well as the variables of the Norton Score. This scoring system is the reverse of that for the Norton Score (Table 3.4), so that a score above 12 indicates "at risk" (Redfern, 1986).

3.7.4 The 24 hours turning clock pressure sore predictor

This scale has been devised by Lowthian (1983) for orthopaedic patients at the Royal National Orthopaedic Hospital at Stanmore, Middlesex. It has been designed in conjunction with a 24 hours turning clock (Table 3.5). Six elements are involved. The preliminary result of using this scale shows a correlation between risk score and development of skin breakdown and the deterioration of the

Table 3.3 The Douglas Pressure Sores Predicting Score

Nutritional Status/Hb	Activity	Incontinence	Pain	Skin State	Mental State
Well balanced diet 4	Fully mobile 4	Continent 4	Pain Free 4	Intact 4	Alert 4
Inadequate diet 3	Walks with Difficulty 3	Occasionally 3	Fear of pain 3	Dry/red/ skin 3	Apathetic 3
Fluids only 2					
Peripheral/ parenteral feeding 1	Chairbound 2	Urine 2	Periodic 2	Super-ficial break 2	Stuporous/ sedated 2
Low Haemo-globin 1	Bedfast 1	Doubly 1	Pain on movement 1	Full tissue thickness or cavity 1	Unco-operative 1
			Continual Discomfort 0		Comatose 0

Special Risk Factors - deduct 2 for each factor - steriod therapy, diabetes cytotoxic therapy, dysprioea.

Total score of 18 or below = At risk

Table 3.4 The Knoll scale for liability to pressure sores

Parameters	0	1	2	3	Score
General state of health	Good	Fair	Poor	Moribund	___
Mental State	Alert	Lethargic	Semi-comatose	Comatose	___
			Count these conditions as double.		
Activity	Ambulatory	Needs help	Chairfast	Bedfast	___
Mobility	Full	Limited	Very limited	Immobile	___
Incontinence	None	Occasional	Usually of urine	Total of urine and faeces	
Oral nutrition intake	Good	Fair	Poor	None	___
Oral fluid intake	Good	Fair	Poor	None	___
Predisposing diseases (Diabetes, neuropathis, vascular diseases, anaemias)	Absent	Slight	Moderate	Severe	___

The higher the scale the greater is the potential to develop decubitis ulcers.

Patients with scores above (12) should be considered at risk.

Completed by: Patient:

Date:

1	No	= 0
	No, but..	= 1
Unconscious	Yes, but..	= 2
	Yes	= 3
2	No	= 0
	No, but..	= 1
Very ill	Yes, but..	= 2
	Yes	= 3
3	No	= 0
	No, but..	= 1
Incontinent	Yes, but..	= 2
	Yes	= 3
4	No	= 0
	No, but..	= 1
Sits up	Yes, but..	= 2
in bed	Yes	= 3
5	Yes	= 0
	Yes and No	= 1
Lifts up	No	= 2
6	Yes	= 0
	Yes and No	= 1
Gets up	No	= 2
and walks?		

Total scores:

Table 3.5 Pressure sores prediction score.

Source : Lowthian P T 1983

sores or their severity.

3.7.5 Waterlow predicting scale

The technique has been developed by Waterlow (1985), who used it to assess all groups of patients. It is the reverse of that used by Norton (Table 3.6), i.e. the higher the score the more likely the patient is to develop pressure sores and the higher the danger of developing skin breakdown. Thus, it is an easy scale in identifying at-risk patients, as no patient scoring lower than 12 is considered likely to develop pressure sores. This valuable tool has been used to assess the patient on admission and to re-assess him weekly so as to establish the degree of risk of his developing pressure sores. This helps staff to be aware of patients at risk. It has been used mostly in geriatric and orthopaedic wards, where pressure sores are a growing problem because of the increasing age of the patient and the severity of surgery performed (Waterlow, 1985). However, to date no other research relates to this predicting scale.

3.8 Thermography or radiometry

The level of the blood supply through the skin will regulate skin temperature. However, there is a relationship between pressure on the tissue and the skin temperature. Sufficient pressure causing capillary occlusion in the blood supply to the skin leads to lower skin temperature and the correlation between pressure effect and blood supply to the skin can be detected by

Table 3.6 The Waterlow Assessment Value - Pressure Sores Risk Assessment

Ring Score in Table, ADD Total to Special Risk Scores.
Several scores per category can be used.

Build/Weight For Height		Visual Skin Type Risk Areas		Continence		Mobility		Sex Age		Appetite	
Average	0	Healthy	0	Complete	0	Fully Mobile	0	Male	1	Average	0
Above Average	2	Tissue Paper	1	Occasion incont	1	Restricted Difficult	1	Female	2	Poor	1
Below Average	3	Dry	1	Cath/incont Faeces	2	Apathetic	3	14-49	1	Anorexic	2
		Oedemators	1	Doubly incont	4	Inert Traction	4	50-64	2		
		Clammy	1					65-74	3		
Special Risks		Discolours	2					75-80	4		
		Broken/Spot	3					81+	5		
1) Poor Nutrition, eg Terminal Cachexia							8	Total Score =			
2) Sensory Deprivation, e.g. Diabetes, Paraplegia, CVA							5	Assessment Value			
3) High Dose Anti-inflammatory or steroids in use							3	At Risk = 10			
4) Smoking 10+ per day							1	High Risk = 15			
5) Orthopaedic surgery/fracture below waist							5	Very High Risk = 20			

thermography. This technique for pressure risk assessment has been used to show the difference in the skin temperature and deeper tissue and can identify damage before it appears on the skin. Further, thermography was developed to measure and to detect the localised inflammatory response (Bergtholdt and Brand, 1975), and has been described as a useful way of assessing blood circulation through identification of cold spots where tissue necrosis and poor vascularisation are present, and hot spots where there is an inflammatory response. These minor variations in skin temperature over the pressure area may be detected by infra-red cameras in the absence of visible symptoms, as Barton and Barton (1973, 1981) point out:

> Human skin acts physically as a black body when examined thermographically and this technique is quite useful in determining or discriminating between the type of sores.

Due to the proliferation of vessels at the ulcer margin, there will be a temperature difference of vessels at the sore sites of approximately 25 ^{o}C between the skin at the sores margin and adjacent healthy tissue in type (I) sores, whilst type (II) sores show a variation of only 1 ^{o}C. Newman and Davis (1981a,b) studying newly-admitted geriatric patients, showed that thermography can be an accurate early predictor of tissue damage and thus of pressure sore formation, compared with the Norton Score.

Thermographic equipment is bulky, and noisy during transferring and moving it. However, with advancing technology more compact portable thermography has been developed with a low cost. Besides this, radiometry, another measure of heat emitted by the skin, is also available to detect tissue damage and predict the development of pressure sores. It can be identified as

> an instrument used to measure skin temperature without actually touching the skin and display the information numerically, and can be easily used as an assessment tool to detect tissue damage.

A variety of pressure transducers have been explained in the literature. But still there is no standard method for assessing patient at risk of pressure sores. Pressure sensors such as the 'Denne Gauge', which is very simple to use by nurses or occupational therapists to check skin pressure, has been developed (Barbenel et al., 1983).

Another method of pressure transducers is electro-pneumatic pressure sensors which has been shown to assess the value of patient support surface (Clark, 1988).

From all the predictors of skin breakdown described above, some of the scales are more comprehensive than others and some, no doubt, are more accurate while some are more simple and easily understood. Many hospitals still use their own scale for their own satisfaction. All scales together are useful in assessing the patient on his admission to the hospital and in re-assessing him when his condition changes or deteriorates. However, there is insufficient research evaluating them and showing which is the best one for identifying the patient at risk.

Pressure sores still present a real problem to the health services, despite medical and nursing progress for they are costly (Anderson et al., 1982; Lowthian, 1982; Kenedi, et al., 1976). In addition to the economic cost of pressure sores, vitally important are the social and humanitarian costs in which the patient and his family are involved. Apart from the distressing appearance of pressure sores and their debilitating effects, repeated admission to hospital due to the pressure sore occurs. For this reason it is important to focus attention on patients 'at risk' and identify them using a predictive scale, after identifying the factors responsible for pressure-sore occurrence. Therefore, anything that is a reasonably good predictor of patient at risk is useful and also a more efficient and effective way of prescribing preventive care. Thus, lack of evaluation of the existing risk calculators is a cause for concern, since at present it is difficult to say how accurate they are (Barratt, 1987).

Further, it is important to say that although nurses need to use predictors to aid in the diagnosis of patients at risk, they should not be used as an alternative to good clinical judgement when an at-risk patient may be identifed without recourse to such a predictor.

3.9 Summary

No one is immune to pressure sores. Thus, even a patient in otherwise good health, lying still in one position for 6-12 hours as a result of being unconscious is likely to develop pressure sores. However, some patients will be more at risk of developing pressure sores than others, depending on the predisposing factors that they are exposed to. The patients more likely to develop pressure sores are:

(1) elderly, confused, immobile, incontinent, and with poor appetite;

(2) patients with neurological defects and injuries, e.g. head injury, spinal cord injury;

(3) hospitalised patients, mainly sedated patients;

(4) patients with chronic illness;

(5) elderly with fractured femur/fractured hip.

However, Abruzzese (1985) stated that:

> Early detection through nursing admission forms and institution of vigorous preventive measures for at risk patients should obviate most pressure sores. Four factors need consideration: knowledge of assessment variables, systems for implementation, consistency, and time.

In order to identify the patient at risk and to implement pressure-relieving policies as early as possible to prevent pressure sore formation, many risk calculators have been developed. The Norton Score (1962) was the first and best-known and has been widely adopted in nursing practice. Other risk calculators have been devised more recently: Gosnell, 1973; Knoll Predictor Score, 1982; Waterlow, 1985; the 24-Hour Predicting Score, 1983; the Assessment Form, Abruzzese, 1985. Furthermore, many instruments have been used in order to ascertain if there is a deep pressure sore in the deeper layer of the tissue under the skin instruments such as thermography to see the difference in temperature between the affected tissue and the healthy tissue. The difference in temperature is clearly shown with this instrument. Thus, assessing the patient's risk of developing pressure sores is the essential first step towards their prevention, i.e. by identifying those at risk from pressure sores on admission and later at weekly intervals and when there is any change in patient condition, by the same observer; these precautions being taken in order to eliminate possible error that might happen while assessing patients who are at risk.

CHAPTER FOUR

Prevention and Treatment of Pressure Sores

4.1 Historical notes on prevention and treatment

Pressure sores are not a 20th century occurrence; they have been around a very long time. A lesion has been found in the mummified body of an Egyptian priest in Egypt (Thompson, 1961). Moreover, in the days of Hippocrates c.400 B.C., superficial ulcers were treated first by a wash with warm water, the temperature of the water being considered critical to keep the ulcer relaxed, i.e. by preventing chills and to facilitate bleeding. The ulcer was then sponged with vinegar, excised, and covered with a padded wool poultice, soaked in a mixture of the following: copper acetate, flower of copper (copper oxide), wool grease molybdaina (lead oxide), alum, myrrh, frankincense, gall nuts and vine flowers (Majno, 1975).

The Indian physician, or 'vaidya', of the fourth century B.C. had two absolute rules: not to accept fatal cases, and not to take a patient with an incurable ulcer (i.e. one that was malignant). Considered in this category were fleshy ulcers with raised edges, and painless ulcers. The vaidya knew that bleeding could be stopped by placing a bag of sand on the wound; that an ulcer that smelled like a dog, a horse, or putrid meat was unfavourable; and that a wound shaped like the barb of a spear, a chariot, a horse, an elephant, a cow, an ox or a temple was fatal.

In China, in the second century B.C., a document called 'Chou Li' was complied to portray the ideal state of the Han dynasty. A sub-division of the five medical services was designated 'service of the ulcer physicians'.

These men, relatively low-ranking as surgeons, were in charge of swollen ulcers, dripping ulcers, and ulcers caused by sharp instruments or fractures. They treated the ulcer with five poisons, fortified them with five medicines, and tempered them with five flavours. They fortified each of the following: The bone, the nerves, the pulse, the respiration and the bodily openings, with an acid principle, stinging principle, salty principle, bitter principle, and oily principle, respectively (Majno, 1975).

Fabricius (1593) suggested that pressure sores were due to loss of blood supply and to nerve severance. Brown-Seguard (1853) wrote specifically about ulcers in paralysed normal animals. Later, Paget (1873) defined the major causative agent in bed sores as pressure. However, Charcot's (1879) description of a theoretical "trophic factor" elaborated by denervated tissues and responsible for ulceration and tissue atrophy was the basis of the common belief that pressure ulcers were unavoidable and incurable. This was in agreement with Leyden (1874) that sores occurred when sensation and reflexes were absent and incontinence was present. Between then and 1940 great names in medicine and physiology turned their attention to the aetiology and treatment of pressure sores.

A distinction was made between purulent ulcer and (non-purulent) wounds by Celsus (C.A.D. 30). Furthermore, he recommended sutures of a woman's hair to close small wounds. Also, he decided to remove foreign bodies to avoid inflammation of a wound, and loose closure if drainage was to be expected.

The belief that the pressure sore is a desperate, if not hopeless, condition has fostered the development of an enormous pharmacopeia of topical and mechanical remedies of varying quality and biological validity. The selection of the appropriate topical and surgical therapy is critical (Constantian, 1980).

4.2 Prevention of pressure sores

Emphasis on the prevention of pressure sores is more beneficial for the patient and society than emphasis on curing of the pressure sore. Much time, energy, and money have been expended in the curing process. It seems that the NHS is willing to spend millions of pounds annually on the care of pressure sores, but very little on their prevention!!! This is in spite of the fact that prevention is an easier and more economical approach to the problem, whether in savings in pounds for treatment or in nursing time and effort for the patient and for the one who cares for him (Torrance, 1983; Waterlow, 1988b).

Fernie (1973) estimated that £60 million a year was being spent on treating pressure sores in hospitals, as approximately 25,000 patients had these sores - Nine years later the cost was £150 million pounds (Scales et al., 1982). However, recent nursing research has estimated the cost of treating pressure sores as £200 million pounds per year (i.e. the cost of pressure sore treatment in each district is approximately £750,000 per year (Hibbs, 1987). This is attributed to an increasing percentage of patients surviving serious illness or the multiple pathology of diseases in particular elderly patients who become at risk of developing pressure sores. Meanwhile, the pressure sore is a problem that with an increasing elderly population is unlikely to disappear.

In the United States of America, the cost is estimated as from $2,000 to $10,000, and even up to $15,000 per pressure sore (Spence et al., 1967; Merlino, 1969; Edberg et al., 1973). Thus, the cost of a pressure sore continues to increase as the elderly population increases. Further, nursing time also increases (Barton and Barton, 1981) in addition to the problems set out below:

1) The time a patient is away from his job.
2) The patient stays in hospital for a long time.
3) The pressure sores cause great pain and are a source of serious systemic diseases in some and seriously impaired health in others.
4) Pressure sores increase the workload of nursing staff and also cause feelings of guilt and distress which can not be measured.
5) It delays other patients' care by a long stay in hospital, sometimes 10-12 weeks for a grade four sore (Hibbs, 1987).
6) If the standards of care have fallen below acceptable levels, authorities can be sued for the development of a pressure sore.

Thus, the pressure sore problem demoralises patients, their carers, and the nursing staff. However, prevention of pressure sores can be achieved after identifying both intrinsic and extrinsic risk factors, and taking all possible measures to circumvent them. Recognition of a patient at risk is essential and have been discussed in the previous chapter.

Ek and Boman (1982) states:

> In certain cases it was difficult for the person interviewed to separate methods of prevention from methods of treatment. Many methods are used both as prevention and as treatment. Most of the measures for prevention of pressure sores are based on the idea of reducing pressure or to limit the duration of pressure.

Hence, there is no general method of preventing pressure sores and care has to be tailored to the individual needs of each patient (Barton and Barton, 1981).

4.2.1 Principles of effective pressure sore prevention

Relieving "pressure" is the first principle that needs to be considered in pressure sores prevention and this can be achieved by:

1) Reducing the amount of pressure being exerted on susceptible tissues. This would be either decreasing the mass which is acting on a pressure area or, conversely; increasing the area on which that mass is acting.
2) Reducing the amount of time that pressure-susceptible tissues are in contact with bed, chair or other surface (Kosiak, 1959; Husain, 1953).

After being subjected to pressure the skin may become oedematous and local thrombosis may occur in small vessels. Animal experiments using the electron microscope have confirmed this thrombosis of the micro-circulation and the endothelial damage, (Barton and Barton, 1973).

Moreover, outside the area of greatest pressure there is another area of occlusion of vessels by platelets which renders this ring of tissue highly vulnerable too. The result is likely to be anoxic skin necrosis. Nearly thirty-five years ago it was shown that high pressure for a short period is safer to the skin than low pressure for long periods (Husain, 1953). However, even when the patient is in the sitting position a pressure of 300mm Hg per cm^2 can be built up (Kosiak et al., 1958) although most people do not have to sustain greater pressure than 100mm Hg per cm^2. Active people can move themselves freely in bed or while they are sitting on a chair. Others, who are forced to be immobile, or are in coma, very ill, paralysed, or in too much pain to move are potential victims of pressure effects.

Therefore, relieving pressure on the patient is one of the fundamental aims of prevention and this applies as much to chairbound as to bedbound patients. The totally helpless chairbound patient might be at greater risk than the same patient in bed because body weight is not distributed over such a large area, and preventive measures may not be applied rigorously.

In one study, 24.8% of totally helpless chairbound patients had pressure sores compared with 18.6% of totally helpless bedbound patients (Barbenel et al., 1983). In fact, pressure sores can develop regardless of what position the patient is in, as long as pressure is applied to an area where a bony prominence is present. Positioning in bed is of great significance. In particular, a patient in an upright sitting or semi-recumbent position will always be sliding down the bed. This is called 'a forward slide', and subjects the skin to shearing stress at the pressure points. If, having slid, he is dragged up the bed again instead of being lifted, contrary skin-shearing stress will be brought to bear (Lowthian, 1971).

4.2.2 Possibilities of prevention

Prevention. This could be:

A. Primary

Care aims to prevent skin breakdown developing (e.g. regular turning of patient position).

B. Secondary

Care aims to minimise the effects of existing or unpreventable skin breakdown (e.g. when skin breakdown is present on admission).

In normal healthy people, skin discomfort signals the need for position change, even during deep sleep. But neurological, vascular, and orthopaedic problems may well cause skin breakdown to appear through either blocking the transmission or reception of the stimulus signal to shift position or by removing the patient's ability to make an appropriate response. Thus, the patient in this case needs somebody to change his position and that is the essence of the pressure sore prevention problem, (Parish et al., 1983). Hence, careful positioning and regular repositioning of the patient are the most effective ways of relieving pressure (Norton et al., 1962, 1975).

In the Royal Orthopaedic Hospital, turning schedules have been used and gave effective results in orthopaedic wards regarding pressure sore prevention (Lowthian, 1979b).

Lowthian's schedule of the turning clock has been widely adopted to suit an individual's routine (Lowthian 1979b). However, many individual hospitals have their own schedules for repositioning. Most repositioning schedules record the previous position of the patient to ensure that each area of the body is subjected to the minimum period of pressure. It must be borne in mind that a turning schedule is as essential for community patients as for hospital patients, with implementation of the resources that are commonly used in hospital (i.e., turning using a relieving device).

Moreover, Crow (1979) points out that mobility achievement depends upon the following:

1) Whether it is day or night
2) Whether the patient is bedfast, or chairfast
3) Whether the bedfast patient is nursed in the prone or semi-recumbent position
4) The patient's general health status.

4.3 How frequently should a patient be turned?

When we asked nurses to identify the factors liable to place patient at risk of developing sores, all mentioned, pressure and incontinence - though few considered that frequency of care (Norton et al., 1962, 1975) and time for giving care might be related. The appearance of the pressure sore has long been regarded as positive evidence of indifferent nursing care (Norton et al., 1962, 1975;

Pinel, 1976).

Turning the patient's position should be planned hourly, or at least every two hours, sometimes more frequently than two hours. However, Bliss et al. (1967) suggested 2-4 hourly turning was impracticable as a general measure for geriatrics, and most manual turning is now performed three-hourly or four-hourly for patients with low risk. The demands of this regime are too great for many geriatric wards. Norton et al. (1962, 1975) indicated that the incidence of pressure sores can be reduced if sustained pressure is relieved two to three-hourly even when the patient is in poor condition. Reddened areas of the skin should return to normal coloration within five minutes after the position is changed. However, if reddened areas remain inflamed for more than five minutes, the turning schedule period should be reduced by a half an hour. The regime of a turning schedule every 2 hours has no research basis. But more recently, Lowthian (1987) shows the two-hourly changing of a patient's position is the best (Fig 4.1).

In most geriatric wards the procedure of turning depends on the nurse/patient ratio. This ratio should be higher than a general ward dealing with the younger patient. The burden may be heavy in terms of the amount of nursing man-hours required for the care of sick, confused, elderly patients who usually need doubly handling, feeding and four-hourly toileting (Wilfred, 1967). The more nurses that are available, the more frequently turning can be carried out and the less likely is the individual nurse to get back-trouble (Green, 1976). The shortage of nurses on the ward

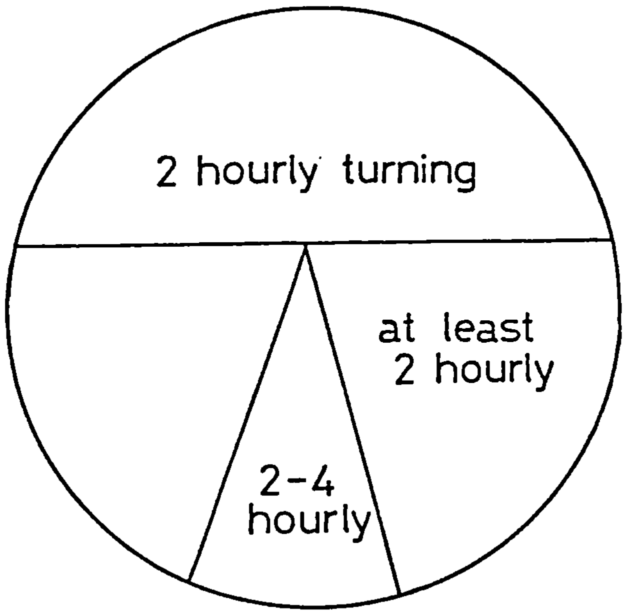


Fig 4.1 The 2 hourly manual turning is the best (Lowthian, 1987).

for a few hours can be a cause of concern in pressure sore development (Lee, 1985). But this could be avoided if nursing staff were allocated to the ward according to its immediate nursing needs, not according to the bed capacity. However, in the hospital even if sufficient nurses are available, pressure sores can happen and this might be attributed to:

1) nurses' negative attitude towards patient complaints
2) some nurses being unaware of clear standards of care which are essential to a satisfactory staffing policy
3) team work failures during night hours
4) lack of interest in keeping a daily record sheet showing the time a patient's position should be changed so that it can be crossed out each time the nurse finishes and she can avoid disturbing the patient by unplanned pressure area care
5) lack of understanding of the pressure sore problem
6) poor nursing management involving all the staff day/night and lack of organising the staff work.

Continuity of pressure area care day and night is crucial. There may be a high number of patients at risk during night hours, when there is least general activity and the natural tendency is not to disturb the patients. In addition, caring for elderly patients at night needs special nursing skills (Skilleter and Complin, 1986).

In fact, there is risk from disturbed sleep, but greater risk from unrelieved pressure. Bereck (1975a) reported the suggested reasons for failure of the turning schedule as a preventive measure:

1) Inadequate understanding of the appropriate frequency

of turns needed.

2) Lack of acceptance of the need for frequent turning.

3) Inadequate numbers of staff to carry out the turning regime.

On the other hand, Torrance (1983) listed the disadvantages of regular turning as follows:

1) There is inconvenience to, and disturbance of the patient.

2) Sometimes disturbing his sleep may cause pain and can contribute to disorientation in the elderly patient.

3) A turning schedule is a time-consuming regime keeping nurses busy with the schedule for 24 hours; but on the other hand the development of skin breakdown will increase this time by as much as 50% of nursing time (Barton and Barton, 1981). Thus, in spite of this disadvantage and the heavy demand on nursing time, regular turning still appears the best way to prevent pressure sores.

Furthermore, in the community it has been noted that patients being nursed at home by their family seldom developed pressure sores, as nursing care was continued for 24 hours, with the help of the community nurse (Bliss and Murray, 1979).

4.3.1 Inspection of vulnerable area

It is important that with each turning position the pressure area be inspected by the nurse, the family or by the patient himself. Any reddened area must be considered as the beginning of a pressure sore, and immediate action must be taken to relieve pressure from such an area. Therefore, daily inspection of wheelchair patients includes encouraging him to use a mirror to see the posterior area. Alternatively, such inspection by a carer seems vital in the early prevention of pressure sores.

4.4 Time spent on pressure area care

Effective and rational measures of preventing pressure sores depend on faithful, regular and continuous nursing care. It is likely that almost any method of prevention will work, provided it involves the relief of pressure and is followed consistently around the clock. The major factor in the aetiology of pressure sores is the pressure exerted on soft tissue over time, leading to tissue damage. Whilst there may be a relationship between the length of time for which pressure is exerted and the intensity of pressure in general, the consensus view is that a long period of relatively low pressure causes more damage than a short period of high pressure (Scales, 1976; Kosiak, 1959; Husain, 1953).

Further, there is a lack of appreciation of how much time is needed to carry out even simple nursing procedures such as turning the patient's position (Lee, 1985).

Barton and Barton (1981) argued that once a pressure sore has become established a 50% increase in nursing time is necessary and an added burden is thrown onto staff, apart from the increased suffering caused to the patient. The most logical solution to the problem of pressure sores is to prevent them; hence, the focus of this present study.

Bearing in mind that there is no perfect way to maintain standards of care, and that pressure sores and their prevention is still one of the most time-consuming problems faced by the nursing team, it can be said that the total time devoted to pressure area care reflects the standard of nursing care. However, Grant (1977) indicated that the amount of time required to undertake an activity may be affected by several factors and these include:

1) the amount of training and experience of the staff member undertaking the activity
2) age, sex; the patient's general condition
3) the design of the ward
4) the equipment available
5) the standard of care
6) the effect on the staff of being observed.

Therefore, it was decided to collect data to determine the amount of time devoted to preventive pressure area care actually received by patients and to compare the hospital setting with the community with respect to this (Clarke and Kadhom, 1988).

4.5 Skin care

> **Ventilation and skin cleanliness are equally essential**
>
> Nightingale, (1859)

Skin care is an essential part of pressure sore prevention. Hence, the skin should be dry and clean all the time, particularly with the patient at risk of developing pressure sores. Too frequent washing will remove the skin surface lipids or sebum which creates the skin's own barrier to replacement. Using mild soap and rinsing with warm water is essential (Torrance, 1983). Incontinence is one of the contributing factors in pressure-sore formation (Norton et al., 1962, 1975). Thus, incontinence must be controlled using an indwelling catheter with regular checking and using an aseptic technique of nursing care. Faecal incontinence is another problem that must be taken into consideration, especially with the immobile elderly. Powder should never be used on incontinent patients.

Clothing and bedding must be regularly cleaned and dry and free from irritants - sheets should be checked to remove crumbs - and the top sheet should be loosely tucked in.

Further, massaging the skin distorts circulation and may cause more tissue damage (Dyson, 1978; Ek, 1984).

4.6 Preventive measures

The majority of pressure sores can be avoided by:

1) adequate nursing care
2) maintaining patient nutrition
3) mechanical devices
4) education of
    A. Patient
    B. Nurse
    C. Other members of the health team and

relatives and persons who give care to the patient.

4.6.1 Adequate nursing care

> If a patient develops bedsores, it is the fault of the nurse and not the fault of the diseases.
>
> Nightingale, (1859)

This statement emphasises that pressure sores can be prevented with adequate nursing care. Up to now, pressure sores have been generally assumed to be a nursing rather than a medical problem. However, even 'Nursing text books' still contain scanty reference to them. But there is no doubt that with a high quality of nursing care pressure can be prevented (Bliss et al., 1967; Norton et al., 1962, 1975; Lowthian, 1983).

In fact, not all pressure sores are preventable but many are. Since the nurse has the responsibility for instituting preventive measures and documenting her efforts, she should examine her armament of assessment tools in order to discriminate regarding which patients are at high risk of pressure sores and which are not. Meanwhile, it is possible to draw up a pressure area care plan appropriate to the needs of the individual patient and effectively prevent pressure-sore formation if it is followed precisely and concisely and exactly (McFarlane and Castledine, 1982). Thus, in order to draw up a plan for pressure area care, those responsible must have an accurate understanding of the problems, the aetiology and pathogenesis, the complications, and the method of assessing patients at risk.

In planning for pressure area care, team work employing "Doctor, Nurse, physical therapists and other carers" should be involved, because working as a team is essential in planning for prevention. However, it is nurses who spend most of their time with the patient and have immediate responsibility for basic care such as pressure area care (Torrance, 1983).

4.6.2 Maintaining patient nutrition

Good nutrition is an important factor in maintaining healthy skin. Moreover, maintaining good nutrition with a caloric diet, high-energy and rich in protein, e.g. milk, eggs, cheese, meat, fish, beans, sufficient vitamins and iron and minerals is an essential part of pressure-sore prevention. Malnutrition is considered as a factor significantly associated with pressure-sore development (Norton et al., 1962, 1975). Elderly patients are the common victims of malnutrition and poor appetite. That may be due to economic status, which could affect all sections of the community. It particularly hurts the elderly, who may deprive themselves of a decent diet because:

1) They like to keep money available for other bills.
2) They may lack an interest in cooking because of loneliness, troublesome dentures, fuel being costly. Elderly people are less able to cope with nutritional abuse; they may even be unable to handle the kettle due to muscle weakness or sometimes due to a bandage used for relieving their pain.
3) They may have shopping difficulties; elderly patients

prefer small local shops which have a delivery service rather than far-away supermarkets.

Patients should enjoy an attractive diet, because many elderly people themselves complain of lowered appetite, often attributable to drug-induced confusion, depression and apathy (e.g. sleeping pills) or impairment of food flavours.

However, with increasing numbers of elderly people in long or short-term care, there is a need for more practical research into the role of malnutrition and poor appetite as factors contributing to pressure sore formation, in order to devise preventive measures in this regard.

A. Calorie requirements

The main sources of energy in the diet of the elderly might well be biscuits, cakes, pastries and bread, followed by milk, meat, fats and oils. The carbohydrate and fat content must not be high, as this will lead to overweight. If the patient is obese, his weight must be reduced by giving him a suitable reducing diet, because obesity discourages proper turning to avoid pressure sores; occasionally skin breakdown is produced by dragging the obese patient across a bed sheet, rather than elevating and turning.

B. Mineral supplement

Iron supplements and zinc sulphate are necessary to prevent tissue damage and promote healing, particularly for elderly patients or the seriously ill. Individual nutrition may make the difference between the success or failure of the treatment of pressure sores.

C. Vitamin C

Vitamin C is an important factor in the synthesis and maintenance of collagen for the repair of tissue; its deficiency leads to inhibition of the hydroxylation of the amino acids, proline and lysine, an essential step in collagen formation. Vitamin C deficiency may reduce the healing of pressure sores. Food rich in this vitamin are fruit, sprouts, potatoes, etc, (Davidson and Passmore, 1966).

D. Fluid

Fluids are essential not only to keep the urinary system free from infection and formation of calculi, but also to help prevent constipation and keep the tissues well hydrated. Dehydration is a predisposing cause of pressure sores, as due to it the skin becomes fragile and easily breaks.

E. Protein

Further, protein and maintaining a positive nitrogen balance is essential in pressure sores prevention. Elderly people have a greater need for protein if they are to maintain good nitrogen balance. Unfortunately, several factors operate to lead to poor protein intake, as set out below:

1) Ignorance about good protein sources such as milk, cheese and eggs.

2) The cost of protein. For instance, in 1971 a gram of protein obtained from an egg cost 0.35p; now in 1988 it definitely costs more. However, patients with some degree of kidney damage should avoid excess protein.

The role of good nutrition in wound healing is acknowledged as being important, although there are many differing opinions as to how this can best be achieved. Mulholland et al. (1943) showed rapid healing of a patient with pressure sores, who was mildly protein depleted, when a positive nitrogen balance was established with high protein and a high-energy diet consisting of an amino acid/dextrose mixture.

For the wheelchair elderly, approximately 1.5-2% of the total population of the U.K. were receiving meals-on-wheels at the time of one survey in 1970. By 1979 this figure had risen to approximately 2.5-3% (Davies, 1981). These patients who received meals-on-wheels might be:

1) Living alone or alone during the day, and having difficulty in preparing or cooking the main meal; those who were mentally confused or physically infirm.
2) Those in temporary difficulty (e.g. the convalescent).
3) Those who had inadequate cooking facilities or lacked the will to make proper use of their facilities, but could not get meals from other sources (e.g. clubs). Bearing in mind such cases, the community nurse should be on the alert for major nutrition factors in her clients' diet. In addition, she should know the risk factor entailed in poor nutrition, and methods of assessing the nutrition of elderly patients (Davies, 1985). The primary objectives of nutritional

assessment are:

1. The prediction of those patients most likely to require nutritional support.
2. The definition of the nutritional status of a patient at certain times to allow measurement of future changes.
3. The estimation of base energy needs so that nutritional support can be provided to adequate levels.

4.6.3 Patient support systems using mechanical devices

Basically, any patient identified as at risk during assessment must be provided with an effective pressure-relieving system immediately, in order to reduce compression of those areas likely to develop pressure sores. Pressure-relieving devices are nursing aids and can be very useful in the prevention and treatment of pressure sores if they are used and operated in a correct way. However, these devices differ in function and complexity, and the choice must be based on meeting the patient's individual needs.

Generally, all of these devices fall into one of the following three categories (Bereck, 1975b):

1) Devices that support specific pressure areas of the body, such as heels, sacrum, buttocks and elbows
2) Devices that aid in turning or moving a patient
3) Devices that support the entire body in such a way that pressure is either minimised or equalised.

4.6.3.1 Devices designed to support specific pressure-areas of the body

These are often pads made from a gel of similar consistency to human fat. Using these pads may provide a thick layer of 'artificial fat' over the bony surfaces of the body to distribute pressure over a larger area by lessening the chance of supracapillary pressure developing over the bony prominences.

Spence et al. (1967) and Walden et al. (1971), showed in their studies that the gel pad has potential in both the prevention and treatment of pressure sores.

A. Gel and foam cushions

These were described by Jay (1983) as a cushion made from foam with a middle layer of gel. They are likely to be more supportive than all-foam cushions because the gel will contour better than foam without bottoming out. They are lighter than all gel cushions of similar size and warmer too. One of its disadvantages is, it requires careful usage and careful maintenance, which it might not get if used with a variety of patients on a busy ward. Further, these cushions are more expensive than most of the alternative types of pad.

B. Sheepskin

Sheepskins have been widely utilized in both the prevention and the treatment of sores. Sheepskin is a dry, resilient substance capable of producing a dispersion of pressure over a larger surface of the body; supposedly friction is not created when skin surfaces rub against or slide over a sheepskin; moisture is absorbed and dissipated by the spongy and dry qualities of the wool; it can be laundered and is almost indestructible. Sheepskins vary in quality and effectiveness. Natural, good-quality sheepskins are very effective and are far superior to some of the cheaper synthetic products.

Sheepskins are not recommended for regularly incontinent patients. Generally a sheepskin is used as a large pad under the back and buttocks to protect the sacral area of bed-bound patients. Besides this, it is available in the form of elbow and heel-pads, especially when these areas are at risk of pressure-sore developments.

Functions of sheepskin

A major function of a sheepskin is to reduce shear forces. A sheepskin has a surface which will not stretch the patient's skin. It also tends to prevent skin-folding effects, which are especially likely when there is loss of subcutaneous fat such as happens more often with females. Natural sheepskins are best for protecting against shearing force damage.

Sheepskin absorbs water vapour in order to maintain a low relative humidity at the interface. Natural sheepskin will not only hold a high level of water vapour but will at the same time allow some loss of heat by this transfer of water vapour. In this respect artificial sheepskins is less effective than natural sheepskin (Denne, 1979). It may be placed directly on the seat of the chair or on the bed over the sheets, in direct contact with the patient. Full-length fleeces are useful on trolleys when transporting vulnerable patients.

Disadvantages of real sheepskin

One of the disadvantages of natural sheepskin is that if it is washed too frequently or without sufficient care, the leather backing will get hard and shrink in the laundry and may crack, while the fleece may become tough and compacted and lose its softness. Real sheepskin takes a long time to dry, so two sheepskins may be needed so that one is in use when the other is being washed. If real sheepskin is used for incontinent patients, it may smell unpleasant even after normal washing. Also cross-infection might occur if it is not laundered properly after patient use (Jackson, 1983).

Synthetic sheepskin

Usually this is knitted into or glued onto a fabric base and consequently the pile may be shorter than real sheepskin. It washes better and dries more quickly; but most of these fleeces may become compacted if not combed occasionally.

4.6.3.2 Devices specifically designed to aid in turning or moving a patient

This group of devices includes these which help the patient to move himself, in addition to those which help the nursing staff carry out turning regimes. They protect the patient by reducing the duration of the pressure, and include:

1) The Foster frame
2) The Stryker frame
3) The circoelectric bed
4) The tilt bed.

Those beds are either automated or hand-operated, but all are constructed to allow regular alteration in the distribution of pressure for patients who are nursed mainly in the supine position. Such devices would appear most appropriate in the maximum nursing-care units for multiple fractures cases, extensive burns, and unstable spinal injuries.

A. The monkey pole

This simple device allows the bedfast patient to move, lift himself, and give him an active role in his treatment. It can be useful for paraplegic patients who can use it to compensate for the lack of spontaneous movements resulting from loss of power in their legs.

4.6.3.3 Devices designed to support the entire body surface; to change, minimise or equalise pressure distribution

A group of factors which will increase the probability that a patient will develop a pressure sore are those associated with a reduction in mobility. This includes "any degree of paralysis, sedation and increasing age" (Crow 1986). Given relatively immobile patients who are bed bound, Crow (1986) states that "for practical purposes the harder the patient's support surface the higher will be the pressure" and this pressure will be exerted within soft tissue lying between the bony tissue and the support surface.

Much research has been carried out to identify the optimum type of support surface (eg mattress) to prevent sores in those patients at high risk. These support surfaces mainly act by reducing the pressure exerted upon patient's soft tissue using air inflation or flotation principles.

These mattresses are generally of two types:

1. Alternating pressure devices.
2. Moulding devices in which the surface moulds itself to the shape of the body allowing the weight of the body to be spread over a sufficiently wide area to prevent excessive pressure at bony prominences (Scales 1976).

One of the earliest such mattresses in common use is the alternating pressure mattress.

A. <u>Alternating pressure mattresses</u>

These have been used since 1948, and are quite popular, and called 'ripple mattress'. They are of two kinds:

A. The large-cell ripple mattress
B. The small-cell ripple mattress.

They are placed on top of the existing mattress.

The ripple mattress works on the principle of a series of air cells which are alternately inflated and deflated. The cycle of inflation and deflation of the air varies from two to six minutes, depending on the model, and is controlled by a time-switch in the pump unit. The first set of cells in inflated while the second set is deflated. The cycle is automatically repeated so that no part of the body is constantly under pressure (Bliss and Murray, 1979).

Thus, the pump unit inflates the alternate sets of cells in turn so that the patient is supported alternately on different parts of the body (Table 4.2), reducing the length of time for which any one part is subjected to pressure. The air tubing is connected to the pump units outlet and the unit can be suspended at the foot of the bed where its warning lights can be seen. Some pump units can operate two alternative mattresses and others can be set for large or small-celled mattresses, most pump units can also be adjusted to weight of the patient, although in practice the heaviest setting is usually best for most patients.

An alternating pressure mattress must be correctly set up, adjusted to operate properly and care must be taken to ensure that the pump setting suits the type of mattress and weight of the patient.

Ripple beds are an excellent support system if properly maintained. Each patient must have a newly cleaned and serviced mattress and it should be returned to work-shop for cleaning and maintenance after use or if faulty (Bliss and Murray, 1979).

The unit is switched on and if necessary the patient can be placed on it before it is fully inflated. However, it is better to allow the mattress to inflate fully before placing the patient on it, as this allows for fault

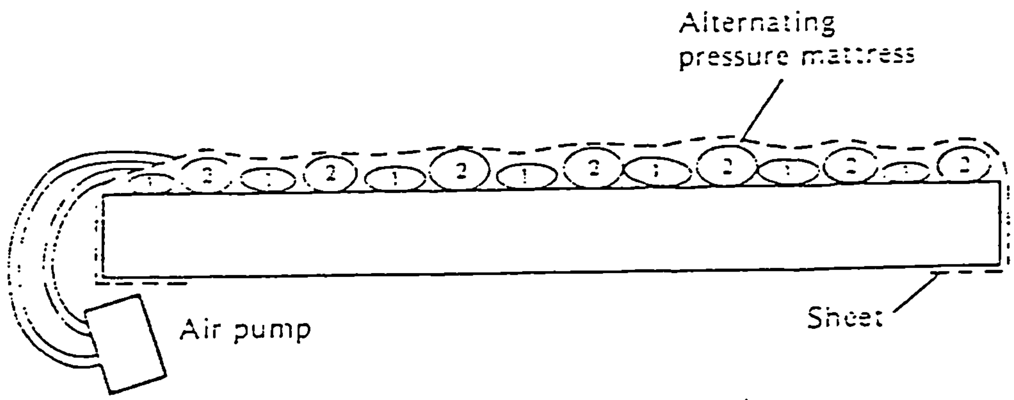


Fig 4.2 Diagram of a large-cell Ripple mattress showing transverse cells. An alternating-pressure mattress is a plastic or (sometimes rubber) air mattress rather like a beach mattress, but connected to a motorised air pump that causes different parts of it to be alternately blown up and let down underneath the patient. All the cells labelled 1 are connected to the motor by one set of tubes and all those labelled 2 by another. Once every five minutes the 1 cells inflate while the 2 cells deflate, then the 2 cells inflate while 1 cells deflate. The body thus rests first on the row of 1 cells and then on the row of 2 cells, so that the points of support, and therefore of pressure, are constantly being changed.

checking and repair. While the mattress inflates two indicator lights will come on, an amber mains power indicator and a red warning light. If the red warning light does not go off within 10-45 minutes (depending on the model) it indicates a low pressure and the mattress must be checked. A red warning light at any other time is an indication of malfunction and must not be ignored.

The air tubing must be unobstructed, it is not unknown for tubing to be neatly tucked under the ordinary mattress out of sight. The connection to the pump outlet needs to be checked, as occasionally the tubing can be pulled off. Tubing should be free of kniks and not crushed against the bed frame. The pump unit should be kept working properly and ancillary staff warned not to switch it off or it may be left off (David, 1986).

When alternating pressure mattress is used only one sheet is used to cover it, and it is tucked in loosely. The effectiveness of the mattress is progressively reduced by each additional layer of linen and the sheet should be free of wrinkles and crumbs. To encourage the patient to move if he is able, the top bed covering should be loose.

Several types of ripple bed are now available conventional alternating pressure mattress range from small-celled models (height 3-5cm) to medium (7cm) and large (10-11cm) mattresses for theatre use and ripple cushions for wheelchairs have also been developed. The conventional ripple bed usually has its air cells lying transversely but some models are produced with longitudinal cells. The large-cell mattress is more effective than the medium or small cell types (Bliss et al., 1967, Torrance, 1983).

B. Pegasus air wave bed

This consists of two ripple mattresses placed one on top of the other to give 17.8cm of clearance before grounding. A fleece should be used on top of the mattress for the skin-mattress interface and this is aerated by perforation in the upper ripple mattress which allows air to seep out. Hibbs (1985) and Exton-Smith (1987) pointed out that this bed is mostly suitable for:

1) patients with existing sores
2) patients with poor mobility, especially patients suffering from serious neurological diseases
3) patients for whom constant manual lifting is contra-indicated.

Livesley (1986) explained the rationale for using the air-wave technology. The pegasus system (Fig 4.3) was found to be significantly more effective than other alternating device and was reliable and free from mechanical breakdown. It is highly effective in reducing the shearing forces over the sacral area. The contouring of the mattress to the under surface of the body when the patient is nursed in the semi upright position and additional support system given under the thighs prevent downward sliding. The two layers of air cells produces a deep rhythmic wave effect that constantly simply deflating every third cell of the mattress in a cycle taking seven and a half minutes. A continuous flow of air is also produced to ventilate the mattress and reduce the problems caused by sweat and urine. Regular zero skin (interface) pressure for every pressure area allows blood recirculation for about

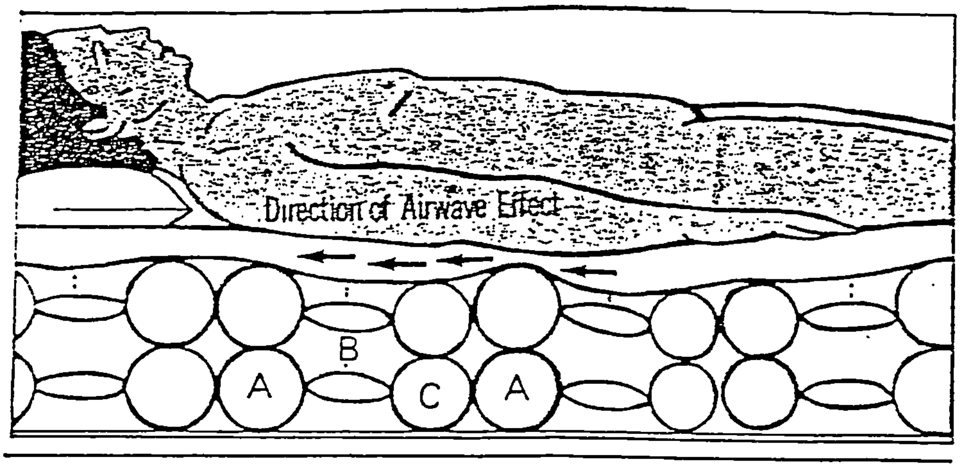


Fig 4.3 Pegasus air-wave bed.

Effects of synchronised airwave cycles showing one-in three cell pairs vacuum deflated to produce feet to head airwave effect.

two minutes of every seven and a half minute cycle. This has the obvious advantage of allowing physiological reactive hyperaemia to flush with blood any potentially ischaemic areas. The average pressure in an arterial capillary (in the skin of men at heart level) is 32mm Hg.

It must be noted that when utilising the various alternating pressure devices the following conditions are needed (Redfern, 1986):

1) The patient must be positioned on the mattress so that all parts of his body are lying on the cells. Pillows, pads or splints coming between the recumbent patient and the mattress negate its effects.
2) The mattress must be checked frequently to see that it is connected properly and that all tubes are patent.
3) The motor has to be on at all times, which has proved to be somewhat stressful for certain patients using the mattress or other patients on the ward.
4) Equipment must be kept in good order. Whatever the defect, a faulty mattress must be removed and replaced immediately.

C. Polyfloat mattress

This mattress is much thicker than the standard hospital mattress and consists of two layers of foam bonded together with the upper layer cut to give almost separate blocks of foam. The cuts greatly reduce the hammock effect from the tension with a normal foam mattress. It is most suitable for those patients who need a firm base such as orthopaedic patients (Hibbs, 1985).

D. The Clinitron Support System

The Clinitron bed uses an air fluidised bead support system that provides a uniform stiffness over the entire support surface. The Clinitron bed provides pressure relief redistributing loads away from areas of bony prominence and to determine if the body build of the person lying on the bed affect the relative effectiveness. It works when a blower unit pumps warm air through amedium of soda lime glass microspheres. The medium absorbs exudate which can be removed with a filter. Air fluidisation is continuous but can be stopped when the patient is handled or removed. This bed is very expensive and needs regular maintenance and changing of filters. It is most suitable for critically ill patients who do not tolerate manual lifting (Krouskop et al., 1983; Hibbs, 1985).

E. Beaufort Bead Pillow Mattress

This bead pillow mattress consists of 10-12 pillows attached to undersheet by velcro fastening. The mattress fits on top of an ordinary mattress. The device is simple to use, but care should be taken when making up the bed that the sheets are not tucked in or stretched against the mattress. The bead pillows can be sent to the laundry or soaked in a bucket of warm water and biological washing powder. It can be used in the patients home and is suitable for any patient who finds it comfortable (Hibbs, 1985; Torrance, 1983).

The bead pillow mattress is an effective low deformation device. It is simple to use, but as with all such devices care must be taken when making up the bed to avoid reducing its effectiveness. Two sheets are needed to cover the mattress. The sheets are folded deeply between the pillows and are not tucked in at the side. Sheets should never be stretched across the mattress.

F. Air fluidised bed

The air-fluidised bed uses dry flotation to provide a medium capable of providing hydrostatic support. A flow of warm air is pumped through a fine particulate medium, separating the individual particles to produce fluid-like support characteristics. Sand or glass microspheres are used as the support medium. A blower unit compresses air and forces it though a diffuser into the medium to separate and suspend the spheres. The air temperature can be controlled and the medium absorbs exudate. As the support medium used has a greater density than water, the patient does not sink into the bed to the same extent as he would on a water bed. The fluidised bed has all the advantages of hydrostatic support without the disadvantages of instability associated with the water bed (Allman et al., 1987).

G. The low air loss bed system LALBS

A high air loss bed system (HALBS) was developed to treat severe burn injuries. The HALBS supported the patient directly on air (Scales et al., 1967). The LALBS places a thin vapour-permeable membrane between the patient and the supporting air. This reduces the volume of air needed to support the patient and hence the size of the blower unit. The LALBS is available commercially as the medicus air bed (Medicus Products Ltd). The medicus mark V bed is the best design for hospital use and the medicus minor is a more compact, simplified version for home use.

The LALBS consists of 21 water proof, but vapour-permeable, sacs arranged in groups of five with pressure valves controlling each group. The air sacs are easily removable for washing, each group is colour coded and its pressure is indicated by a dial on this control unit. The sacs are connected to the blower unit which can supply air at controlled temperature. The pressure valves adjust each group to suit body contours. The bed is hinged and bellows at the head and foot of the bed control posture. A simple push button control operates the bellows allowing the patient readily to adjust his posture and to tilt the bed (Scales, 1974; Torrance, 1983).

H. <u>Water bed</u>

The first water bed has been reported as being used by Dr Arnote (1833). The rationale for its use is based on Pascal's law, which states that

> The weight of a body floating on a fluid system is evenly distributed over the entire supporting surface, so that pressure points are eliminated.

This bed comprises a metal frame supporting a stout canvas bag inside which is a thin nylon bag partly filled with water. The water is circulated by means of a pump. A heater and a thermostat regulate its temperature at normal body temperature. An overhead hoist is employed to help a nurse to move a patient. This bed gives positive results in the prevention and treatment of pressure sores (Torrance, 1983).

Disadvantages of the water bed

A deep-water tank has a number of disadvantages shown by Bliss and Murray, (1979). These are set out below:

1) It inhibits whatever movements the patient would be able to make when not on the bed, and this can lead to an increase in a degree of muscular atrophy.

2) Some patients become hallucinated and suffer from nightmares or disorientation.

3) There can be difficulties in lifting the patient from the bed.

4) It can interfere with the performance of daily nursing tasks for the care of the patient.

5) There can be difficulty in cleaning the bed.

6) It might cause hypothermia.

7) A heavy patient can develop heel sores whilst using this bed.

Other devices

Besides the above provisions there are other relieving devices such as cushions for wheelchair patients. Most of the research into wheelchair cushions has been done with those people most at risk of pressure sores such as paraplegics and tetraplegics, but they are minority users of the wheelchair. However, the wheelchair cushion performs a vital function by reducing local concentration of stress in tissues to prevent tissue ulceration (Ferguson, 1977). Thus, elderly people who spend much of the day in an armchair may benefit from a wheelchair cushion both for comfort and to prevent tissue damage.

Further, many devices used in the hospital and in the community still have a positive effect in preventing pressure sores. Nonetheless, further studies are needed to prove their effectiveness. Certainly there is no substitute for basic and comforting nursing skills.

4.6.4 Education

4.6.4.1 Patient education

It is essential to consider patient education as a factor in pressure-sore prevention, as all nursing procedures depend upon the patient and his individual needs. The key to prevention is the acceptance of the responsibility by all members of a team: the patient, his family, the doctor, the nurses, and the allied health professionals. Once this responsibility is accepted a pressure sore can be avoided. When the patient is physically and mentally capable of carrying out the preventive programme himself/herself, education in pressure-sore prevention in hospital and in the community seems crucial to the patient.

However, when he or she is not able to complete the programme of education, the family or other relatives and friends can carry out the programme for him.

Prevention of pressure sores requires that the body weight be distributed such that areas over bony prominences sustain only small pressure. In addition, the patient should completely and regularly obtain relief from pressure by a patient lift-up (Ferguson et al., 1980).

A chairbound patient develops pressure sores more than a bedbound patient (Barbenel et al., 1977) because the area exposed to the pressure is small in comparison with a patient lying in bed. The distribution of the pressure will be greater in a lying position. To help a wheelchair patient, we should encourage him to raise himself from the chair from time to time, in order to allow the blood circulation to the vulnerable areas (Barton and Barton, 1981). Later, the patient must be self disciplined and make these movements regularly a few minutes every half an hour through the day while he is sitting in a chair, in spite of the presence of the cushion under him. This lift-up soon becomes an unconscious habit. Basically, there is no standard frequency for a lift-up schedule for the wheelchair patient. Parish et al. (1983) considered that lift-ups giving 4-5 seconds of complete relief of pressure from the buttocks every 10-20 minutes is a reasonable and practical goal. In addition, there are four manoeuvres which are important in pressure relief:

1) Wheelchair lift-ups - elevating the trunk by pressing down on the arms of the chair.
2) Bending forward while in the sitting position and lifting the buttocks from the chair.

3) Having the chair tilted backwards to shift weight from ischia to sacrum.

4) Shifting weight from side to side to free one ischium at a time.

However, an overweight patient can hardly lift up himself. Obesity as well as sore-risk makes disability more severe and increases the patient's dependency. Another consideration is that when even a young paraplegic patient starts to work perhaps in an office the patient stops doing routine lift-ups because it makes him feel that he looks different from other people. Thus, an ischial sore may often appear, within a month of a patient going out to a job (Jones, 1979).

Pressure sore sites should be inspected frequently with each lift-up using a mirror to see if there is a blemish of any kind at the site of ischium and sacrum. This can be implemented by encouraging the patient to do it by himself, because monitoring the posterior body areas of the skin is essential to eliminate pressure sores and prevent further ones.

Bed-ridden patient

A bed-ridden patient must be encouraged to lift his pelvis clear of the bed support. This is where an overhead pulley and monkey pole is useful, especially with orthopaedic patients. Later on, where there is improvement in his condition, early patient ambulation and restoration of independent activity using a relieving device is normal practice for geriatric patients.

Moving the patient while he is in a wheelchair or bed-ridden is important to reduce the incidence of pressure sores (Exton-Smith and Sherwin, 1961). However, maintaining the integrity of the skin depends also upon the willingness or motivation of the patient to practise it actively and adaptively (Andberg et al., 1983). It is also important that a patient be supplied with documentary information, especially when he is discharged home, to let his relative(s) follow it if he is not able to.

4.6.4.2 Community patients

The number of people aged 75 or over is predicted to rise to 4 million by the year 2011. Even now nearly three million elderly people live alone and just over a third are 75 or over (Wheeler, 1986).

Taking the elderly over the age of 85, 66% are to some extent ill or disabled and 10% of them are in need of a considerable amount of nursing care. Only 5% of old people are in the hospital at any one time. (Turton and Orr, 1985.) Therefore, nursing the elderly requires an involvement within the community. Approximately one million old people are visited by a district nurse per year. These visits account for three quarters of a district nurse's total patient contact time and almost half (44%) of the work is with peple over 75 years old (Turton and Orr, 1985).

Further, in order to achieve perfect *PAC in the community two aspects of care must be followed (Cantrell and Dawson, 1983):

*PAC = Pressure area care

1. Intrinsic. Self-care when the individual looks after himself.
2. Extrinsic. Self care when family/relative(s) look after him.

Discharging the patient from the hospital poses a problem. Sometimes, unfortunately in many cases, the facilities and nursing help are inadequate and the patient is at risk of developing further sores (Wyllie et al., 1984).

However, Marks (1977) made the significant finding that people stayed at home when the family was intact, but needed institutional care when the family broke down.

Patients nursed at home are cared for by fewer individuals and the degree of liaison between nurses, the family and practitioner is far greater than when patients are in hospital, where there are more trained nursing staff who should be well versed in the method of preventing pressure sores.

Nursing staff have responsibilities which include directing the patients in their learning, acting as sources of more information and adapting the programme to each patient's needs, because the responsibilities of *PAC may be with the patient more than the staff, once the patient is discharged. Information related to PAC should be documented before the patient is allowed home and followed up by nurses later on to see whether the patient or relative is carrying out pressure area care activity or not.

Meanwhile, the frequency of pressure area care needs to be specified in the care plan for at-risk patients

*PAC = Pressure area care

who live with relatives, especially if the patients themselves cannot adequately cope physically and psychologically with the constant care required.

Frequency of care must be appropriate to individual needs. Relatives and patients should be educated about the importance of exercise and movement, and also about identifying the patients' ability to become increasingly independent and self-caring (e.g. in activities such as combing hair, lift-ups, deep breathing, feeding themselves, preparing to dress themselves, walking, and so on.

4.6.4.3 Can the problem of pressure sores be reduced?

Immobilised patients are more likely than others to develop pressure sores, but much of the misery of pressure sores could be prevented by simple improvement in the care of dependent and helpless patients, both at home and in hospital, and by more active measures necessary to reduce pressure sores and prevent them in susceptible patients.

Hibbs (1987) has noted that

> **95% of all pressure sores could be prevented in the future if every district could generate the will and corporate effort to make this happen.**

4.7 Treatment of pressure sores

Pressure sores do not arise as an act of God, and even in patients who are dying, cure of the sore is possible. Sores can be treated by good nursing care. Once a sore occurs, treatment is usualy aimed at restoring the patient's metabolism, preventing a superficial bed sore from progressing to a deep sore, combating infection, and above all providing pressure relief to prevent occurrence of further sores. There is no single cure for pressure sores for all patients (Torrance, 1981). But if the appropriate treatment is applied correctly and according to individual needs then at least 95% of sores can be expected to heal satisfactorily. Here it must be noted that David (1982) examined 90 reported preparations for treatment of pressure sores. But still there is no literature to show which treatment will best suit which particular type of pressure sore - so the nurse is faced with a variety of offered solutions when the problem itself is not clearly defined. David suggests that the lesion of a pressure sore should be treated as a wound, and that the principles are the same as for any other such wound.

Successful treatment is dependent on team effort. However, pressure sores can be classified clinically in order to communicate the degree of involvement needed and to develop a treatment plan. This classification is based purely upon the clinical appearance of the tissue (Lowthian, 1978). The choice of pressure-sore treatment depends upon the grade of the pressure sore. Each type requires its own approach. The presence of infection or necrotic tissue, and the vascular state of the pressure sores are among the factors which influence the pressure sore itself. The location, the depth and the presence or absence of underlying osteomyelitis should also be taken into consideration.

4.7.1 Plan for treatment

When preventive measures have failed, treatment should be started to achieve treatment, and three steps must be taken into consideration, including

1) local teatment and dressing
2) wound care (wound healing)
3) supportive treatment

4) surgical treatment.

4.7.1.1 Local treatment and dressing

A. Topical therapy

To promote pressure-sore healing, many topical preparations have been recommended recently for the treatment of pressure sores. A list of some of these preparations which have been widely used in practice was given by, Torrance (1983) and by Parish and Joseph, (1983). Most topical therapies are of limited effectiveness and some of them may actually be harmful, unless medically prescribed (David, et al., 1983). Local medication is mostly used to create sterile conditions in which optimum cellular activity and wound healing can take place, such as Dermalex skin lotion, creams, povidine iodine and spray disadin.

B. Dressings

There are various effective dressings which are commonly used in promoting pressure sores healing. Other effective healing methods are as follows:

1) The essential step of removing the pressure, and minimising predisposing factors by, for example treating systemic diseases and providing adequate nutrition and vitamins as in wound care.
2) Ultra-violet light may be useful in promoting healing and where appropriate, exposure of the lesion to air may hasten healing to a remarkable extent, while ultra-sound therapy has been used for treating deep sores. Ultra-sound is quite a useful alternative therapy to

ultra-violet light. By this technique the sore itself is not touched, but an area of skin 30cm (12 in) square is treated (Barton and Barton, 1981).

Further, cold therapy, vibration and electrotherapy have been used for pressure-sore treatment (Marshal, 1971; Wolcott et al., 1969).

4.7.1.2 Wound care

A. Wound healing

The healing process manifests itself in four-five stages (Bennett, 1983b; Barton and Barton, 1981).

1) debridement
2) wound contraction
3) granulation
4) epithelialisation
5) remodelling.

The healing process has been discussed by Schilling (1968) and Westabay (1982).

B. Which factors affect wound healing?

Nutritional level and inter current diseases affect the healing process. Pressure sores can also be influenced by factors affecting the local wound environment including some factors interfering with wound ability to combat infection such as the presence of necrotic tissue, temperature, pH, osmolarity, dehydration, oxygen, and movement at the wound margin which are all local factors involved in healing. They may be influenced by wound-cleaning agents or dressings (Torrance, 1981).

C. Infection

A good environment for bacterial growth develops in established pressure sores, which are likely to have mixed growth and may be infected by almost any organism, aerobic and anaerobic (Galpin et al., 1976).

Control of bacterial infection is a requirement in deep sores. Thus, to prevent further development of infection appropriate systemic antibiotic agents are essential to destroy or inhibit the spread of bacteria. Basically, the care of established sores is the same as that of any surgical wound.

The ulcer must be adequately drained and debrided, (Waterlow, 1988b). Furthermore, there is clinical evidence that glycaemic control with concurrent improvement in glucose tolerance is associated with better healing. Insulin-resistant obese diabetic patients have a defect in leukocyte function which will lead to an increased rate of infection. The exact mechanism or mechanisms of the defect in healing in diabetes are still unclear and need further research.

4.7.1.3 Supportive treatment

The first step to achieve active treatment of established pressure sores is to keep the ulcerated area free from further pressure on a more vigorous level, because no pressure sore can heal if the pressure is not removed. Dispersing pressure on any area on which the patient is lying or sitting with appropriate protection from hard or traumatic surface is essential. So is the avoidance of shearing and tractional stress, thus preventing further tissue damage when tending or moving the patient. This can be implemented by adopting a turning schedule or the employment of an effective pressure-relieving device, bearing in mind that a relieving device is an aid, not a substitute for good nursing care whether at home or in hospital, because it is nursing care rather than technology which will avoid pressure sores (Barbenel et al., 1983).

Treating any predisposing factors is important. This will have to be considered as a second step in treating established sores. Each patient will have different predisposing factors which contribute in pressure sore formation. This has been discussed in some detail in Chapter Three. Attention to nutrition, vitamin deficiency, skin care, anaemia and infection is important. Sather et al. (1977) showed that infection control can be another important factor contributing to delay with wound healing. Treatment with drugs which delay healing - for example, corticosteroids or anti-inflammatory drugs - may need to be stopped until healing has taken place (Torrance, 1983).

In spite of all this, healing of established sores is time-consuming, often a discouraging and even frustrating activity, and serves strongly to underline the importance of prevention. Understanding the mechanism of wound healing is useful for both the nurse and the doctor, so that they are in a position to control any aspect which retards or complicates the healing process (Barton and Barton, 1981).

4.7.1.4 Surgical therapy

Surgery is used in pressure sores when supportive treatment and medical measures have not succeeded in treating the lesion (Torrance, 1981).

Deep sores extending through the subcutaneous tissue, often down to and into the underlying bone represent a far more serious clinical problem. There is often extensive soft tissue necrosis and this can be associated with osteomyelitis, septic joint dislocation, dehydration, anaemia and sometimes even septicaemia.

Surgical debridement has been shown to hasten recovery and to provide a sound skin cover over bony prominences. This process is rapid but painful; therefore it is necessary to use local or general anaesthesia.

Surgical closure can have many complications in spite of its effectiveness in treating a persistent deep sore, and these include:

1) Complications accompanying general anaesthesia.
2) A need for blood transfusion(s) due to the excision and drainage of pus.
3) The development of a further sore due to a prolonged period spent on the operating table and the length of the postoperative period needed to achieve perfect healing of the original sore(s). This applies in particular to elderly patients (Norton et al., 1962, 1975; Torrance, 1983).

The three stages in achieving perfect surgical treatment are set out below:

1) Debridement

Usually this is carried out to remove the necrotic tissue. Using an enzyme preparation for debridement is quite likely to be more effective than surgical debriding because it promotes granulation and helps in healing.

2) Closure

In a deep sore skin grafting can be used to close it. However, reconstruction is necessary as skin grafts are vulnerable to the original cause of breakdown.

3) Reconstruction

Excision of the ulcer is made, including any bursa and affected adjacent bone. Tissue may be taken from adjacent soft tissue to repair the defect. Any existing skin graft is removed before reconstruction is carried out again (Constantian, 1980).

4.8 Summary

The problem of pressure sores has been recognised for many years. However, they continue to be a common problem both in hospital patients and in patients cared for in the community. The presence or acquisition of a pressure sore often delays considerably the discharge of patients from hospital and always involves nursing staff in much more work. Therefore the best treatment is prevention; here is where an ounce of prevention is really worth a pound of cure. Besides, prevention is better and cheaper than cure (Waterlow, 1988b).

The striking feature of effective pressure sore prevention is relieving 'pressure' and this can be achieved by:

1. Reducing the amount of pressure being exerted on susceptible tissues.
2. Reducing the amount of time that pressure-susceptible tissues are in contact with bed, chair or other surface.

There are two possibilities in pressure-sore care prevention or primary pressure area care, which aims to prevent skin breakdown developing, e.g. regular turning of patient position; and secondary care, which aims to minimise the effects of existing or unpreventable skin breakdown.

Pressure sores can be avoided by:

1. Adequate nursing care
2. Maintaining patient nutrition
3. Mechanical devices
4. Education, and this includes the patient, nurse and other members of the health team, and relatives. However, when preventive measures fail and the patient develops pressure sores, the problem is not how to prevent a sore but how to treat it. The basic aim in the treatment of an existing pressure sore is to prevent skin breakdown from progressing to a deep pressure sore. In a sense, therefore, treatment of skin breakdown is chiefly preventive and consists of relief of pressure over bony prominences by frequent

changing of position, improvement of the patient's nutrition, and curbing local infection that may be produced by soiling with urine or faeces.

Treatment of pressure sores can be achieved by:

1. Local treatment and dressing of the wound
2. Wound care (wound healing)
3. Supportive treatment
4. Surgical treatment.

CHAPTER FIVE

The Research Study

5.1 General introduction

The literature review emphasises the importance of care designed to prevent pressure sores. It also serves to show the sparseness of research which has been carried out in relation to the prevention of pressure sores in the community. The researcher decided, therefore, to carry out a study in which the nursing care relevant to the prevention of pressure sores could be related to the outcomes and in which hospital and community practice could be compared.

Three areas for research have been identified as essential to the advancement of nursing and the improvement of health care (Jacox, 1978). They are:

1) Studies to improve the care of people with existing health impairment.
2) Studies to develop preventive methods designed to reduce the occurrence of illness, complications and disability.
3) Studies to identify vulnerable groups.

The present practical research was undertaken to determine the amount of time devoted to pressure area care actually received by patients and to compare the hospital setting with the community with regard to the development of pressure sores. It was hoped that this research would provide some base-line data for future work. The study is one which should help in the improvement of care of people with an existing health impairment as in category (1) above.

5.2 The purpose of this study was to find out the average time spent per patient per day in care designed to prevent pressure sores, and to compare the nursing time devoted to this amongst hospital patients with the time contributed by relatives and nurses to this activity within the community.

5.3 <u>The objectives of the study were</u>:

1) To investigate the time spent on pressure area care in hospital and the community
2) To test the study method of the use of a diary sheet
3) To determine whether there is a difference in the amount of time received by patients in relation to pressure area care between the hospital and the community
4) To relate pressure area care to the outcome, (i.e. whether the patient develops a pressure sore or not)
5) To obtain additional data which would permit analysis in the event of significant differences in outcomes being noticed between different settings for care.

The outcome measure to be used in the study was whether or not the patient developed a pressure sore. Defining the outcome in this way leads to the identification of the proportion of patients who developed sores out of the total number studied.

It should be noted that in spite of the fact that this proportion is the incidence of the occurrence of sores for these patients, the methodology of the study is not that of an incidence study and should not be regarded as such; neither, of course, is it a prevalence study.

5.4 Methodology

Prior to undertaking the research study the means by which the aims of the project could be fulfilled needed to be decided upon; the rationale behind these decisions will be discussed in this section.

The research methods which were rejected for use and why they were rejected?

In this study the researcher wished to obtain a record of all care given to patients within the sample in relation to the pressure area care. Clearly the most appropriate method to collect such data would have been non-participant observation. However, this method was rejected as impracticable since for up to six weeks in any case such observation was beyond the scope of a study by a single researcher for a higher degree. A questionnaire administered to nurses or interview schedule would probably have involved retrospective recall of nursing action and this is open to major error and inconsistency.

On careful exploration it was decided to use diary sheets so that carers could record their activity of giving care immediately when they had occured.

Very importantly, the researcher was allowed to pursue her study on condition that it did not interfere in any way with the nurse's routines and working methods, and this accounts for the very limited use of interviews with staff, and anything other than a non-participant role in the nursing activities.

The discussion covers several issues but falls into basic sections as set out below:

A) Choice of the method and research design.

Three methods were used to gather the required data:

1) Interview

2) Observation

3) Diary sheets completed by care givers.

(1) <u>Interview</u>

The interview method of collecting data was a very powerful tool for the researcher. Face-to-face interviews were used, as the interviewer can have a great deal of influence on the outcome. Interviewing usually gives a better response rate, as it may be difficult to refuse to be interviewed in a face-to-face situation. To a certain extent the interviewer is able to control the environment, the time, and the place of the interview. Most of the data obtained are usable. There are fewer missing data and 'uncertain' responses because the interviewer can clarify questions and encourage complete answers. Another advantage of interviewing is its flexibility; objections can be pointed out and rapport established, so that the respondents may be more able or more willing to respond and cooperate. Generally, an interview can be used to elicit information from a broader group of individuals, since the respondents do not have to know how to read or write. However, possible disadvantages of this method could be: introduction of bias, when the researcher expects a particular response from the patient, and the patient tries to please the researcher, arrangements for interviews may be difficult to make; data from interviews may be hard to analyse; interviewing allows less anonymity, and subjects may be unwilling to answer some questions, especially those of a personal nature; in the hospital research settings some patients may be reluctant to answer a question when other people are around or on the other hand, may not want to disappoint the researcher by refusing to give an answer; patients may be tired, hungry, or waiting for visitors, and the impracticality of the interview from the patient's point of view must be always considered by the researcher; furthermore, the process of carrying out an interview is time- consuming for both the researcher and the patient.

The researcher should create a permissive, neutral atmosphere in interviewing, so that the patient feels he/she can give honest answers, even when that may show him/her in a less than good light. A guarantee of anonymity is also crucial in obtaining frank and revealing responses from the patient.

(2) Observation

The most direct way of finding out how nurses perform particular procedures, how they communicate with patients, or how they relate to colleagues is to observe them in their working situation. Observation for research purposes needs skill and rigour.

The greatest advantages of direct observation are that it is possible to record behaviour as it occurs, and to gain insights and ideas that can be tested later on a larger population. It may also be used to gather supplementary data which can help to interpret information on a diary sheet. Alternatively, it is useful as a primary method of data-collection in a small-scale study where depth of information is required. Observation technique allows the researcher to view the complete situation at first hand, as it develops, and also affords the inclusion of a sequence of events. The observation technique can begin or be stopped at any time. However, the method does have limitations. It is less effective in giving information about a patient's perception, beliefs, feelings, motivations or future plans (Vera and Rogers, 1986). Bias might arise by this method. However, Simon (1978) offered some suggestions for reducing bias in observation. In accordance with these, the data were collected by the researcher using the technique of non-participant observation, which is frequently used in nursing research and in which the observer aims to take no part at all in ward activities.

(3) Diary Sheets

Advantages of the diary sheet as a method of collecting data, from the researcher's point of view are:

1) A diary sheet provides a first-hand account of a situation to which a researcher may not have direct

access.

In relation to the current study:

2) The diary sheet provided a direct method of collecting data by which the nurses/patients/relatives could write down information exactly without misinterpretation by the researcher.
3) It provided information over a long period of time.
4) It gave information as to whether there was a shortage of nursing staff with regard to pressure-sore information.
5) The standard of nursing care in various wards could be identified regarding the input into care for some individual patients, as all grades of nursing staff recorded their pressure area care activity and the time of this activity.
6) Could be used as a base for interviews (Burgess, 1984).
7) The diary sheet could be used as a method of assessment, regarding the frequency and time spent on pressure area care.
8) The summary sheet seemed very useful during data analysis, as all the information was gathered in one sheet.

Disadvantages of the diary sheet

1) The diary sheet consumes a large amount of nurses' time due to the frequent recording of information required by the researcher.
2) The diary sheet needs frequent checking and supervision.

3) The diary sheet is expensive and it is difficult to design and analyse it.

Specific to this study

4) Bias might have arisen due to misunderstanding the way of completing the sheet, e.g. pressure area care information according to the coding list of the variables.
5) The diary sheet needed to be filled in at regular intervals at the time when pressure area care activity was carried out. However, inaccuracy might have arisen, especially when nurses or relatives left all recording on the diary sheet to the end of the day or to the following day.
6) Since the researcher was not present for the whole of the time, staff might sometimes have forgotten to complete the sheet, providing an underestimate of the time devoted to pressure area care.

Case studies, using both health service documentation available to the researcher and research data, were compiled to illustrate detail with regard to the giving of pressure area care and the outcome.

5.5 Research design and the procedure

Stages of research in relation to each participating patient

1) Admit the patient to the study
2) Assess patient

    Using diary sheet - summary sheet

3) Continued study - nurses and relatives complete the

diary sheet

4) The researcher visits for assessment and checking

5) End of the study according to the criteria and patient's condition.

The design of the study refers to the framework or structure specifically conceived and executed to bring empirical evidence to bear on the research problem (Kerlinger, 1973), bearing in mind that research design depends upon:

1) What observations are necessary

2) How observations should be obtained

3) How the data should be analyzed.

The overall design of the present study is that of a survey involving a non-experimental descriptive study of current nursing practice. In identifying an appropriate research design to be used for seeking an answer to a research question, it was felt that a diary sheet would be most suited to assessing patients with regard to the outcome. Although it is expensive and difficult to design and analyse, it may be the best means of recording the time for pressure area care devoted by carers as it is difficult or impossible using other methods to recall such data accurately after a passage of time. For a researcher to have observed pressure-area care over the whole twenty-four hours for a fortnight or more, would have been even more costly and time-consuming.

5.6 Reasons for choice of diary method

There was a need for a method of recording the nursing care in which the researcher was interested (i.e. pressure area care) over the whole of the twenty-four hours and for up to 4 weeks during the pilot study and up to 6 weeks during the main study, over which time it was clearly not possible for a single researcher to obtain this data by observation. Therefore, it was decided to explore the use of diaries (i.e. to ask, why the diary sheet and summary sheet?).

When selecting the data-collecting method, taking into account the length of time and resources available, a diary sheet seemed the appropriate method of collecting data. See discussion of this, in Section 5.4 above.

A diary sheet is a technique which has been considered more helpful in problem-solving than in actual research. However, the purpose of using this method was twofold:

1) To provide an intimate descriptive account of the everyday life of individuals
2) To determine how nursing personnel spend their time, particularly the time spent in pressure area care, because diaries deal with a specified span of time that must be decided on the basis of the problem, (Oppenheim, 1966).

In both research areas - the hospital and the community - the criteria for inclusion and ending the study of the patients were the same.

5.7 Criteria for inclusion of the patients in the study

From the start of the period of data-collection until one week before the end of the study within the chosen hospital wards or the community catchment areas, all new admissions were considered for inclusion. The criteria used were:

Patients who were bedfast or chairfast and without existing pressure sores. This meant in principle patients of either sex, any adult age group and any diagnosis were acceptable.

5.8 Criteria for ending the study of patient

A case was considered to have ended when one of the folowing conditions pertained:

1) A patient developed a break in the skin due to pressure
2) The patient was discharged from the care of the hospital or the community nursing service
3) The patient increased his or her mobility and was thus no longer chairfast or bedfast
4) A patient was admitted within the final week of the data collection
5) The patient died
6) Six weeks of data collection had been completed.

5.9 Design of instruments for data collection

1) Diary Sheet - Nurses and relatives recording the elapsed time for pressure area care and the methods used.

2) Summary Sheet - Individuals' assessment.
- Interview schedule.

In fact two types of diary sheets were constructed and designed for collecting hospital/community data.

1) One was an on-going record of pressure area care, (Appendix 1). In hospital the nurses and in the community the patients, relatives and district nurses were asked to keep a continuous record on the diary sheet showing each time that pressure area care was given (i.e. to record the length of the time elapsed since the previous care, and the methods used for pressure area care according to the numbers of a code listed on the diary sheet).

   In both areas, hospital/community nurses and relatives were asked to record the time of starting the pressure area care the time of finishing the care the pressure area care methods used and the nurses'/relatives' observation of the state of the skin at the site of pressure area care. Further, they were also asked to sign each time they completed an entry on the sheet and their comments on any change. Codes for use were listed on the same sheet to make completion easier for nurses/relatives in both areas.

2) The second diary sheet was completed by the researcher (Appendix 2). This was a summary of the daily information from the first diary sheet which was transcribed on to this sheet. It also included information such as the patient's personal description data, such as age and sex, diagnosis, Norton Score,

nutritional status, appetite and level of mobility, weight and height, whether the patient smoked. This latter information was obtained from the patient by interview and observation.

The purpose of designing this summary sheet was to aggregate information related to each individual patient and to facilitate data analysis. Furthermore, this sheet gave the researcher opportunity to check all necessary collected data.

B) Preliminary Work

For preliminary work a pilot study was carried out in both the hospital and the community before conducting the main study.

> A pilot study is a small-scale trial of the main study (Van Ort, 1981).

The reasons for carrying out the pilot study were to:

1) Evaluate the methods of data collection, (i.e. the diary sheet)
2) Identify any problems experienced by the data collectors
3) Test the feasibility and the reliability of the method used
4) Test the organization of the study
5) Test the methods of analysis
6) Give the researcher some practice and experience with methods used
7) Provide information required for estimating the sample

size required for the main survey

8) Give an opportunity to modify the procedures and methods involved.

A pilot study was carried out in two geriatric wards in the local general hospital, whilst in the community the study was based on two local health centres.

The period of study was for one month in each area. The criteria for including patients in the study, and ending the study with an explanation of the researcher's role in collecting data were identical to the main study. Thus, to avoid repetition, these will be discussed in greater detail in the main study.

5.10 Hospital pilot study sample

Originally 15 patients fitted the criteria for entry to the study, but only 11 continued in the study long enough to obtain meaningful data. The other 4 dropped out due to:

1) Early mobilization of the patient
2) Insufficient information
3) The period of pilot study being too short to collect eligible patients for it.

5.11 Community pilot study sample

Complete data were obtained from only 8 patients out of the 9 who fitted the criteria for entry to the study. One patient dropped out due to inadequate information recorded on the diary sheet.

5.12 Pilot study data analysis

The pilot study data were analysed by using a statistical package of social science, i.e. discriminant analysis to distinguish between groups of patients, after aggregate statistics had been done for the qualitative data. Details of the methods of analysing the data will be included in the discussion of data analysis of the main study.

5.12.1 Results and discussion of pilot study

Of the 11 patients in the hospital sample, 4 developed pressure sores - 3 women and 1 man, whilst in the community sample 1 woman out of 8 patients developed sores.

The independent variable total time spent on pressure area care seemed an important discriminant variable showing predictive ability among the groups of variables (Table 5.1).

Hospital data	Community data
1. Condition of skin	1. Care given by, or category of person giving care
2. Total time on care	2. Total Norton Score
3. Turning position	3. Total time on care
4. Cleaning the skin	
5. Pressure-relieving device	
6. Category of person giving care	

Table 5.1 Variables accounting for and discriminating between outcome groups.

In conclusion, from this small pilot study work it seems that the patients nursed at home received proportionally more hours of nurses' and relatives' care for pressure sores prevention than did the hospitalised patients and here it should be noted that the percentage of patients who developed sores was greater in hospital than in the community. However, the longer a patient is left without care, the longer the body is subjected to pressure and the more likely is the development of sores. In the same way, the more time the nurse needs to treat a developed pressure sore, the higher the cost of hospitalisation. Further, patients who developed sores were immobile, incontinent, with poor appetite.

5.13 Problematic issues in the methodology. Changes made for main study in hospital

Minor modifications were needed before proceeding with the main study and these were:

Hospital pilot study	Hospital main study after modifications
(A) Selected sample	
1. Elderly patients only were selected.	Young patients were included in addition to elderly patients.
2. The sample was obtained from two geriatric wards in one hospital.	Data were collected from 13 wards in two different hospitals.

	Hospital pilot study	Hospital main study after modification
3.	The sample was selected by nursing staff.	Permission was gained for admission of patients deemed eligible by the researcher.
(B)	<u>Conduct of the study</u>	
1.	The researcher visited every other day to collect case data.	To increase the reliability of data, the researcher arranged to visit every day.
2.	The maximum study period for each patient was one month.	The maximum study period for each patient was extended to six weeks.
(C)	<u>Diary sheet</u>	
1.	Two types of diary sheets were used by nurses/ relatives in hospital/ community (Appendix 1a,b).	All information was included within one type of diary sheet (Appendix 1) to be used by nurses.
2.	Difficulty in obtaining the variables 'weight' and 'height'.	An estimate of body type based on the researcher's observation was used instead; e.g. Weight = obese, thin, normal Height = tall, short, medium.
3.	Recording patient appetite depended upon what the	Permission was gained to observe the patient

	Hospital pilot study	Hospital main study after modification
	patient requested.	during meal time to gather more reliable data with regard to patient appetite.
	The variable Initial Norton Score was listed on both the diary and summary sheets.	The variable Initial Norton Score was shifted to the summary sheet to be checked by the researcher during a patient's assessment.
		During analysis, coded variables such as PRD* and 'site of skin area' were changed to one column instead (Appendix 2).
(D)	Nursing staff involved	
1.	Nursing staff were reluctant to complete the diary sheet.	Although some nursing staff still showed a negative attitude toward the research and the diary sheet, this was less of a problem than in the pilot study.
2.	The ward sister refused	Permission was gained to

*PRD - Pressure-relieving device

Hospital pilot study	Hospital main study after modification
to keep the diary sheet attached to the patient's bed.	attach the diary sheet to the selected patients' beds.
3. Not all the nurses had been contacted by the researcher before the study was started as some were on holiday, some were off duty and others were on sick leave.	Meetings were arranged to see all day/night duty staff and establish good communication with nurses. Some of them had been aware of the research since the pilot study.

5.14 Difficulties and problems with community pilot study and changes made before main study started.

Some general difficulties were found during the community pilot study. These are set out below:

Community pilot study	Change made in the main study
(A) Selected sample	
1. The sample was too small to show the significance of the variables.	An effort was made to get a larger sample.
2. A sample of elderly patients had been selected by the	Young patients were included in the study in

Community pilot study	Change made in the main study
nursing staff, rather than the age-spread desired by by the researcher.	addition to the elderly patients.
	Detailed investigation was possible for two groups of community patients with regard to the development of pressure sores (i.e. a group of patients who were living alone and those who were living with relatives).
(B) Period of study The researcher spent one month carrying out the pilot study.	The minimum period of the researcher's time to be spent on the study was extended to six weeks. This is because: 1. The patients were living in geographically scattered areas. 2. There was some difficulty with transportation. 3. There was a limited

	Community pilot study	Change made in the main study
		number of eligible for study (i.e. patients without existing sores, and bed- or chair-bound.
(C)	Diary sheet	
1.	It was difficult for nurses/relatives to use two types of diary sheet.	One type of diary sheet was used. (Appendix 1)
2.	Variables listed on the diary sheet were not numbered (Appendix 1a,b).	Variables in each column were numbered (Appendix 1) to make it easier to complete the diary sheet.
(D)	Community nursing staff	
1.	Community nurses were reluctant to complete the diary sheet.	All staff were eager to participate. (N.B. A different Health Authority was used in the main study).
2.	Some relatives had a negative attitude towards the research and towards participation in the study.	The majority of relatives were eager and willing to fill in the diary sheet and to participate in the research.
3.	Thëre was poor communication with nursing staff, with	There was good communication between

	Community pilot study	Change made in the main study
	regard to the research and the continued filling in the diary sheet.	nurses in reminding one another to record the pressure area care regularly.
	<u>Researchers Role</u>	
4.	The researcher was accompanied by the community nurse when she visited the patient.	The researcher visited patients at home, alone, after obtaining names, addresses, and a map of the locality concerned. For acceptability to patients and relatives the researcher wore a blue uniform whilst visting the patient at home throughout the study period.

Reliability and validity of methods used in both pilot study and main study

As regards the reliability of the data, 'reliability' is understood here to mean 'the extent to which repeated measures of the same thing, or measures by two different data collectors of the same thing at the same time will produce exactly the same information'. Validity is taken to mean the extent to which the research instrument measures which it is said to measure. The vital data, included Norton Score, patient appetite, other pressure area care information, and also nurse's and/or relative's observation of skin condition. These data were checked frequently by comparing the researcher's own examination of patients with the diary sheets and carer's comments and records made for the nursing reports, nursing history and assessment sheet etc.

Norton Score. Assessment using this score was made by the researcher on the patient's admission to the study, and repeated every alternate day. The data were checked by discussion with the nurses and their nursing record. The aim of checking the score derived by the researcher with that derived by the nurse in charge of the patient was to confirm the total score. In addition, it was to test agreement on the various important sub-categories, such as continence/incontinence.

Patient appetite

There existed no readily available scale for recording appetite as there was with the Norton Score. therefore the researcher devised a classification of appetite and criteria for this classification especially for the present study. This was piloted by checking inter-rater reliability in relation to 10 patients on a medical ward. The score of the researcher, a member of staff of the University Department and the nursing staff on duty were examined for agreement. Agreement was at the acceptable level of 90%.

The classification and criteria used can be seen in the table below:

Classification of appetite

1-Poor	2-Fair	3-Good
Rarely eats complete meal; is dehydrated has minimal fluid intake.	Occasionally refuses to eat, or leaves large portions of a meal; must be encouraged to take fluids.	East some food from each basic food category everyday; drinks 6-8 glass of fluid a day; eats major portions of each meal, or is receiving tube feedings.

Reliability of the diary sheet

Clearly the reliability of the diary sheets was crucial to the success of the study. Since the reason they were used in the first place was because the researcher was unable to be present to observe care given. She needed to check the diary sheet carefully for accuracy of recording. This was done by checking the sheet against the verbal report of the carers every time the researcher visited the patient. Where it was possible for the researcher to check observations (eg skin condition) this was done. Careful questioning ascertained that carers used codes easily and correctly. Data on frequency of care was checked against nursing care plans and reports. Gaps in the record were questioned and apparently excessive times recorded for care were explored with carers to identify the reason. In this way every possible effort was made to ensure the reliability and validity of the diary sheets. Nonetheless, some records were not kept up by the carers and this accounts for the loss of patients from the study since they could not be included if the diary was incomplete.

C. Main Study

The findings of the pilot study were encouraging enough for the researcher to proceed to the main study. Moreover, one important function of the pilot study was to provide information on the variability of characteristics within the immobile population. This information was then used to estimate the sample size of the main study. Thus, a survey of a larger sample of patients to identify current nursing practice was thought to be necessary for the main study.

5.15 Hospital main study

It was intended that this research would not interfere with on-going work. The hospitals location was important not only because of financial and transport considerations but also because of time-saving to the research, since there was the necessity of a daily visit by the researcher. Therefore, two general hospitals controlled by a local District Health Authority were selected. The hospitals were miles apart and near public transport within the city limits. Further, they differed in size and in number of beds, as tabled below.

Hospital	Number of beds
A	758
B	up to 370

Types of hospital buildings

Hospital A is a modern hospital opened in 1965, but working in collaboration with Hospital B, which is an old hospital.

Choice of wards

It was not possible to include all the wards in a hospital, since the researcher was working alone. However, the study was carried out in a typical environment in which non-ambulatory and elderly patients might be treated. Thus, the selected wards were:

Wards	Hospital
5 Geriatric	A
4 Orthopaedic	A
1 ICU	A
3 Geriatric	B
13 wards	Two Hospitals

The number of beds in these wards varied between 19-30 and the range was as below.

The number of beds	Ward
19-21	Geriatric wards
29-30	Orthopedic
5-8	ICU

Design of wards

The design of these wards varied as between the hospitals and within the one hospital, as listed below:

Wards	Design	Hospital
3 Geriatric	L-Shaped	B
5 Geriatric	Nightingale shape	A
4 Orthopaedic	L-Shaped	A
1 ICU	Nightingale shape	A

However, each of these wards also has the usual service areas such as a sluice, lavatories, bathroom, kitchen, day rooms, sterilizing equipment, preparation room and linen room. (Figs 5.1 and 5.2).

Nursing staff

It was noticed that the numbers and grades of nursing staff were different even between two wards within a hospital. Both full-time and part-time nurses were employed.

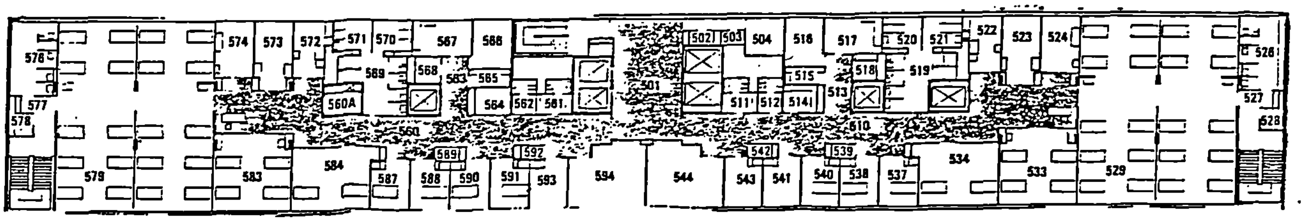
The nursing staff worked three shifts divided into two periods, day duty and night duty. However, both hospitals also used a split shift of duty when staff were off for an afternoon. The hours worked by full-time nursing staff were:

0730 - 1600 early duty

1200 - 2100 late day duty

2045 - 1745 night duty.

Fig. 5.1   Nightingale Ward



560 Corridor
560A Automatic elevator
561 F. staff lockers
562 M. staff lockers
563 Lobby
564 Linen
565 Flowers
566 Ward store
567 Ward kitchen
568 Cleaner
569 F. lavatories
570 Bath
571 Bath
572 Sluice
573 Treatment
574 Utility
576 F. lavatories
577 Lobby
578 Sluice
579 20 bed ward
580 4 bed ward
584 2 bed ward
587 I bed ward
589 Lavatory
590 I bed ward
591 I bed ward
592 Store
593 Ward office
594 Day room
501 Lift lobby
502 M. visitors lavatory
504 Visitors
510 Corridor
511 F. staff lockers
513 Lobby
514 Linen
515 Flowers
516 Ward store
517 Ward kitchen
518 Cleaner
519 M. lavatory
520 Bath
521 Bath
522 Sluice
523 Treatment
524 Utility
526 M. lavatories
527 Lobby
528 Sluice
529 20 bed ward
533 4 bed ward
534 2 bed ward
537 I bed ward
538 I bed ward
539 Lavatory
540 I bed ward
541 Ward office
542 Store
543 Doctor
544 Dayroom

Fig 5.2 The layout of orthopaedic wards

Each shift included a tea break of 15 minutes and half an hour meal break, as follows:

1300 - 1330 first staff meal

1330 - 1400 second staff meal.

In fact, the study was not concerned with a specific grade of nursing staff as all grades of staff listed below helped in pressure area care activity

1) Sister
2) Staff Nurse
3) Enrolled Nurse
4) Student Nurse
5) Pupil Nurse
6) Auxiliary Nurse.

Negotiation for entry

After formal discussion with the Nursing Officers, access to the two general local hospitals was gained five weeks later, before the study started. However, gaining access to clinical agencies for the conduct of research is a much more complicated and time-consuming process now, than in the past (Hodgmans, 1978). Informal discussions were carried out with the Nursing Officers for both day/night duty, and with medical, geriatric and orthopaedic consultants to gain permission to interview and assess the patients at risk (Table 5.2).

Meanwhile, three requests had been approved during the contact with the Nursing Officer of each ward (i.e. the Nursing Officers of the geriatric wards, orthopaedic wards,

Table 5.2 Contacts made and time for completion in hospital

Contact	Action	Time taken for completion
Hospital Administrative Nursing Officer	Permission to undertake the study in the hospital. Request for ethical approval. Permission to see Nursing Officer/ Consultants.	4 - 5 weeks
Hospital Consultants Nursing Officer day/night duty	Permission to visit any patients in their care. Selection of the wards to be studied. Approval of visits and timing.	2 - 3 weeks
Ward Sisters day/night duty	1. Notification of intention to visit. 2. Permission to attach the diary sheet to patient bed. 3. Permission to interview and assess the patients. 4. Permission to get names of staff involved.	1 - 2 weeks
Ward Staff day/night duty	Discussion and instruction re-filling in the diary sheet when they finished *PAC with the patient.	Immediate

*PAC = Pressure area care

ICU unit day/night duty). These steps were:

1) to select the wards for the study
2) to see the ward nursing staffs involved
3) to arrange the times of visits to hospital wards.

Permission was gained to carry out the study in two general hospitals as follows:

1) 8 Geriatric wards
2) 4 Orthopaedic wards
3) 1 Intensive care unit.

All the Nursing Officers agreed that the study was ethically acceptable and their formal permission to proceed was given. However, before arranging to see the ward Sister and nursing staff a copy of a diary sheet was left with the Nursing Officer to discuss it with the ward sisters and to see their attitude towards contribution to the study. Further informal discussion was held with a group of ward sisters altogether for each ward designated so that, they were fully informed on the aims and objectives of the study and the way of filling in the diary sheet.

In fact, all ward sisters day/night duty agreed to:

1) Participate and contribute to a study
2) Diary sheet being attached to patient bed
3) The researcher choosing the patients for the study and assessing them
4) The researcher visiting the wards every day as agreeable to both the researcher and the nursing staff
5) The researcher interviewing the patients

6) The researcher interviewing ward sisters and nursing personnel if any suspicious data appeared in the diary sheets.

The ward sisters' permission was gained after they had been assured that the research design would not involve any disruption or alteration of the ward routine.

A further meeting with each of the wards' nursing staff was arranged to see them all together and accompanied by the ward sisters re-explain the details, aims and objectives of the research and the way of filling in a diary sheet. However, it was not possible to see every nurse before the study started. An attempt was made to see each one as she/he came on duty. A list of nurses' names, work shifts, nurses' location was taken to check that the staff knew how to continue recording pressure area care information on the diary sheet.

A good working atmosphere, a good rapport and trust was established between the researcher and the nurses. Hence, all staff were eager to participate in the study, some of the nursing staff already had a good idea about the research since the pilot study had been undertaken in one of the selected hospitals.

Explanation of the diary sheet to the hospital staff

Before the nursing staff were interviewed, they and the ward sister were aware of the research, the reasons and the aims and objectives and the methods used (i.e. the diary sheet). During the first day of interviews the researcher began by introducing herself as in (Appendix A).

A copy of the diary sheet was distributed to each of the nursing staff before explaining and demonstrating it and stressing how important was the continuity of recording on the sheet. A full explanation of the diary sheet took place after showing an example of a filled-in diary sheet, and the researcher explained the way of filling it in. This included the time of starting the pressure area care activity, the time of finishing and the importance of recording these times; in addition, recording the method of prevention, and nursing observation which included the condition of skin area(s) likely to be vulnerable to pressure sores. The end to these recordings when the patient had already developed skin break down at the site was explained.

As the survey involved all the staff, on day/night duty, it was important to achieve continuity of recording pressure area care for 24 hours. Thus, the researcher decided to meet all the staff involved. In particular, any staff who were not present when the original explanation was given were identified and given a detailed explanation of the importance of the regular and continuous recording required. The researcher emphasised the reliability of the data recording (i.e. recording the information as soon as the nurse finished pressure area care activity).

Thus, explanation of the diary sheet was extended to

1) new members of nursing staff coming to work after the study had started
2) nursing staff who had been on off duty, on sick leave, or on holiday during the time of negotiation with

nursing staff

3) nursing staff who were shifted or transferred from other wards and had no idea about the study and the diary sheet. There were no refusals to participate and all staff were eager to:

1) Admit a patient to the study when there was a new case fitting the criteria
2) Fill in the diary sheet
3) Allow an interview with nursing staff to check the reliability of the study.

After one week of negotiation for entry, one ward sister was reluctant to take part and to involve her staff in the study, stating that filling in a diary sheet would be too time-consuming. Therefore, this ward was withdrawn from the study.

Patients' agreement to the study was sought and they had the research aims and objectives explained to them during the time of assessing and interviewing. It was impossible to do this in advance, due to patient turnover. Also, since the focus of the research and the interview was on the timing of the pressure area care activity and identifying the methods of prevention used by nursing staff, it seemed unnecessary to obtain written consent from the patients, although they were informed about the research and the necessity of daily assessment (using the Norton Score), and for visiting them every day to collect the filled sheets and put out new ones if necessary. No objections were noticed from any patients involved in the study.

5.16 The role of the researcher in the study during data collection within the hospital study

Each ward was visited daily in order to:

1. Admit patients to the study
2. Assess the patients by using the Norton score
3. Collect the completed diary sheets, after checking the reliability of the data collected, with the ward Sister and with the nursing records
4. Collect additional data needed for the summary sheet
5. Keep in touch with the nursing staff to remind them to fill in the diary sheet
6. Follow up the patient.

(1) Admit Patients to the Study. Admission of a new patient to the study could have been time-consuming for the staff. There was a regular need to place a new, continuous diary sheet at the foot of the bed. Unused sheets were kept in the office in each ward involved. It was easy for staff to forget to attach a new sheet when a new eligible patient arrived in the ward. Hence, to avoid missing the information and to save nurses' time, the researcher gained permission to join the staff at the time of a patient's admission, according with researcher's daily visit to the wards.

The researcher's admission procedure was as set out below:

1) Checking patients' admission books to see whether there was any new patient who fitted the criteria of the study

2) Checking with the ward sister and other nursing staff whether there was any patient referred from other hospitals or from other wards
3) To identify the patient's location in the ward and to attach a diary sheet to the patient bed.

(2) Assessing the patient by using the Norton score. Using the Norton Score as a method of assessment on the day of the patient's admission was crucial. Rechecking of the Norton Score was carried out every other day from this date. The Norton Score was used by the researcher to:

1) Identify a patient at risk of pressure sores with regard to the outcome
2) Re-score at regular intervals so as to identify any need for an increase in the degree of vigilance or even a change in nursing management as the patient clinical condition improved or worsened.

(3) Collecting a completed diary sheet. This was the researcher's responsibility throughout the study period as set out below:

1) To ensure the continuity of recording and to supply new sheets as necessary
2) To ensure the reliability of the data, since the researcher was able to keep a check on the recording process

Filling in the diary sheet depended on the following important points:

1) The design of the diary sheet
2) The space between the lines
3) The handwriting of staff, whether small or so big as to cover more sheets than usual
4) Clarity of writing.

(4) Collecting additional data. During the patient's interview additional data were collected by the researcher, such as patient's body type, whether patient was diabetic, a smoker or not; in addition to information related to a clinical description of the patient such as age, sex, diagnosis, initial Norton Score, all of which was recorded on the summary sheet.

(5) Keeping in touch with nursing staff and reminding them to continue filling in the diary sheet in time. This descriptive study was continuous for 24 hours daily. Therefore the researcher needed to keep in touch with nursing staff and continue reminding them to identify the following points whether by day or night:

1) Lack of communication between staff on day/night duty when passing on the pressure area care plan
2) Shortage of staff members
3) Presence of new staff who had no idea about the study
4) Whether there was follow-up of patients who were transferred to another ward
5) The discontinuance of study of patients according to

the prescribed criteria.

The researcher's demand was to be certain that the message of continued recording of the elapsed time between pressure area care activities was successfully passed among the nursing staff. It should be noted that pressure area care was given according to individual care plans.

(6) Checking the reliability of collected data. Reliability means the accuracy of the data in the sense of their stability or repeatability. To test the reliability of the data, the researcher checked with the ward sister and with nursing staff, the presence of any information recorded in the diary sheets which appeared strange during or after changing each of the nursing work shifts.

Relevant to the patient interviews and assessments by the researcher, Tilton and Maloof (1982) found that patients' communication abilities fluctuated with the time of day, level of fatigue and psychological outlook. Therefore, data collected directly from the patient was checked with the nursing record, to ensure its reliability and to check whether he was confused, incontinent etc. Meanwhile, some of the patient's data depended upon his personal feelings and experiences over the time and his level of confidence in the presence of the researcher.

(7) Following up the patient. The researcher followed up the patient to:

1) See whether he had been transferred to another ward, in order to continue with him for the rest of the study

period after informing the sister and nursing staff in that ward.

2) Collect the diary sheet in case patient had died, transferred to another hospital, developed skin breakdown. However, it was noticed during the first week of the study that some of the diary sheets went by mistake to another hospital when the patient was discharged. Some were found in that hospital's record office.

The equipment to be used by the researcher

The reliability of elapsed time between activities of pressure area care cannot be achieved to the nearest minute. Nurses used their ordinary wrist watches to record pressure area care timing, which would be less demanding of the staff than a stop-watch. Recording the elapsed time was to be used as a guideline and did not appear to require accuracy greater than to the nearest minute.

Further, the other equipment used throughout the study period was a clip board to support the papers on which the patient's answers and the assessment score was written.

Procedure of collecting data

On the day prior to the study the researcher visited all the wards involved, for the following reasons:

1) To remind the staff of the first day of the study
2) To distribute sufficient diary sheets to each ward office and to remind staff about using one when a new eligible patient was admitted. Continuation sheets

provided to be used when replacing full diary sheets

3) To learn each ward's layout and to recognise the nurses' and patients' locations

4) To gain an idea of the workload of each ward and the timetable for the theatre, in particular for orthopaedic patients. This was important when arranging a visit to check the Norton Score for assessing patient at risk.

The procedure of data collection was carried out using two methods: first, observation: second, interviewing the patient and the nurse. The interview with the patient started when he was in bed or sometimes in a wheelchair, with the researcher using a chair beside him. The researcher introduced herself to the patient (Appendix A). In this way patient permission was gained before proceeding with the interview and data-collecting procedure, using a clip board to support the papers.

Information related to the patient and his Norton Score was collected in conjunction with observation of the patient during his replies.

For identifying eligible patients the researcher carried out this procedure of interview at the time of admission during the day. However, when a patient was admitted during night hours the initial Norton Score was checked during the early hours of the following morning, as this seemed essential with regard to the outcome of pressure area care.

The procedure of interviewing and observation were the same for each patient in all the wards involved. For unconscious or confused patients the researcher depended on nursing records, the ward sister and sometimes the ward staff. Precise information related to the patients' clinical description, diagnosis, mental and physical state, incontinence: and appetite for an unconscious patient was available in the ICU.

Further, data-collecting procedures never interfered with ward activity, although the researcher was willing to see what was going on behind the curtains when staff were carrying out their activities (i.e. pressure area care). In some suspicious cases, permission was gained to see the site of the skin concerned, whilst checking the reliability of data recording with the ward sister.

Interviewing a patient varied in length of time from 15-25 minutes, depending upon:

1) The patient's physical and mental condition
2) Whether the patient was unconscious or had had an operation
3) Whether the patient was anxious waiting for some visitors to come
4) Whether it might interfere with some nursing activity such as checking the vital signs.

The researcher tried to establish a good rapport with nursing staff and with the patient and seemed to succeed, as the majority of nursing personnel and patients remembered the researcher even when the survey had finished. A request for a presentation of the pilot study results came from the nursing staff.

Several nurses, by informal means, told the researcher of short-comings in equipment and notes were made of these. Further, during the period of collecting data the researcher noted that patients themselves complained of lack of pressure-relieving devices, in particular sheepskin. And mainly in the orthopaedic wards, no educational pressure area care programme was arranged for discharged patients or even his relatives to follow when the patient returned to his/her home with his family or other relatives.

Conducting the interviews

Interviewing the patients occurred every day or night and during weekends, for a period of more than six weeks. Times of interviews were chosen by the researcher after the meeting with the ward sisters. In practice this was any time except the time of ward rounds and visiting hours. However, meal time was not excluded as it was useful to observe the patient, whilst he/she was eating, in order to gain more reliable information related to variable appetite. The patient was always given the opportunity to refuse to take part in the study, but fortunately the majority of patients approached, agreed to participate. A few were reluctant to answer the questions. Some patients were afraid of being overheard, or regarded as being imprudent.

The interviews went smoothly. The researcher introduced herself by name, and then proceeded to explain herself as in Appendix A. To promote a casual and unofficial image, she did not wear a white coat or name badge.

5.17 Hospital sample

The sample which fitted the criteria of the study was drawn from the following wards: (Table 5.3)

1) 8 Geriatric [There was a ninth geriatric ward, but as noted on page 169 the ward sister did not wish to participate].
2) 4 Orthopaedic.
3) 1 ICU.

Initially, 124 patients were eligible for the study. The data used for discriminant analysis was from only 82 patients, as 6 cases had one or two missing discriminant variables. However, sufficient data for some analysis was obtained from 88 patients.

36 Patients were dropped out of the study and these were patients who

1) (15) started mobilising very early
2) (5) died during the first week of the study
3) (10) had insufficient information available from nurses, in particular ICU patients
4) (4) did not wish to continue
5) (2) had a blank sheet. The staff did not like to continue recording the information. Although this sample was not representative of all the at-risk patients by any means, it should be stressed that it is not an incidence nor a prevalence study.

Wards	No. of patients	%
Orthopaedic	49	55.7
Geriatric	32	36.4
ICU	7	8
Total	88	100

Table 5.3 Location of the patients in the wards

5.18 Community study

negotiation for entry

At the beginning of the study permission was obtained from the Local Medical Practitioner Committee who fully approved the project and requested a copy of the results (Table 5.4).

Formal discussions took place after a letter was sent showing the aims and the objectives of the research and asking for community nurses' cooperation. Meanwhile, the formal meeting with the Community Nursing Administrator had been arranged. Fortunately, he asked all the district Nursing Officers to join the discussion. Here the researcher introduced herself by name, and then proceeded as in her letter Appendix A. Explanation of the diary sheet and summary sheet came after showing the aims and objectives and the need to visit the eligible patients at home, in order to

1) Assess the patients at home using the Norton score
2) Check the recordings made by the community nurse, the relatives' pressure area care activity and the elapsed times between applications of this care.

In Community

Table 5.4 Contacts made and time for completion in community

Contact	Action	Time taken for completion
Medical Practitioner Committee	Approval of project.	3-4 weeks
District Nursing Officer	Permission to undertake the project in the district.	
Administrative Officer	Request for ethical approval. Request for list of health districts to be involved in study and names of GP's of the selected patients.	2-3 weeks
Health District Consultants	Permission to visit the patient under their care.	
Nursing Officers	Request to arrange with community nurses to visit patient. Notification of intention to visit.	1-2 weeks
District Nurses	Request to visit at-risk patient. Permission to interview the patient.	Immediate
Patient's relatives	Interview. Permission to visit the patient and assess him throughout the study period. Request for the relatives to contribute in the study and fill in the diary sheet.	1-2 days

The conclusion from this formal meeting was arrangements to:

1) Carry out the study in the catchment areas of three health centres
2) Obtain a sample of patients at risk, of not more than sixty patients
3) Discuss the criteria for inclusion of the patient in the study and the criteria for finishing or ending his participation
4) Discuss the ways of contacting the patients at home, which to some extent depended on which sort of transport the researcher used
5) Fix an appointment to interview the District Nursing Officer accompanied by her community nurses, to:
    1) Discuss the criteria of the study and the sample size
    2) Gain permission from the patient's GP to visit the patient at home
    3) Obtain the patient's name, address, location in the district involved
    4) Discuss the degree of involvement of patients and relatives in the study and the possibility of the cooperation in filling the diary sheet.

Following this, family and patient contacts were gained through a community nurse, who arranged an interview with the patient at home to ask his cooperation. Fortunately, most of the patients and relatives were eager to participate in the study, except one confused patient living with her daughter who refused to be interviewed or contribute.

Furthermore, access was also granted to involve further community services such as day hospital and geriatric home, because many of these patients had to visit such a place twice a week.

Explanation of diary sheet to the community nurse and the relatives

Arrangements were made with the nursing officer at each health centre to interview the community nurses separately. This informal meeting gave the researcher the opportunity to explain the diary sheet in the same way as to the hospital nurses. All the community nursing staff were asked to make a record of: the pressure area care; the elapsed time between applications; the preventive methods (i.e. pressure-relieving device); the nurse's observation of the skin at the pressure sites; her signature each time she completed an entry on the sheet; and her comments which might arise from the care activity. In addition, nurses were asked to follow the codes listed on the same diary sheet to facilitate completion and to save time when listing the preventive methods.

Further, using the experience gained during the pilot study, the researcher arranged with community nurses to have patients' relatives' permission before visiting. Some of the community nurses preferred to accompany the researcher during the first home visit in order to obtain the patient's and relatives' acceptance, and to avoid possible difficulties with understanding and filling in the diary shet, besides the researcher's need for patient assessments every other day.

The GPs were contacted before patients and relatives, and all approved the researcher's aims, objectives and desired visits when these were explained. Therefore, the researcher proceeded to visit after obtaining names, ages and addresses from the community nurses at the health centre during their lunchtime meeting to discuss the daily care plan of the patients.

On the first visit the researcher introduced herself, the purpose of her visit and the necessity to continue recording the pressure area activity in a way similar to the community nurses. However, the researcher tried not to mention the term 'pressure sores', using 'skin area care' instead to assure the patient and family since some family carers did not like to mention this term or were apprehensive. No difficulties was found, except that some working families refused to record the information as they were at work during the day and returned only at night.

The diary sheet was also explained to the staff of other community health services where the patient temporarily attended, e.g. at a day hospital. Thus, access was gained and no refusal noted from the patient, day hospital or day centre staff to contribute and to continue the research study.

5.19 The researcher's role in collecting data in the community

The activities of the researcher in the community were:

1) Calling on the patients at home
2) Assessing the patients using the Norton Score
3) Collecting the full diary sheet
4) Keeping in touch with community nurses and

patient's relatives

5) Following up the patient to other community services

6) Checking the reliability of the data with the community nurses.

1) Calling patients at home

The researcher visited the selected patients in order to admit them to the study and obtain personal, clinical details including age, sex, diagnosis, body type, and other information listed on the diary sheet (Appendix 2). Revisiting was arranged, as good communication was already established with the patients/relatives. However, some of the relatives did complain about the filling in of the diary sheet wasting their time and making them confused.

2) Assessing patients

The patient were assessed every other day, by checking his Norton Score, and appetite with regard to the outcome of the study.

3) Collecting the full diary sheet

The full diary sheet was collected by the researcher when it had been completed by the community nurses and the relatives at home.

4) Keeping in touch with the community nurses and with patients' relatives

Most of the community patients lived in scattered areas. Thus, district nurses, relatives, and other carers involved were either telephoned or contacted at the health centre to remind them about filling in the diary sheet. Keeping in touch with community nurses seemed quite useful for admitting new patients and reminding and encouraging them to continue recording.

5) Following up patients to other community services

The study extended to other community services for a limited period (i.e. day hospital, geriatric nursing home).

The role of the researcher was the same in:

1) Assessing and reassessing the patient at each visit
2) Checking the patient's Norton Score and appetite
3) Collecting the patient's full diary sheets.

6) Checking the reliability of the information

Unclear writing of information by a relative or district nurse was checked with the writer, to avoid bias and increase the reliability of the data.

Procedure of data-collection from community patients

The procedure of data collection in the community was more difficult and time-consuming for the researcher than in hospital, since patients were living in widely spread areas of the study region. Data-collection started during the negotiation period of checking the feasibility of the study and contacting community patients. Thus, when nurses' and relatives' acceptance was obtained the researcher started to list patients' names, ages, and addresses, using a map to see the patient location. Meanwhile, a visit was expected because of information passed on by community nurses.

During the patient interview, the researcher sat beside him on a chair and asked questions related to the Norton Score, using a clip board to support the papers. After the interview, she discussed with the relatives the possibilities of filling in the diary sheet and asked the patient's permission to reassess him and check his Norton Score every other day.

The length of interviewing procedures varied between 10-20 minutes, depending upon:

1) The patient's physical and mental state
2) The presence of a relative(s) at the interview.

However, interviewing patients followed the same procedure for each patient in each area. Many patients lived 5-6 miles from the health centres.

5.20 Community health services

The research method was fully explained to the staff concerned, for continued recording of the information while the patient was being treated by the community services.

To be more socially acceptable the researcher wore the same blue uniform while visiting the patients. She also made good rapport with patients and the relatives to strengthen the communication with them. However, the visits were every other day instead of daily, due to:

1) Transport cost, as the patients lived in scattered areas
2) The bad weather (i.e. winter time)
3) The possibility that too frequent visiting of patients might lead to a negative attitude toward the research.

The high level of cooperation offered by community nurses and relatives gave the researcher confidence and trust in them to convey reliable information related to the Norton Score sometimes by telephone.

Further, in spite of the difficulty in contacting patients they were highly cooperative with the researcher even when the period of the study extended over the six weeks. This was noted in:

1) The good communication between the community nurses and the researcher, whom they contacted every time a new eligible patient was discharged from the hospital
2) The researcher being permitted to contact the nurses at any time, and even at home
3) The researcher being permitted to contact relatives by telephone to arrange a convenient time for visiting a patient
4) The carers filling the diary sheet frequently and regularly and as explained in Appendix A.

5.21 Difficulties during data collection in the community, from the researcher's point of view

1) Inaccurate information was sometimes given (e.g. the number of the patient's house was incorrect)
2) One patient lived in a block of flats but there was no indication as to which one. It was a top flat, and the relatives were very slow to come to the door. The researcher was unaware of this problem and therefore left before the relatives answered the door bell
3) One patient's neighbour was on holiday, and this neighbour cared daily for the patient
4) Throughout the study period there was dependence upon the community nurse in selecting the sample for the study, as no previous permission was gained to get access to nurses' records or the registration book, unlike the hospital study
5) The negative attitude of some patients towards participating in the study
6) Missing the actual initial score of some patients due to the time spent on getting permission to visit the patients at home
7) Occasionally, patients were not at home because some of the community nurses had forgotten to contact the researcher to say so or to report a patient's death.

5.22 Community sample

Because of the scattered location of selected patients, the study concentrated upon the case load of nurses working from three health centres (Table 5.5).

A total of 35 patients were reported as fitting the criteria of the study. However, completed data were obtained from only 30 patients. Five of the total 35 patients were dropped from the study for the reasons below:

1) Two patients died within the first week of the study period
2) Inadequate data were recorded on the diary sheets of the other three patients.

Health Centre	F	M	Total number
A	3	1	4
B	9	10	19
C	6	1	7
Total	18	12	30

Table 5.5 Selected sample of males and females within three health centres.

5.23 Data analysis

Data analysis was carried out using a statistical package of social science - an SPSS[x] which provides a comprehensive set of survey analysis routines.

Due to experience gained by the researcher during the pilot study analysis, a summary sheet was used to draw up clear data prior to the computer analysis, as set out below.

	Variable	Action
(1)	Length of stay in the study.	Consider as a number of days of patient being in care.
(2)	Norton Score	Patient was scored and assessed on admission to the ward and this first score referred to the Initial Norton Score, whilst the Final Norton Score was considered as a last score for the patient at the end of the study according to the criteria for ending the study.
(3)	Time spent on pressure area care.	Calculating the average daily total time for the pressure area care obtained from each patient.
(4)	Appetite	Assessing patients' appetite on admission to the study and again when he was dropped from the study according to the criteria for ending the study.

The purpose of using the $SPSS_x$ statistic was to distinguish between groups of patients by using a discriminant analysis, in which a combination of variables was used to distinguish between two or more categories of cases. The variable discriminant between groups of cases classified on outcome gives an indication of variables which predict the category or group in which cases fall, based upon the values of these variables.

The dependent variable used in this study was the outcome of pressure area care in terms of whether or not pressure sores developed. The rest of the variables were used as the independent variables, including, age, sex, diagnosis, length of stay in the study, initial Norton Score, final Norton Score, total time spent on pressure area care, methods used for pressure sores prevention and nurses' observation of pressure area site(s) in hospital and community, category of care given, patient appetite, and the frequency of care given.

However, data from the hospital sample were entered separately from those of the community sample of patients. Meanwhile, the same computer programme was used for analysis of both hospital and community data. Calculation of qualitative descriptive data were done during preliminary analysis using means, standard deviations for variable total time spent on pressure area care, age and Norton Score components. The preliminary analysis of these data has been explored (Clarke and Kadhom, 1988).

5.24 Summary

The main purpose of this study was to evaluate the amount of time spent on pressure area care with regard to the prevention of pressure sores formation in both hospital and community. The period of study was for six weeks or until the patient developed skin breakdown, died, was discharged or became mobile. Three methods were used to collect the data: interviews, observation and a diary sheet designed for use by nurses in hospital and community, and relatives in the community. They were asked to record the data related to: actual pressure area care given; the time spent on care; the methods used for prevention of pressure sores; and nurses' and relatives' observation of the skin area. Further data were collected by the researcher, including Norton Score, patient appetite, patient personal information, age, sex, diagnosis, body type.

A pilot study was carried out before proceeding to the main study, to test methodology for the main study. The pilot study showed that the total time spent on pressure area care in the community was more than the total time spent in hospital. Moreover, the percentage of patients developing sores in hospital was higher than in the community. One patient who lived alone in the community developed sores. All patients who developed sores were predominantly incontinent and immobile.

Only minor modifications were made before conducting the main study. Because of geographical dispersion of the patients within the community the sample of the patients was small (n = 30). Whilst the number of hospital patients used were n = 88.

Daily summary information was collected throughout the period of study for each variable, from the beginning of the study period, particularly information regarding methods of pressure sore prevention used by nurses at the hospital and in the community, and their observation of the sites of skin area.

CHAPTER SIX

Results and Discussion

Hospital Study

6.1 Why was discriminant analysis used?

Any researcher faced with the need to analyse data requires a rationale for choosing between alternative methods of analysis. Several considerations should enter into such a choice; these include:

1) The purpose of the investigation.
2) The general mathematical characteristics of the variables involved.
3) The statistical assumptions made about those variables.
4) The manner in which the data are collected. However, knowledge of the first two is generally sufficient to guide the researcher toward the appropriate analysis (Kleinbaum and Kupper, 1978). In fact, the researcher was interested in classifying patients at risk into groups, one developing and the other not developing pressure sores; hence, it was felt that it was essential to use discriminant analysis for analysing data.

The main purpose of choosing this analysis was that information was collected about a number of independent variables, and discriminant analysis allowed judgement to be made distinguishing between the importance of these variables by considering them one by one in relation to outcome. Independent variables included intrinsic patient characteristics and nursing intervention. However, the general purpose of choosing this analysis was to show how one or more independent variables can be used to discriminate among different categories of a nominal dependent variable, as discriminant analysis involves a nominal dependent variable (i.e. to determine whether or not and to what extent the independent variables can be used to discriminate between patients developing and patients not developing pressure sores. This particular statistical technique was first introduced by Fisher, (1936) as a statistical technique useful in "taxonomic problems". In scientific literature, discriminant analysis has interesting potentialities: it can be used in two main ways - for classification and diagnosis, and to study the relationships among variables in different populations and groups. Further, discriminant analysis was used because it is capable of performing multiple analyses in which different sets of discriminating variables are used or in which different criteria are used for the entry or removal of variables. In addition to the direct entry method, discriminant analysis provides five methods of stepwise variable selection so that we can use many options to set statistical controls for entry or removal. We can obtain classification function coefficients to classify all cases or only those cases for which group membership is unknown; and to establish the unstandardised discriminant function coefficients, the structure matrix, F ratios, mean and standard deviations and various covariance matrix, and the level of significance. Besides, discriminant analysis is used to justify the sample and to avoid the discrepancy and dispersion which might happen between the groups of independent variables. However, if any of the group cases have missing values for any of the variables, discriminant analysis will exclude those cases from the computation function.

Discriminant analysis allowed the analysis of the data collected without losing too much of the information.

6.2 Results and discussion of the result

Considering the format of the observation and interview schedule and the nature of the data collected, it seemed logical to incorporate a discussion into the presentation of the results.

As was mentioned in earlier chapters, 2 hospitals were used for collecting data. At one hospital 3 geriatric wards were used, whilst at the other hospital 4 female geriatric wards, and one male geriatric ward. In addition, 2 female orthopaedic and 2 male orthopaedic wards, and one mixed-sex, intensive care unit were used. Thus, a total of 13 wards altogether were found to be necessary to gain the total sample. Moreover, it was felt that it was essential to show the man-hours of different grades of the staff with respect to pressure sore prevention and to gather a larger sample from different wards in the different hospitals.

Therefore, the results fall into discrete categories and each section is accompanied by a discussion of what was found, as set out below:

1. Hospital results.
2. Community results.
3. General discussion.

6.2.1 Hospital results and discussion

This will cover:

A. Pressure sore distribution in relation to

1) Age and sex of the patient
2) Location of patients in hospital
3) Patient diagnosis
4) Length of stay in hospital for the group who did not develop pressure sores
5) Norton Score and patient's appetite.

B. Nursing intervention:

1) Total time spent on pressure area care
2) Total time spent in relation to age, sex, diagnosis
3) Patient location, Norton Score, patient appetite
4) Total time spent on pressure area care during the day and night hours in relation to the outcome of pressure area care
5) Grade and skill of nursing staff in relation to the pressure area care
6) Average interval between pressure area care (frequency of pressure area care)
7) Anatomical distribution in relation to the outcome of pressure area care
8) Body type and the outcome of pressure area care
9) Pressure area care methods used.

C. Case study.

6.2.1A The pressure sore distribution in relation to

6.2.1.1 Age of all admissions to the study

A total of 88 patients who fitted the criteria of the study formed the final sample. The average age of these patients admitted to the study was above 70 years of age (Table 6.6). However, the individual ages of patients admitted to the study were distributed among the age groups (Table 6.1). It can be seen that the largest percentage (77.3%) of patients were above 70 years of age and the rest (22.7%) were patients under 70 years of age. The youngest patient in the study was 21 years old and the oldest was 97 years; both of them were male patients.

6.2.1.2 Ages of patients at risk in relation to the outcome

62 (70.5%) of the patients admitted to the study did not develop skin breakdown. (45) (72.58%) of these patients were 70 years of age and above, while only 17 (27.41%) under 70 years of age (Table 6.2). However, according to the definition of pressure sores used for the study, (26) of the (88) hospital patients studied developed a sore (i.e. 29.5%) (Table 6.3). Most of the patients who developed sores were aged 70 years and above. Whilst fewer patients who developed sores were below 70 years of age than among those over 70 (Table 6.2).

In both settings the average age of the patients who developed sores was higher than the average age of those who did not develop sores (Table 6.4). This finding supports our knowledge of the aging process of the skin in reducing ability to withstand traumatic pressure, in-

Age group	No. of patients	% of patients in each age group
0 - 39	4	4·54
40 - 49	5	5·7
50 - 59	1	1·1
60 - 69	10	11·36
70 - 79	27	30·7
80 - 89	33	37·5
90 +	8	9·1
Total	88	100

Table 6.1 Age of patients admitted to the study.

Age group	Patients developing pressure sores		Patients not developing sores		* T no.	T %
	No.	%	No.	%		
0 - 39	1	3.8	3	4.83	4	4.54
40 - 49	0	0	5	8.06	5	5.67
50 - 59	0	0	1	1.61	1	1.1
60 - 69	2	7.6	8	12.9	10	11.36
70 - 79	8	30.7	19	30.65	27	30.7
80 - 89	12	46.1	21	33.87	33	37.5
90 +	3	11.5	5	8.06	8	9.1
Total	26	100	62	100	88	100

Table 6.2 Age of patients in relation to outcome of pressure area care.

*T no. = Total number

T % = Total percentage

No. = Number of patients

Patient group	No.	%
Patients developing pressure sores	26	29.5
Patients not developing sores	62	70.5
Total	88	100

Table 6.3 Distribution of patients in relation to outcome of pressure area care.

Outcome of pressure area care	Average age	S.D.
Group developing pressure sores	80.31	10.54
Group not developing pressure sores	74.18	15.75

Table 6.4 Age of patients in relation to outcome of pressure area care.

addition to factors considered by the Norton Score. This finding was in agreement with Norton et al., 1962, 1975; Petersen and Bittman, 1971; Versluysen, 1983, 1985; Nyquist and Hawthorn, 1985); who all indicated a higher percentage of patients developing pressure sores with age, especially patients over seventy years of age (i.e. there is a correlation between pressure sore development and advanced age). However, Moolten (1972) disagreed with this when he discussed the role of age:

> Age seemed to play little or no role in bed sore formation, as much as the underlying condition generally overshadowed the effect of age. For example, stroke, multiple sclerosis, fracture of hip, senile dementia. Thus, 10 out of 31 patients with deep bed sores were less than 60 years of age.

6.2.1.3 Gender distribution for patient studies

It is clear that more women (77.27%) than men (22.73%) were admitted to the study (Table 6.5) i.e. triple as many women as men.

6.2.1.4 Sex of patient in relation to the outcome

Since a higher percentage (77.27%) of female patients than (22.73%) male were admitted to the study, this might indicate that patients at risk of developing skin breakdown were in the ratio of 3:1 female to male. In fact, 21 (30.8%) of the female patients developed pressure sores, whilst only 5 (25%) of the male patients did so. Hence, of the patients who developed pressure sores the female:male ratio was 4:1 (i.e. a higher proportion of females than males developed pressure sores) (Table 6.7). These findings were in accordance with those of earlier studies (Norton et al., 1962, 1975; Barbenel et al., 1977; Lowthian, 1979a; Warner, 1982; Versluysen, 1983; Nyquist and Hawthorn, 1985).

Sex	Number of patients	%
Male	20	22.73
Female	68	77.27
Total	88	100

Table 6.5 Gender distribution of patients in hospital study.

Sex	Average age	S.D.
All patients, male and female	75.57	
Male	64.1	18.42
Female	78.3	7.2

Table 6.6 Age of patients in relation to gender.

Outcome	Female No.	Female %	Male No.	Male %	Total No.	Total %
Groups developing pressure sores	21	30.88	5	25	26	29.5
Groups not developing pressure sores	47	69.12	15	75	62	70.5
Total	68	100	20	100	88	100

Table 6.7 Sex of patients in relation to the outcome.

6.2.1.5 Age and sex

Inspection of the data on age and sex suggests a relationship between them in admission to the study as a whole and a relationship of each factor with pressure sores development. 82.35% of patients who were 70 years of age and above were female, a greater proportion than that (60%) of male patients of the same age (Table 6.8). Furthermore, the females were on average older than males on admission to the study (Table 6.6). This was in line with the fact that females do live longer (Waldron and Johnson, 1976), in spite of the increasing predisposition to develop pressure sores as age increases (Norton et al., 1962, 1975).

The majority of patients who developed sores were female, mostly 70 years of age and above (i.e. 19 were 70 years of age and above and only two were within the range of 60 - 69). In contrast, of the males who developed sores 4 were 70 years of age and above (Table 6.9).

Further, there was no statistically significant difference in pressure sores development (i.e. outcome of the study and patient sex, Table 6.56), although there was some predictive ability of the age variable to discriminate between outcome of patients (Tables 6.57 and 6.58).

Age group	Male	%	Female	%	Total number	Total %
0 - 39	3	15	1	1.47	4	4.54
40 - 49	2	10	3	4.41	5	5.68
50 - 59	0	0	1	1.47	1	1.13
60 - 69	3	15	7	10.29	10	11.36
70 - 79	9	45	18	26.47	27	30.68
80 - 89	2	10	31	45.58	33	37.5
90 +	1	5	7	10.3	8	9.09
Total	20	100	68	100	88	100

Table 6.8 Age and sex of all patients admitted to the study.

6.2.2 Location of at-risk patients on admission to the study

A sample of immobile bedfast, chairfast patients was selected from 13 wards in two general hospitals. 77 (87.5%) of total admissions to the study were from 'Hospital A' and 11 (12.5%) of total admissions were from 'Hospital B' (Table 6.10). 55.7% of all these patients were in orthopaedic wards, 36.3% were in geríatric wards, and 8% were in *ICU (Figs 6.1 and 6.2). These proportions might be due to the high number of patients generally admitted to orthopaedic wards, since all the orthopaedic beds were fully occupied throughout the study period. Meanwhile, there was a higher number of patients in the sample that were admitted to hospital with fractured neck of femur and for total hip replacement than for other reasons, during the period of study. The latter was in 'April', a time when people with these conditions seem particularly prone to pressure sores. This impression might support (Versluysen, 1983), who found that

> The number of new cases of pressure sores peaked in the winter and spring months (i.e. December, January and April).

6.2.2.1 Location of elderly patients

Within the study sample there were 49 (55.7%) patients from the orthopaedic wards, 32 of these patients were mostly females aged 70 and above 70 years and only 4 were male patients aged 70 years and over. There were 9

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*ICU = intensive care unit

Age of patients	No. of males	%	No. of females	%	Total number
0 - 39	1	20			1
40 - 49					
50 - 59					
60 - 69			2	9.52	2
70 - 79	2	40	6	28.57	8
80 - 89	1	20	11	52.38	12
90 +	1	20	2	9.52	3
Total	5	100	21	100	26

Table 6.9 Age and sex of patients developing pressure sores.

Hospital	Number of patients	Total %
Hospital (A)	77	87.5
Hospital (B)	11	12.5
Total	88	100

Table 6.10 Location of the patients in the hospitals.

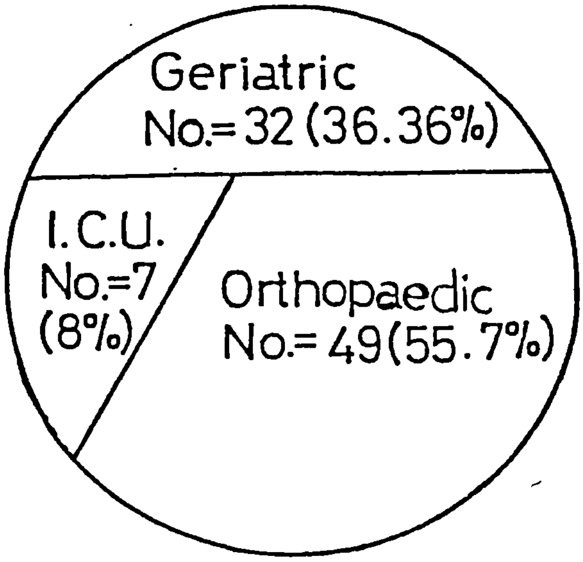


Fig 6.1 Ward designation among hospital patients

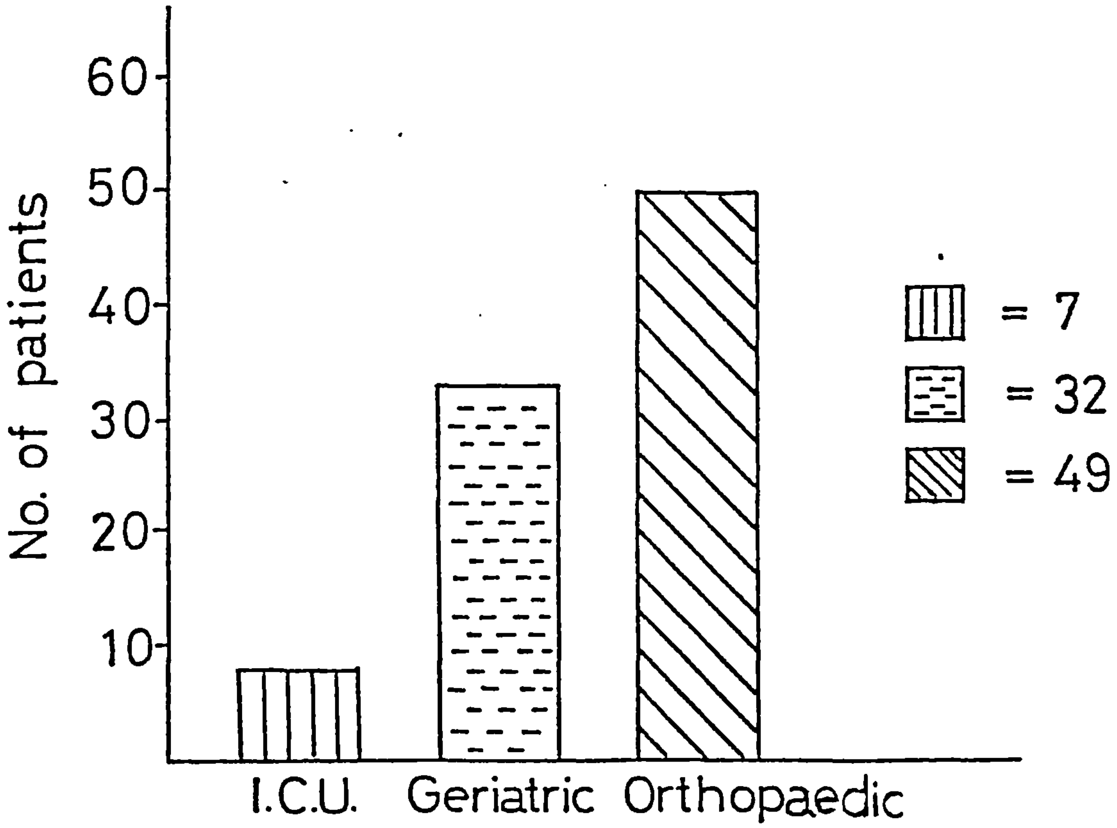


Fig 6.2 Location of patients in the sample in relation to the selected wards

females and 4 males from orthopaedic wards all were under 70 years of age.

Furthermore, there was a slightly higher proportion of female patients in the sample from the orthopaedic wards than from the geriatric wards. Whilst the sample of patients from ICU was small, 5 males and 2 females all were under 70 years of age (Table 6.11).

Wards	70 years of age and over		Under 70 years of age		Total number	Total %
	Male	Female	Male	Female		
Orthopaedic	4	32	4	9	49	55.7
Geriatric	7	25	0	0	32	36.3
*ICU	0	0	5	2	7	8
Total	11	57	9	11	88	100

Table 6.11 Location of elderly patients.

*ICU = intensive care unit

6.2.2.2 Location of patients at risk of developing pressure sores and the outcome

Of the patients admitted to the study, 21 (42.86%) (18 females and 3 males) developed pressure sores during their stay in care in the orthopaedic wards. Meanwhile, in the geriatric wards there were 3 females and 2 males, giving a total of 5 (15.6%) developing pressure sores (Table 6.12). However, none of the patients in ICU developed pressure sores. This finding might support Nyquist and Hawthorn, (1987), 20 (15.2%) of the patients in whose sample had major orthopaedic conditions, bearing in mind that this present study is not, an incidence or prevalence study.

Thus, a higher percentage of the orthopaedic ward sample developed sores. This obviously influenced the discriminant analysis which was carried out and revealed a significant level of probability related to ward designation (Table 6.56).

It should be borne in mind that a higher proportion of the sample were located in orthopaedic wards, and that 57.1% of these did not develop pressure sores at all. In the geriatric wards, 84.37% of patients were free from pressure sores, (i.e. 5 male and 22 female). Only 8% of the patient sample were in ICU 5 males and 2 females. These were vulnerable to pressure sores on admission to the study but they did not develop pressure sores throughout the study period.

Outcome	Orthopaedic		Geriatric		ICU		Total number
	M	F	M	F	M	F	
Group developing pressure sores	3	18	2	3	0	0	26
Group not developing pressure sores	5	23	5	22	5	2	62
Total	8	41	7	25	5	2	88

Table 6.12 Location of patients in relation to the outcome and patients' sex.

M = Male

F = Female

ICU = intensive care unit

6.2.3 Diagnosis of all admissions to the study

Patients have been classified according to the nature of their illnesses (Table 6.13). Within the orthopaedic wards 40 (45.5%) of the patients had been admitted with fractured neck of femur, 34 of them were female and only 2 (2.27%) were having total hip replacement. The remaining 7 orthopaedic patients, 2 (2.27%) had spinal cord injury and the other 5 (5.7%) had back pain on admission to the study. In other wards the second highest percentage of patients was 15 (17%), mostly female with cerebrovascular accident; 10 (11.36%) had chest infection; 2 were diagnosed as stroke. The other two had cancer; 2 (2.27%) patients had arthritis; two were diagnosed as senile dementia and 4 (4.55%) patients diagnosed as myocardial infarction patients (Tables 6.13 and 6.14).

6.2.3.1 Diagnosis and the outcome

19 orthopaedic patients with fractured neck of femur developed pressure sores. It remains a common complication, mainly in the postoperative period (Apley, 1977). In recent years closed intra-medullary nailing has become a more popular method of managing a fracture of the shaft of femur. However, new medical and surgical techniques for the elderly increase the susceptibility of the pressure sites for pressure sore formation. Patients with fractured neck of femur were prone to pressure sores at the point of contact with the orthopaedic table. More traction is necessary to reduce and hold the fractured shaft of femur during closed intra-medullary nailing of the femur

Diagnosis	70 years of age and over		Aged under 70 years		Total number	Total %
	Developing sores	Not developing	Developing sores	Not developing		
Stroke	0	2			2	2.27
Chest infection	2	7	1		10	11.36
Total hip replacement	1			1	2	2.27
Fractured neck of femur	18	16	1	5	40	45.5
Spinal cord injury	0	1		1	2	2.27
Cancer	0	2			2	2.27
CVA	2	8		5	15	17.0
Senile Dementia	0	2			2	2.27
Myocardial infarction	0	3		1	4	4.55
Hemiplegia	0	2			2	2.27
Back pain			1	4	5	5.7
Arthritis and rheumatism	0	2			2	2.27
Total	23	45	3	17	88	100

Table 6.13 Diagnosis and patient age.

Diagnosis	Male	%	Female	%	Total number	Total %
Stroke			2	2.9	2	2.27
Chest infection	3	15	7	10.3	10	11.36
Total hip replacement	0	0	2	2.9	2	2.27
Fractured neck of femur	6	30	34	50	40	45.5
Spinal cord injury	1	5	1	1.5	2	2.27
Cancer	1	5	1	1.5	2	2.27
CVA	5	25	10	14.7	15	17.0
Senile dementia	0	0	2	2.9	2	2.27
Myocardial infarction	1	5	3	4.4	4	4.55
Hemiplegia	1	5	1	1.5	2	2.27
Back pain	2	10	3	4.4	5	5.7
Arthritis and rheumatism	0	0	2	2.9	2	2.27
Total	20	100	68	100	88	100

Table 6.14 Sex and diagnosis of all patients on admission.

(Table 6.15).

This finding is in agreement with Versluysen (1985). She indicated that 31% of patients admitted to an orthopaedic ward as an emergency after an accident or with fractured neck of femur or hip fracture had developed pressure sores.

Hip fracture and hip replacement are two of the commonest reasons for orthopaedic admission and are particularly associated with secondary development of pressure sores (Norton, 1979; Barton and Barton, 1981). Only two patients in this study had hip replacement operations; one of those developed sores. In contrast, Versluysen (1983) showed that a half of the operations on pressure sore sufferers were internal fixation of fracture of femur and a third were hip arthroplasty; whilst Barton and Barton (1976), estimated that 31% of elderly patients developed pressure sores following a total hip replacement or repair to the upper shaft of femur as against 27% who had an operation for hip fracture.

It is highly probable that the damage occurred on the operating table as extra force, most commonly direct pressure, which diminished tissue perfusion which in turn caused ischaemia. Barton and Barton (1973, 1981), Norton et al. (1962, 1975) and Mikulic (1980) indicated that other causes of skin breakdown may be attributed to shear force when the patient is dragged on the table, leading to obstructed capillary flow. The friction produced by mechanical forces is also a problem. The skin may appear normal after surgery for several days before skin breakdown appears. The sacral area is the commonest site for sores

Diagnosis	Group developing pressure sores		Group not developing pressure sores		Total number	Total %
	Number	%	Number	%		
Stroke	0	0	2	2.27	2	2.27
Chest infection	3	3.4	7	7.95	10	11.36
total hip replacement	1	1.13	1	1.13	2	2.27
Fractured neck of femur	19	21.59	21	23.86	40	45.5
Spinal cord injury	0	0	2	2.27	2	2.27
Cancer	0	0	2	2.27	2	2.27
CVA	2	2.27	13	14.77	15	17.0
Senile dementia	0	0	2	2.27	2	2.27
Myocardial infarction	0	0	4	4.55	4	4.55
Hemiplegia	0	0	2	2.27	2	2.27
Back pain	1	1.13	4	4.55	5	5.7
Arthritis and rheumatism	0	0	2	2.27	2	2.27
Total	26	29.5	62	70.5	88	100

Table 6.15 Diagnosis of the patient in relation to the outcome.

and they are caused either by excoriation of the pelvis when dragged along the operating table, mainly by the surgeon or nurse when they position the patient, or by applied traction when the patient lies on the table for an excessive time with neglect of the pressure sites. Therefore, when traction is no longer required to hold the reduction, it should be released during the time of wound closure and application of dressing to reduce the time the patient is on the traction table (Shaw and Hughes 1985).

Two out of 15 patients in the present study who were diagnosed as CVA developed sores (Table 6.15). This was in agreement with Norton et al. (1962, 1975); Jordan et al. (1977); Ek and Boman (1982); in those studies the patients vulnerable to pressure sores were with CVA diagnosis. Usually such patients show less physical and mental activity and are probably immobile and incontinent with regard to the Norton Score.

3 patients with chest infection developed pressure sores. All three patients were in poor general condition on admission to the study. It is worth mentioning that one male patient aged 40 with back pain developed pressure sores on his elbow; this was due to his skin sensitivity when he tried to move himself while traction was applied. However, no patient with arthritis, senile dementia or cancer developed pressure sores (Table 6.15).

6.2.3.2 Diagnosis and age of group developing pressure sores

A majority of patients - 68 out of 88 - were aged 70 years and over. 23 out of this group did develop pressure sores, whilst the remaining 45 did not. However, 18 out of these 23 were patients with fractured neck of femur. On the other hand in the group of patients aged under 70 years, there were 3 patients who did develop pressure sores, of these one was with fractured neck of femur (Table 6.13). Hence, it seems clear that the patients who developed pressure sores were mostly orthopaedic aged 70 years and over. This finding is in agreement with Versluysen (1983).

6.2.3.3 Diagnosis and sex of patients developing pressure sores

The largest group of patients who did develop pressure sores were females with fractured neck of femur (Table 6.16). This was in agreement with Versluysen (1983, 1985); Barton, (1977); Lowthian (1979a).

Diagnosis	Patients developing pressure sores Male	Female	Total number	Total %
Stroke	0	0	0	0
Chest infection	1	2	3	11.5
Total hip replacement		1	1	3.8
Fractured neck of femur	2	17	19	73.1
Spinal cord injury	0	0	0	0
Cancer	0	0	0	0
CVA	1	1	2	7.7
Senile dementia	0	0	0	0
Back pain	1	0	1	3.8
Myocardial infarction	0	0	0	0
Arthritis and rheumatism	0	0	0	0
Total	5	21	26	100

Table 6.16 Sex of patients developing pressure sores.

6.2.4 Length of stay in care

40 (45.5%) of the total admission to the study stayed in care for 7 - 13 days. 19 (21.6%) patients stayed in care for less than seven days (Table 6.17). Only four stayed for 35 - 42 days. However, the mean length of stay in care amongst hospital patients during a period of the study was 14 days, the range being 3 - 42 days.

6.2.4.1 Length of stay in care and the onset of pressure sore formation

Jordan *et al*. (1977) and Petersen and Bittman (1971) indicated that most of patients studied had developed their pressure sores during hospitalisation. Experiments by Husain (1953) and Kosiak (1959) showed the relationship between the length of time for care and pressure sore development.

Kosiak (1959) indicated that the ulceration may follow as late as nine hours after the pressure trauma and that there is a "free" interval without clinical symptoms between immediate oedema reaction and the inflammatory reaction which precedes the ulceration. One criterion of this study was that the "patient should be without existing pressure sores on admission". Therefore, the onset of the pressure sore can be detected throughout the length of stay in hospital during the study period. Thus, although little research has been carried out to explain the time of onset of skin breakdown during hospitalisation (Norton *et al*., 1962, 1975; Versluysen, 1985; Petersen and Bittman, 1971), it is possible to classify the onset of pressure sore according to the length of stay in study (Table 6.18).

Wards	Number of days							Total number	Total %
	Less than 7 days	7-13	14-20	21-27	28-34	35-42	42+		
Orthopaedic	5	25	15	0	3	1	0	49	55.68
Geriatric	11	14	5	0		2	0	32	36.3
ICU	3	1	1	1		1	0	7	8
Total	19	40	21	1	3	4	0	88	100

Table 6.17 Length of patients' stay during study in each ward (Hospital study).

6.2.4.2 Pressure sores appearing within less than 7 days

During the first week of study it seems that 8 (42.10%) of the total of 19 patients developed pressure sores (Table 6.18), these were five female and three male patients, all aged 70 years and above, except one male who was below 70 years of age (Table 6.19). Five out of these eight patients developed sores while they were in orthopaedic wards and the rest were in geriatric wards when they developed sores. However, none of the ICU patients developed sores (Table 6.20). Thus, by the end of the first week of study, 8 (9.1%) of the total admission to the study had developed a sore. This is in agreement with Norton et al. (1962, 1975); Versluysen (1985) in their findings that,

> A percentage of 34% of all cases developed pressure sores during the first week.

Outcome	Number of days							Total number	Total %
	Less than 7 days	7-13	14-20	21-27	28-34	35-42	42+		
Time of developing pressure sores	8	14	3			1	0	26	29.5
Length of stay in study for group who did not develop pressure sores	11	26	18	1	3	3	0	62	70.5
Total	19	40	21	1	3	4	0	88	100

Table 6.18 Time of developing sores and length of stay in the study.

Age of the patient	Number of days								
	Less than 7 days	7-13	14-20	21-27	28-34	35-42	42+	Total No.	Total %
0 - 39		1						1	3.8
40 - 49									
50 - 59									
60 - 69	1	1						2	7.6
70 - 79	1	6	1					8	30.8
80 - 89	4	5	2			1		12	46.2
90 +	2	1						3	11.5
Total	8	14	3			1		26	100

Table 6.19 Length of time before developing pressure sores in relation to patients' age.

6.2.4.3 Sores appearing within the second week of patients' admission to the study

14 (15.9%) of the total admission to the study developed pressure sores during the second week of the survey (Table 6.20), they were mostly female (12); and two males, (Table 6.21). All of these patients developed pressure sores while they were in orthopaedic wards (Table 6.20). This supports Norton et al. (1962, 1975), who found that 70% of pressure sores occurred during the first two weeks of patients' admission. Exton-Smith (1976) and Versluysen (1983) also indicated a higher percentage of pressure sores onset during the first two weeks of patients' admission than later. Therefore it is possible to use the length of stay in care as an indicator of patients' likelihood to develop pressure sores, since the first two weeks of patients' admission seems the crucial time of pressure sore development. Hence, nurses, should realise that pressure area care must be carried out during the first day of patient admission, not after pressure sores appear. Sheepskin, manual turning and other pressure-relieving devices should be applied for at-risk patients on the first day of their admission.

Wards	Number of days							Total number	Total %
	Less than 7 days	7-13	14-20	21-27	28-34	35-42	42+		
Orthopaedic	5	14	1			1		21	80.7
Geriatric	3		2					5	19.2
ICU	0								
Total	8	14	3			1		26	100

Table 6.20 Length of time in days before skin breakdown in each ward.

Sex	Number of days							Total number	Total %
	Less than 7 days	7-13	14-20	21-27	28-34	35-42	42+		
Male	3	2	0					5	19.2
Female	5	12	3			1		21	80.7
Total	8	14	3			1		26	100

Table 6.21 Length of time in days for developing sores and the patients' sex.

6.2.4.4 Pressure sores onset during third week

Three patients developed pressure sores during the third week of admission to the hospital. Only one patient developed sores during the six weeks of admission to the hospital (Table 6.18). This indicates that the patient may develop pressure sores even after 3 or 4 weeks of their admission to hospital, when the general conditon of the patient deteriorates or if there is a failure in nursing care. These findings could be explained in terms of increasing pressure (Kosiak, 1959; Husain, 1953; Versluysen, 1983), and the patient might develop sores due to any of these conditions:

1. The patient lying on the theatre table for a long time or the hardness of the theatre table itself;
2. Age of the patient;
3. Preoperative waiting for theatre;
4. Postoperative causes when the patient is unconscious due to anaesthetic action;
5. Deterioration in the patient's general condition;
6. The traction table in the orthopaedic wards, or the traction itself (Barton, 1976);
7. Faulty nursing care:
   A. Lack of nurses experienced in using pressure-relieving devices.
   B. Lack of nurses' knowledge of pressure sores aetiology.
   C. Pressure-relieving devices not available.
   D. Fault(s) in the pressure-relieving device itself.

6.2.4.5 Onset of pressure sores and the operation

Pressure sore occurrence is associated with operative treatments under general anaesthesia, (Petersen, 1976; Barton and Barton, 1981; Roberts and Goldstone, 1979). A total of 19 out of 26 patients who developed pressure sores were orthopaedic patients. One female developed skin breakdown in the sacral area on the day of her operation, whilst 12 out of the 19 orthopaedic patients developed skin breakdown during the first seven days after operation, which seems a crucial time for pressure sore formation. Five patients developed pressure sores during the second week and one patient developed a pressure sore during the third week after his operation (Table 6.22).

6.2.4.6 Length of stay in the study and the death, discharge or transfer of the patients

Deaths occurred during the first week of the study period. Eight out of 14 patients died during the first week of the study; three other patients developed pressure sores before death; whilst the remaining three were all in a poor general condition before death. However, these latter three patients died before pressure damage had time to reveal itself. Death was related to the age and sex of the patients. 9 of the females who died were over 70 years of age (Table 6.23). However, many patients were discharged from the hospital when their general condition was improving and they had started mobilising themselves. Thus, 29 patients were discharged during the second week and 17 patients were discharged during the third week. Few

Day of operation	Number of patients	% of patient develop sores
During the day of operation	1	5.2
Postoperative days		
1 - 7 days	12	63.1
8 - 14 days	5	26.3
15 + days	1	5.2
Total	19	100

Table 6.22 Postoperative days for orthopaedic patients and pressure sores onset.

	Males	Females	Total number
Died	5	9	14
Discharged	10	49	59
Transferred	3	4	7
Still in hospital after study	2	6	8
Total	20	68	88

Table 6.23 The patients' death, discharge, transfer in relation to gender.

members of the study were discharged during the first week of admission. A total of seven patients were transferred; two were orthopaedic patients and one was transferred to a geriatric ward in the same hospital. Other patients were transferred to another hospital. Three ICU patients were transferred to another hospital. One patient was transferred to a medical ward in the same hospital and followed up in this ward. Only one patient remained in the same ward over the whole period of the study, whilst other patients remained in the hospital after developing skin breakdown.

6.2.5 Norton score

The Norton Score was used as an indicator of the patient's intrinsic condition, since it has been widely used as a method of assessing patients at risk (Norton et al., 1962, 1975), as was mentioned earlier in Chapter Five. The Norton Score data were reduced by considering only the score on admission (i.e. when the patient was admitted to the study) and at the end of the period of study of the particular patient concerned. Thus, the final Norton Score for patients who developed sores is their score at the time the skin breakdown became apparent, whilst the initial Norton Score on admission to the hospital indicates the time at which pressure sores were thought likely to develop and those patients with the lowest score tended to develop pressure sores during the early period of hospital stay.

6.2.5.1 Initial Norton score and patient age

Pressure sore occurrence increases with advancing age. A good relationship shows between the initial score and patient age (Table 6.24). A total of 50 (56.8%) patients were 70 years of age and over, with an initial score of less than 12 on admission to the study. On the other hand, only 9 (10.2%) patients aged under 70 years show an initial score below 12. Ten patients aged over 70 years had scores above 12, ranging from 12 - 14. However, the rest, i.e. 8 out of 68 patients aged over 70 years show an initial score above 14, ranging from 15 - 17. This finding might support Norton et al. (1962, 1975) in their indication that the initial Norton Score decreases with advancing age.

6.2.5.2 Initial Norton score in relation to gender

Inspection of the score of the hospital sample of patients shows lower initial Norton Scores in both male and female patients than their final scores. The male average initial score was 11.1, whilst, the female group shows a slightly higher initial Norton Score of 11.4 (Table 6.25). It must be borne in mind that this was not statistically significant (i.e. the initial Norton Score with the outcome of pressure area care) (Table 6.56).

Initial Norton Score	Patients aged 70 years and over	Patients aged below 70 years	Total number	Total %
Less than 12	50	9	59	67.04
12 - 14	10	4	14	15.91
15 - 17	8	7	15	17.05
18 - 20				
Total	68	20	88	100

Table 6.24 Initial Norton Score and patient age.

Table 6.25 Average initial and final Norton Score in relation to sex for all admissions.

Sex	Average initial Norton Score	S.D.	Average final Norton Score	S.D.
Male	11.1	2.39	12.25	3.44
Female	11.4	2.63	13.4	3.14

Outcome of pressure area care	Sex	No.	Average initial Norton Score	S.D.	Average final Norton Score	S.D.
Group developing pressure sores	M	5	12.2	2.94	11.6	3.78
	F	21	11.28	2.84	10.6	1.96
Group not developing pressure sores	M	15	9.93	3.8	12.7	2.35
	F	47	11.7	2.4	14.8	4.06

Table 6.26 Average initial and final Norton Score in relation to patient sex.

No. = Number of patients

S.D. = Standard deviation

6.2.5.3 Average final Norton score in relation to gender

The average final Norton Score for both males and female groups was higher than the average initial Norton Score when the patients were admitted to the study. Meanwhile, the average final score for the female patients (13.4) was higher than the average male final score (12.25) (Table 6.25).

6.2.5.4 Initial Norton score and pressure sore development

There is an obvious tendency for the Norton Score to decrease in relation to age, whilst the incidence of pressure sores increases with advancing age. Thus, by this calculation 20% of patients admitted to the geriatric wards were especially at risk (Norton et al., 1962, 1975). However, the Norton Score was intended to measure the patient's intrinsic condition and so it seems the Norton Score tends to associate with patients' sickness, frailty and high dependency on nursing care. Hence, pressure sore development was related to initial assessment score. The average initial Norton Score for both groups (Table 6.27) was lower than 12 amongst the hospital sample of patients, whilst the average initial Norton Score amongst patients who subsequently developed sores seems slightly higher than for those patients in the group whose skin remained intact throughout the study period. However, the average final Norton Score for those patients who developed sores is lower than for the average initial score for the same group. The average Norton Score of those with pressure sores has fallen, whilst the average score of those without sores has

Outcome of pressure area care	Average Initial Norton Score	S.D.	Average Final Norton Score	S.D.
Group who did develop pressure sores	11.5	2.39	11.3	2.56
Group who did not develop pressure sores	11.43	2.63	14.25	3.29

Table 6.27 Initial and final Norton Score in relation to the outcome of pressure area care.

risen. On the other hand the patients who did not develop sores had a higher Norton Score on average at the end of the study period than at the beginning. Thus, in relation to the outcome there is a greater difference between the average final Norton Scores for the two patient groups.

6.2.5.5 Norton score in relation to gender and the outcome of the pressure area care

Both groups, male and female, admitted to the study were at risk of developing pressure sores. The average initial score of both groups male and female was below 12 (Table 6.25).

The average initial Norton Score for the female group developing sores tended to be lower in comparison with the males' initial average score for this group. Besides this, the females' average final scores seems lower at the time the skin breakdown became apparent. This might explain why the number of females with pressure sores was greater than the male patients within the same group (Table 6.26).

The final score seems crucial in pressure sores development, as it was associated with skin breakdown appearance. Statistical significance $P = 0.0003 < 0.05$. Discriminant analysis (Table 6.56).

The male patients in the group who did not develop sores tended to have a lower average initial score than the group who developed sores. The final score rose in the female group without sores $\geq$(14) to a level higher than the male average final score and higher than the female average initial score in this group of patients (Table 6.26).

6.2.5.6 Components of the Norton score in relation to the outcome of pressure area care

The Norton Score is commonly used to discriminate between patients who will develop pressure sores and patients who will not. However, it is worth showing the relationship between individual components within the total score and/or various combinations of the components and the presence óf pressure sores in particular (Goldstone and Goldstone, 1982).

When comparing individual components of the Norton Score within this group who developed pressure sores, it seems that on average the variable activity was lower and the incontinence variable higher. Meanwhile, within the group who did not develop pressure sores, the variable mobility seems higher than the same variable within the group who did develop pressure sores. The variable incontinence within the group who did not develop seems higher on average than the same variable for those who developed sores (Table 6.28) (Fig 6.3).

A summary discriminant table shows physical score and mobility score to be important variables by which to discriminate between the groups of patients classified by outcome (Table 6.57). However, both variables appear to be not significant with regard to the outcome (Table 6.56). Further, a canonical discriminant function coefficient shows mobility and physical condition of the patient as a predictor in discriminating between patients who developed pressure sores and patients who did not (Table 6.58).

Mobility of patients can be assessed by using the Norton Score, and interest in pressure sores research

Component of Norton Score	Group developing pressure sores		Group not developing sores	
	Mean	S.D.	Mean	S.D.
Physical condition	2.47	0.51	2.27	0.71
Mental state	2.26	0.68	2.457	1.005
Activity	1.608	0.94	1.271	0.6651
Mobility	2.173	0.77	2.22	1.018
Incontinence	2.782	1.04	3.186	0.937

Table 6.28 Components of initial Norton Score in relation to the outcome of pressure area care.

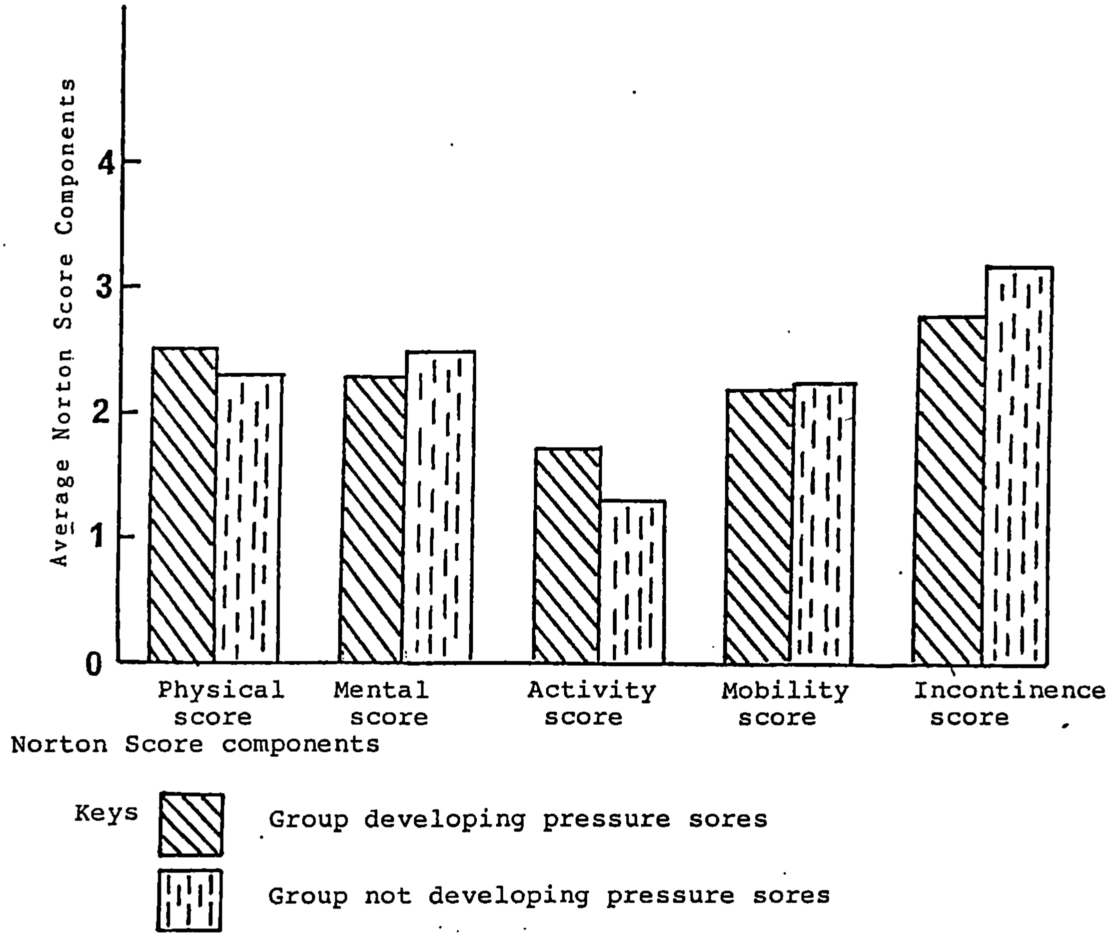


Fig 6.3 Components of initial Norton Score in relation to the outcome (hospital study).

centres on immobile i.e. chairfast/bedfast patients. Moreover, pressure sore prevalence increases with the number of non-ambulant patients. In both Glasgow and Borders Surveys comparing chairfast and bedfast patients of the same degree, the chairfast developed sores at a higher rate (Barbenel et al., 1977). In contrast, Petersen and Bittman (1971) indicated that bedfast patients were more likely to develop pressure sores than chairfast.

Mobility is less frequent in patients who are severely ill and too weak to move, in those with paralysis, and in those who are stuporous or whose depth of sleep is increased by sedation. Hence, the general condition of patients often influences the number of bodily movements, which in turn determine the period during which pressure is exerted and the likelihood of developing sores. Table 6.29 shows the Norton Score componants in association with the outcome of pressure area care.

Exton-Smith and Sherwin (1961) investigated the relationship between bodily movements and pressure sores development, using a record of bodily movement in bed over a period of 7 hours at night. A reduction in the number of spontaneous movements was found to be directly related to an increase in the incidence of pressure sores.

Further, inspection of patients' data in the present study shows that 11 out of 26 patients had slightly limited mobility among the patients who developed pressure sores (i.e. seven patients had very limited mobility and only four patients were immobile, all being female) (Table 6.29). However, 4 out of 26 patients with full mobility developed sores. All were female and in poor general

Table 6.29 Components of Norton Score and the outcome of pressure area care.

Components of initial Norton Score		Group developing pressure sores F	M	Total number	Group not developing sores F	M	Total number
Physical							
Very bad	1	0	1	1	4	2	6
Poor	2	11	2	13	27	9	36
Fair	3	10	1	11	12	4	16
Good	4		1	1	4		4
Mental							
Stuper	1	1		1	5	4	9
Confused	2	12	2	14	22	7	29
Apathetic	3	2	2	4	6	2	8
Alert	4	6	1	7	14	2	16
Activity							
Bedfast	1	19	2	21	38	13	51
Chairbound	3	2	3	5	3		3
Walks/help	3				6	2	8
Ambulant	4	0	0	0	0	0	0
Mobility							
Immobile	1	4	0	4	15	5	20
V. limited	2	5	2	7	18	4	22
Sl/ limited	3	8	3	11	10	4	14
Full	4	4	0	4	4	2	6
Incontinence							
Doubly	1	6	1	7	3	0	3
Usually urine	2	6	2	8	4	1	5
Occasional	3	1	0	1	13	4	17
Continence	4	8	2	10	27	10	37

condition on admission. Hence, we can say that a patient with good general condition on admission to hospital seldom develops sores. This conclusion is supported by the fact that out of 26 patients the one who was in good general condition on admission developed sores only when his general condition deteriorated after being in hospital more than one week.

Furthermore, it will be interesting to know whether the pressure sores were obtained while the patient was sitting up in bed, or out of bed, or lying in bed most of the time. The mobility of the patient might be associated with other factors, such as whether it is day or night, being bedfast, or chairfast, general status, and whether the bedfast patient is nursed in a prone or semi-recumbent position (Crow, 1979). The present study included bedfast patients who could only stand with support and those who were wheelchair bound and able to stand only when transferring from chair to bed, or for toilet purposes. Therefore it becomes apparent that the nursing assessment of the patient is essential, in particular the assessment of mobility, and of physical condition with regard to pressure sores formation.

6.2.5.7 Appetite in relation to pressure sores development

Food intake is a basic biological exercise protected deep in the brain by an appetite centre. This activity has been made easy by a plentiful supply of every nutrient. However, once physical maturity is reached degenerative changes become greater than growth. These changes affect all tissues and organs. Moreover, in the elderly the ability to ingest, digest or absorb nutrients, alter their metabolism and utilise them may be changed. Abilities associated with excretion may also be reduced. Alternatively a client's mental or physical condition, may affect their ability to obtain or prepare food. Although overt nutritional deficiencies are uncommon the physical, psychological and social effects of aging mean that elderly people have individual needs related to their general condition.

Elderly people with physical disabilities which impair mobility cause economic handicap and reduce purchasing power, or the central nervous system which reduces appetite and memory may all experience difficulty in securing an adequate diet (Cape et al., 1983). The majority of patients on admission to the study had a poor appetite and were also in physically poor condition (Table 6.30). Reduced appetite might well be associated with reduced physical, psychological and social status. Appetite at the end of the study does show a significant relationship with the outcome (Table 6.56), indicating a general worsening and deterioration of the condition of those who developed sores. It is possible to attribute the significance to deterioration of the patients' general condition. However, with regard to the importance of discriminant variables and predictive ability, appetite at the end of the study seems an important discriminating variable performing good discrimination, whilst independent variable appetite on admission to the study does not (Tables 6.57 and 6.58).

Patient appetite	Group developing pressure sores			Group not developing pressure sores			Total number
	Good	Poor	Fair	Good	Poor	Fair	
On admission to the study	9	15	2	19	42	1	88
At the end of the study period	4	22	0	45	17	0	88

Table 6.30 Appetite on admission to the study and at the end of the study period in relation to the outcome of pressure area care.

Further, appetite decreases with aging, as most elderly patients show in themselves complaining of lowered appetite often attributable to drug-induced confusion, depression and apathy (e.g. sleeping pills). Thus, depression and social isolation may reduce the appetite and eating alone away from family or spouse remove much of the pleasure of preparing and eating a meal, or the hospital environment itself may reduce the patient's appetite.

A total of 39 out of 88 patients showed poor appetite at the end of the study. 22 of these patients did develop pressure sores, and the remaining 17 did not. (Table 6.30).

The female patients had more of an appetite during admission, perhaps because they did not have to prepare the food. Thus, 18 out of 22 patients who did develop pressure sores were female had poor appetite at the end of the study (Table 6.31). However, attention must be paid to encouraging the patient to eat proper meals and have frequent drinks whenever possible by giving attention to the way of serving the meal, making it attractive on the plate, (e.g. by making fresh gravy or sprinkling parsley over fish). This can stimulate the appetite and can increase salivary flow.

Appetite may be reduced in cases of soreness of the mouth or the presence of a thick mucus coating on lips, tongue and teeth; so a mouth-wash to remove the mucus from the mouth will be essential. There is also a necessity to check the patient's dentures, because in elderly patients forgotten dentures before a meal might be associated with loss of patient appetite.

Appetite	Male	Female	Total number	Total %
Good	1	3	4	15.38
Poor	4	18	22	84.6
Fair	0	0	0	0
Total	5	21	26	100

Table 6.31 Appetite at the end of the study in relation to gender, of patients who developed pressure sores.

Further, it is important to increase the vitamin and mineral supplement, because vitamin and mineral deficiencies and anaemia will contribute as factors associated with loss of appetite.

With regard to the body type of patients with poor appetite, there were 13 out of 26 patients who were thin, 6 with normal body type, and 7 were obese patients (Table 6.32). 12 out of the 13 thin patients developed pressure sores (Table 6.34). Only 5 patients from the group with normal body type and 5 of obese patients developed sores (Table 6.32, 6.35).

On the other hand, among the group of patients who did not develop sores, 12 out of the 30 thin patients had poor appetite and 4 out of (14) obese patients had poor appetite. Only one patient within this group who had normal body type seemed to have a poor appetite (Table 6.33, 6.34, 6.35).

Body type	Appetite at the end of the study Good	Poor	Number of patients	%
Thin	1	12	13	50
Normal	1	5	6	23.07
Obese	2	5	7	26.92
Total	4	22	26	100

Table 6.32 Body type and appetite at the end of the study for the group who did develop pressure sores.

Body type	Appetite at the end of the study Good	Poor	Number of patients	%
Thin	18	12	30	48.38
Normal	17	1	18	29.03
Obese	10	4	14	22.58
Total	45	17	62	100

Table 6.33 Body type and appetite at the end of the study for the group of patients who did not develop pressure sores.

Thin patients

Outcome of pressure area care	Good appetite at the end of the study	Poor appetite at the end of the study	Total number
Group who did develop pressure sores	1	12	13
Group who did not develop pressure sores	18	12	30
Total	19	24	43

Table 6.34 Appetite at the end of the study in relation to the outcome of pressure area care for thin patients. $P = < 0.05$ (Fisher exact probability)

Obese patients

Outcome of pressure area care	Good	Poor	Total number
Group who developed pressure sores	2	5	7
Group who did not develop pressure sores	10	4	14
Total	12	9	21

Table 6.35 Appetite at the end of the study of obese patients in relation to the outcome of the study. $P = > 0.05$

6.3B Nursing intervention

One of the aims of the study was to identify the amount of time devoted to pressure area care of the patient. By means of the diary sheet the total time spent in general pressure area care activities was calculated. An average of 51.5 min/patient/daily were spent on the hospital patients, but it seems that the group of patients who did develop pressure sores had received less than this (Table 6.36). This latter result was statistically significant $P = 0.0017 < 0.05$ (Table 6.56). In fact, this might reflect the importance of the independent variable "total time for pressure area care" in pressure sores prevention. The average total time spent in pressure area care activity came as an important predictive discriminant variable in stepwise discriminant analysis when it entered into the third step of analysis (Table 6.57).

6.3.1 Age and time spent on pressure area care

23 (33.82%) patients aged 70 years or over developed pressure sores. 13 (50%) of these elderly patients who did develop pressure sores had received 40 min or less/24 hours on a range of time for pressure area care. 5 (21.7%) had received care within a range of time from 41 - 60 min/24 hours. However, none of these patients who did develop pressure sores had received more than 101+ min/24 hours, whilst of the group of patients who did not develop pressure sores and were over 70 years of age, 3 (6.66%) were receiving more than 101+ min/24 hours. The patients receiving a time of 40 min or less in this group were 5

Outcome of pressure area care	Total number	Average time spent on pressure area care in min/patient/ daily	S.D.
Group developing pressure sores	26	45.98	23.80
Group not developing pressure sores	62	54.8	24.83

Table 6.36 Average total time in min/24 hour spent for pressure area care in relation to the outcome of pressure area care.

(11.11%) while 23 (51.11%) received time within a range of 41 - 60 min/24 hours (Table 6.37).

On the other hand, of the group of patients who were aged less than 70 years only 3 developed pressure sores and these were receiving 40 min or less/24 hours, whilst, for the group of patients who did not develop pressure sores within the same age-group 8 (45.05%) were receiving 40 min or less/24 hours. Only 1 (5.88%) of this group, received pressure area care for 101+ min per 24 hours.

Therefore, it seems that elderly patients were more likely to develop pressure sores (Norton et al., 1962, 1975) because they needed an extra amount of nursing attention to prevent pressure sores. This group of patients seem more dependent on nursing staff to satisfy their needs for changing position, supplying food, using toilet facilities, cleaning their skin, using a relieving device and monitoring its use. In addition, these patients need sleep and rest and all their routine should conform as nearly as to the rhythm of life outside the hospital.

6.3.2 Time spent on pressure area care in relation to patient gender

The difference between male and female patients who developed sores with regard to the time spent on pressure area care is shown in Table 6.38. The female patients consistently consumed higher amounts of time than male patients - an average of 47.59 min/ female patient/24 hours and 39.17 min/male patient/24 hour. Nonetheless, a higher number of female patients (21 out of 26 patients) developed pressure sores. This might be because female patients were

Range of total time in pressure area care (min/24 hours)	70 years of age and over				Below 70 years of age			
	Group developing pressure sores	%	Group not developing pressure sores	%	Group developing pressure sores	%	Group not developing pressure sores	%
Less than 20	3	13.04	1	2.22	0	0	0	0
20 - 40	10	43.5	4	8.88	3	100	8	47.05
41 - 60	5	21.73	23	51.11			3	17.65
61 - 80	1	4.34	9	20			4	23.53
81 - 100	4	17.39	5	11.11			1	5.88
101 +	0	0	3	6.66			1	5.88
Total	23	100	45	100	3	100	17	100

Table 6.37 Range of total time in minutes/24 hours spent in pressure area care in relation to age and outcome of pressure area care.

Range of total time in (min) spent for *PAC	Male	%	Female	%	Total number	Total %
Less than 20	2	10	2	2.9	4	4.5
20 - 40	7	35	18	26.4	25	28.4
41 - 60	3	15	28	41.1	31	35.9
61 - 80	2	10	12	17.6	14	15.9
81 - 100	3	15	7	10.2	10	11.3
101 +	3	15	1	1.47	4	4.5
Total	20	100	68	100	88	100

Table 6.38 The range of total time in minutes/24 hours spent for pressure area care in relation to gender.

*PAC = Pressure area care

more dependent on nursing staff in satisfying their needs (Table 6.39).

The length of time devoted to pressure area care amongst the small group of male patients who developed sores was only 39.17 min, suggesting that nurses were not good at predicting risk among male patients and giving the appropriate pressure area care. The average total time spent for pressure area care seems lower within the group who did develop pressure sores (Table 6.39).

On the other hand, the group of male patients who did not develop pressure sores had more time devoted to the prevention of pressure sores than female patients of the same group. Moreover, this group had more time for pressure area care than the group of male patients who did develop sores (Fig 6.4).

6.3.2.1 Average total time spent on pressure area care in relation to patient location and diagnosis

Orthopaedic patients received less time than average of pressure area care (40.3min/patient/24 hours). This was less than the average total time of all the geriatric patients (61.04 min/24 hours/patient) and the ICU patients (87.8 min/24 hours/patient). Besides geriatric patients, seems consumed more average time in Hospital (A) than Hospital (B), (Table 6.40). The majority of patients (see Table 6.42) were in orthopaedic wards. Most of these were suffering from fractured neck of femur and seems, received less average time than the group of patients with total hip replacement, but more than the average total time given to patients with spinal cord injury and back

Outcome of pressure area care	Total number of male	Average male time spent	S.D.	Total number of female	Average female time spent	S.D.
Group developing pressure sores	5	39.17	29.98	21	47.59	20.95
Group not developing sores	15	57.7	33.18	47	52.8	23.95

Table 6.39 Average total time in minutes spent for pressure area care in relation to gender and the outcome of pressure area care.

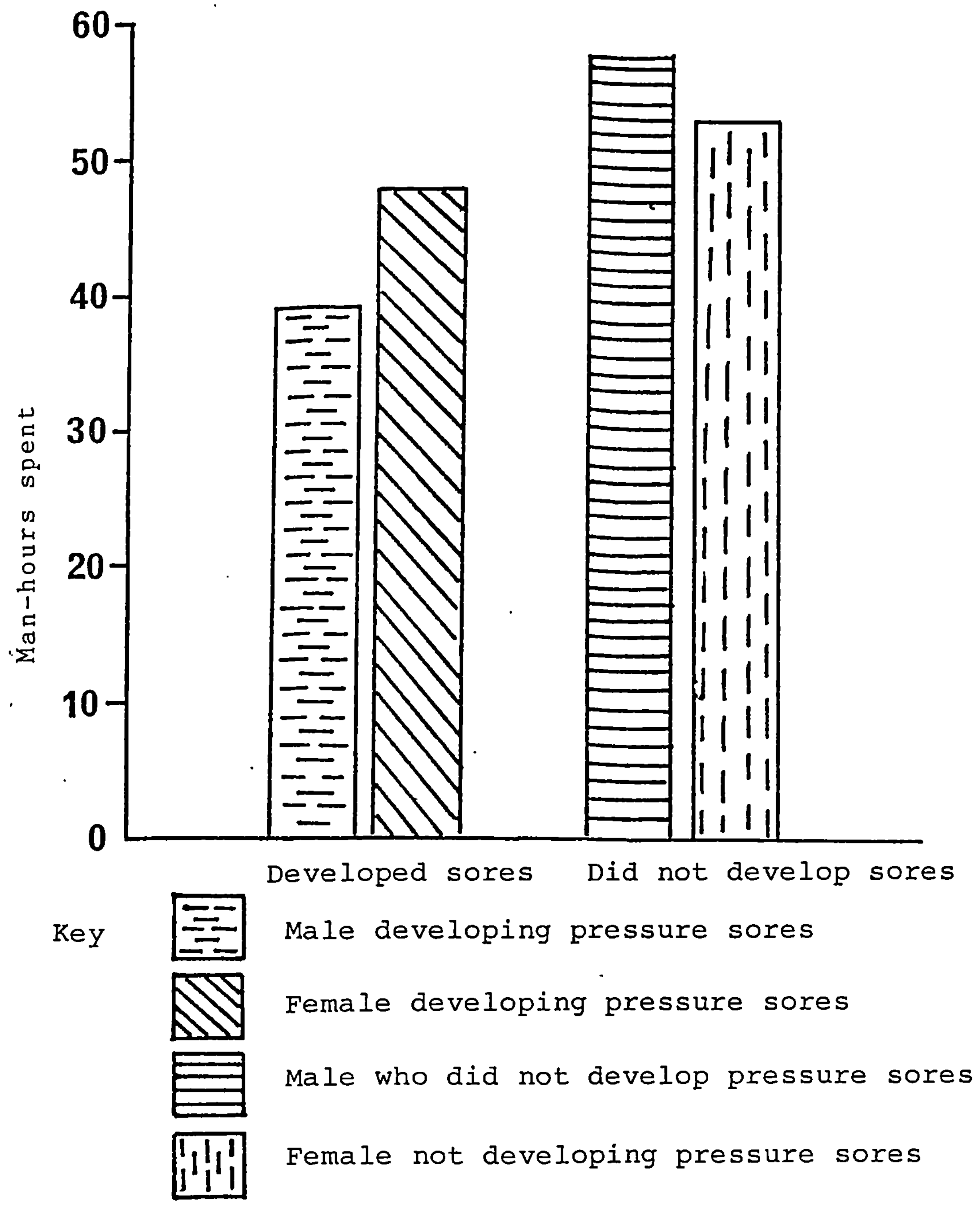


Fig 6.4 Man-hours spent for pressure area care in relation to sex and the outcome of pressure area care (hospital study).

Table 6.40 Average total time in minutes/24 hours spent on pressure area care in relation to ward designation in two selected hospitals.

Hospital	Orthopaedic Average total time	S.D.	Geriatric Average total time	S.D.	ICU Average total time	S.D.
A	40.3 (n=49)	18.583	63.4 (n=21)	36,64	87.8 (n=7)	22.989
B	-		47.5	21.114	-	

n = Number of patients

Outcome of pressure area care	Orthopaedic Average total time	No.	Geriatric Average total time	No.	ICU Average total time	No.
Patients developing pressure sores	45.8	21	46.38	5	87.8	7
Patients not developing sores	36.2	28	61	27		
Total		49		32		7

Table 6.41 Average total time in minutes/24 hours of pressure area care in relation to the patient location and outcome of pressure area care.

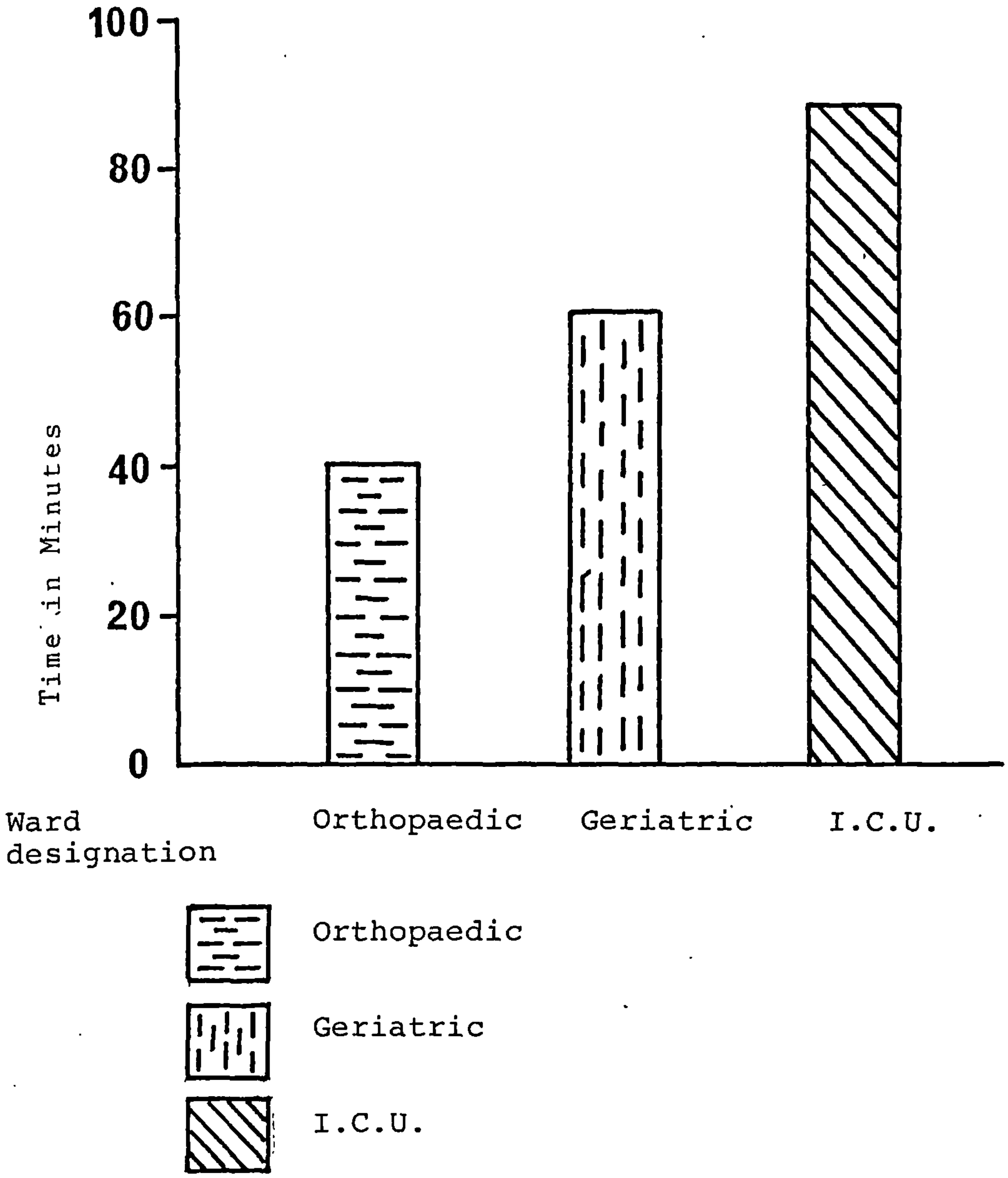
No. = Total number of patients

ICU = Intensive care unit

Diagnosis	Total number	Average total time spent on pressure area care	S.D.
Fractured neck of femur	40	43.36	22.2
Total hip replacement	2	43.7	8.48
Spinal cord injury and back pain	7	31.77	6.83
	49		

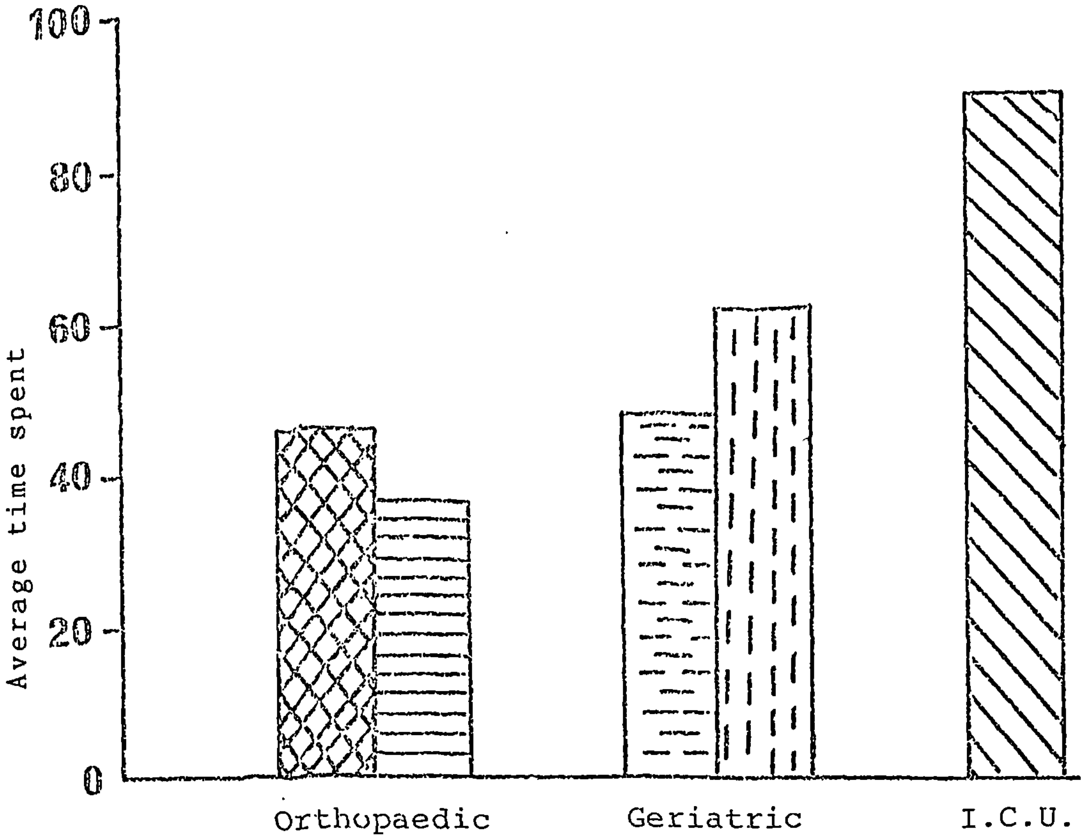
Table 6.42 Average total time in minutes/24 hours spent in relation to orthopaedic patients' diagnoses.

pain. Orthopaedic patients as a group seem to need extra time for relieving pressure, as they are known to be susceptible to pressure sores (Versluysen, 1985; Lowthian, 1979a) (Table 6.41) and (Fig 6.5, 6.6).



I.C.U. = Intensive care unit

Fig 6.5 Total time spent for pressure area care in relation to ward designation.



Keys

- Orthopaedic developing pressure sores
- Orthopaedic not developing pressure sores
- Geriatric developing pressure sores
- Geriatric not developing pressure sores
- Intensive care unit patient not developing pressure sores

Fig 6-6 Average total time spent for pressure area care and patient location in relation to outcome of pressure area care.

6.3.3 Time spent on pressure area care in relation to Norton score

The higher number of patients admitted to the study were at risk of pressure sores, with initial scores less than 12.

Of these patients admitted with low Norton Scores and poor general condition (Table 6.43), one group developed sores and the other did not. The former group had received less time devoted to pressure area care than the latter. Therefore, we can say the time factor in prevention seems crucial in pressure sores occurrence if the patient's Norton Score is taken into consideration. Inspection of the diary sheets shows that four out of 26 patients who did develop pressure sores had Norton Scores on admission above the level normally considered to show risk (i.e., 14). However, their scores remained high during and at the end of the study as they were independent in helping themselves. One of these four patients had received above average total time spent for pressure area care compared with the patients sample as a whole. The other three patients received a good deal less time on average per day/patient than the hospital average of 51.5 minutes (namely 40 min; 35 min; 9.2 minutes respectively).

Outcome of pressure area care	Average total time on pressure area care	S.D.	Average initial Norton Score	S.D.	Average final Norton Score	S.D.
Group developing pressure sores	45.98 (n=26)	23.80	11.5	2.39	11.3	2.56
Group not developing pressure sores	54.8 (n=62)	24.83	11.43	2.63	14.25	3.29

Table 6.43 Average total time in minutes/24 hours spent on pressure area care in relation to the outcome and initial Norton Score.

n. = Number of patients

6.3.4 Average total time spent on pressure area care during day and night hours/patient in relation to the outcome of pressure area care

Continuity of pressure area care around the clock seems very important for pressure sore prevention. The group of patients who did develop pressure sores (Table 6.44) received fewer man-hours of nursing activities devoted to pressure area care (Fig 6.7) during night hours than day hours, whilst the group who did not develop pressure sores also seem to have received fewer night hours for pressure area care in comparison with day hours. On the other hand, the group of patients who did develop pressure sores received less man-hours for pressure area care both during the day and night hours in comparison with the time devoted to the group who did not develop pressure sores. This might be due to any of the several factors set out below:

1. Shortage of nursing staff during night hours.
2. Failure of nursing staff in giving attention during night hours.
3. The unavailability and inefficiency of pressure-relieving equipment.
4. The requirements of individual patients and the degree of physical dependence of the patients in certain wards.
5. Although the highest level of nursing activities in the wards was between 9a.m. and 5p.m., the time of greatest risk is during a night, when there are less general activities and the natural tendency is not to disturb the patient. It is true to say that there is little

Outcome of pressure area care	Average total time a.m. in min/daily/ patient	* S.D.	Average total time p.m. in min/daily/ patient	S.D.
Group developing P.S.	23.39	11.64	22.5	13.40
Group not developing P.S.	30.3	10.46	24.2	17.32

Table 6.44 Distribution of the average total time in minutes/patient/24 hours of pressure area care during a.m. and p.m. throughout study period.

* S.D. = Standard deviation

P.S. = Pressure sores

a.m. = From midnight to midday

p.m. = from midday to midnight

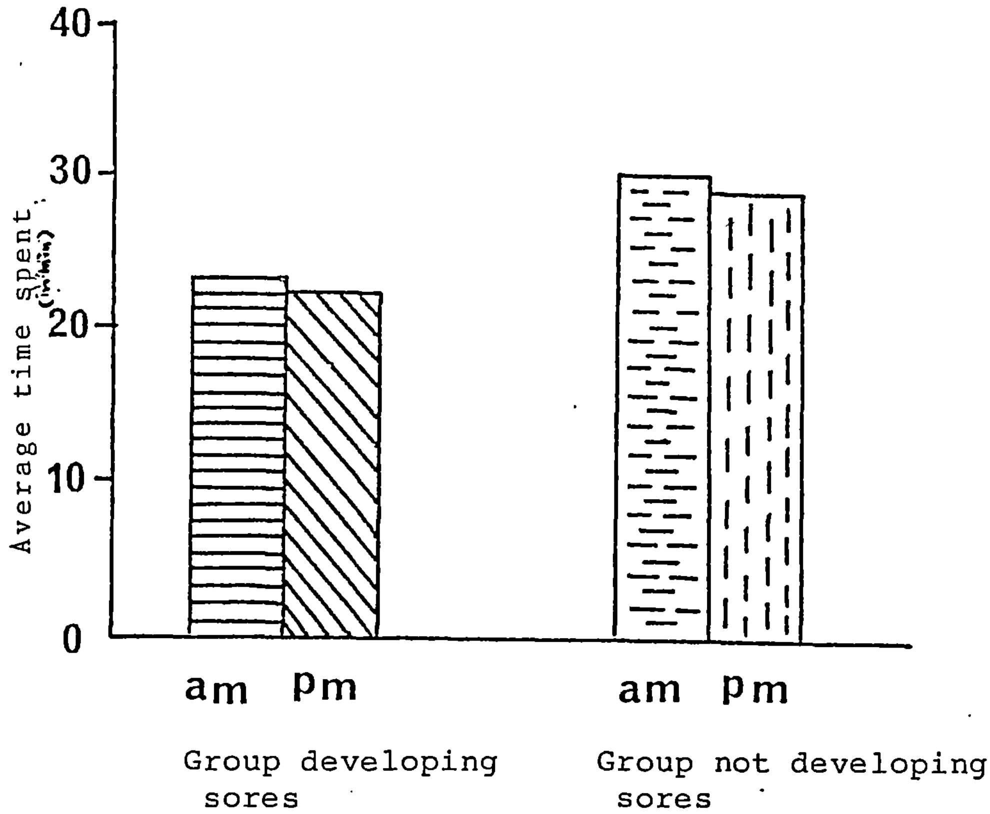


Fig 6.7 Average total time of pressure area care at am and pm in min/day/patient throughout study period.

risk from disturbed sleep, but there is greater risk from unrelieved pressure damage. Patients are less likely to move themselves at night when sleeping than in the day time.

6.3.5 Skill grade mix amongst nurses giving pressure area care

32 (65.3%) of the orthopaedic patients received pressure area care from all grades of nurses (Table 6.45). Similarly, 15 (46.9%) of the geriatric patients received care from all the grades of the staff. So did one (14.3%) of the ICU patients. Also, 14 out of the 26 (53.8%) patients who did develop pressure sores received care from all grade of nursing staff (Table 6.46). This shows that grade of nursing staff was statistically not significant $P = 0.6453$ $P = > 0.05$ (Table 6.56) (i.e. the grade of the staff has little effect on outcome of pressure area care with regard to the time spent on this care). On the other hand, when we examine the nursing intervention range of total time (Table 6.47), the majority of the patients did receive pressure area care from all grades of nursing staff within the time range of more than 40 min/daily. Thus, any depletion of an already limited number of nursing staff on the ward for a few hours can lead to pressure sores occurrence. Another important factor is the loyalty of the nurses to a particular ward. This should not be forgotten in any attempt to achieve flexibility in deploying nursing resources. Nurses remaining for a long period of time in a ward, become loyal to that ward, and can form an efficient nursing team by developing good working relationships with

Ward designation	All grade of staff	Except staff nurse	Except enrolled	Except student nurse	Except pupil nurse	Except pupil & auxillary nurse	Total number	Total %
Orthopaedic	32	7	0	2	8	0	49	55.7
Geriatric	15	7	1	6	3	0	32	36.4
ICU	1	0	0	0	1	5	7	8
Total	48	14	1	8	12	5	88	100

Table 6.45 Distribution of patients in relation to the grades of nursing staff.

Outcome of pressure area care	All grades of staff	All grades except staff nurse	All grades except enrolled nurse	All grades except student	All grades except pupil	All grades except pupil & auxiliary	Total number	Total %
Patients developing pressure sores	14	6	0	1	5	0	26	29.5
Patients not developing pressure sores	34	8	1	7	7	5	62	70.5
Total	48	14	1	8	12	5	88	100

Table 6.46 Outcome of pressure area care in relation to the grades of nursing staff.

Range of total time in minutes	All grades of nurses	All grades except staff nurse	All grades except enrolled nurse	All grades except student nurse	All grades except pupil nurse	All grades except pupil, & auxiliary student	Total number
Less than 20	1	2			1		4
20 - 40	11	4	1	3	6		25
41 - 60	22	4		3	2		31
61 - 80	5	3		2	2	2	14
81 - 100	8	1			1		10
101 +	1					3	4
Total	48	14	1	8	12	5	88

Table 6.47 Range of total time in minutes/24 hours spent in pressure area care in relation to the category of care givers.

other nurses, and become familiar with the patients and their problems and can deliver an effective nursing care of high quality (Chrissafis, 1981).

6.3.6 Average interval between times of pressure area care

The incidence of pressure sores reduces with increasing nursing attention to the vulnerable skin areas (Norton et al., 1962, 1975). Conversely, the longer the time the patient is left without nursing attention and without facilities to relieve the pressure, the greater the pressure effects and the greater the damage to the tissues. It can be agreed that the longer the time the patient is left without care, the more time nurses will need to treat the pressure sores which occur (Barton and Barton, 1981) and the higher the cost of hospitalisation (Kenedi et al., 1976; Hibbs, 1987).

The independent variable frequency of pressure area care given has been calculated as the average interval between the pressure area care for the first two weeks of patients' stay in the study, and the average total interval of pressure area care throughout the whole study period was entered separately into the computer. The average interval between pressure area care for the entire study period was entered for those patients who stayed in the study for less than two weeks. Discriminant analysis (Table 6.56) shows that the interval between pressure area care for the first two weeks of patient stay in the study was statistically significant with dependent variable outcome of pressure area care $P = 0.0448$. This relationship did not hold when analysing the interval between pressure area care throughout the whole period of the study P = 0.1157 using Fisher's exact probability. Besides, the independent variable frequency of pressure area care given (i.e. interval between pressure area care) did not emerge from summary discriminant analysis as an important predictive variable of outcome of pressure area care (Table 6.57).

Further, the group of patients who developed sores were subject to a longer average interval between pressure area care compared with the average interval of the group who did not develop pressure sores (Table 6.48). Average interval of the pressure area care during the first two weeks of the study for patients who did develop pressure sores was 5.25 hours, whilst for the group of patients who did not develop sores it was 4.1 hours. The total average interval between pressure area care throughout the whole study period for all admitted patients to the hospital was 4.6 hours. Calculation of average total interval between pressure area care for the whole period of study for the group of patients who developed sores was 5.1 hours daily, whilst for the group who did not develop sores it was 4.48 hours daily.

The general condition of the patient and the nature of his illness modify the response and often determine the ability of the body to tolerate pressure. Hence, it seems that frequency of pressure area care should be related to initial Norton Score (Table 6.49). In other words, patients with lower initial Norton Score on admission need more frequent pressure area care. In fact, the group who did not develop pressure sores showed their ability to move and help themselves but still had care at more frequent

Table 6.48 Average interval in hours of pressure area care for the first two weeks of patients' admission and the total average interval between pressure area care throughout the whole period of the study in relation to the outcome of pressure area care.

Outcome of pressure area care	Total number	Average interval of PAC for the first two weeks	Total average interval between PAC throughout the whole period of the study
Group developing pressure sores	26	5.25	5.1
Group not developing pressure sores	62	4.1	4.48

Outcome of pressure area care	Number of patients	Average interval between PAC in hr	S.D.	Average initial Norton Score	S.D.
Group developing pressure sores	26	5.25	3.98	11.5	2.39
Group not developing pressure sores	62	4.1	6.90	11.43	2.63

Table 6.49 Average interval between pressure area care and patient average initial Norton Score in relation to the outcome of pressure area care.

intervals than the group who did develop pressure sores. This suggests that being bedfast or chairfast deserves attention in its own right. But from the researcher's observation it seemed that most of the female patients were very often reluctant to change and lift themselves when advised to do so, while they were in bed or sitting on the chair for a long time, although such movement is important in particular for female orthopaedic patients with traction which might restrict their movement and in which skin breakdown is more likely. Therefore, patients needed frequent nursing attention to the pressure site (i.e. changing patient position, cleaning the skin, and use of relieving device). The frequency of pressure area care seemed to have a high priority in "ICU" as the plan of 2-hourly nursing attention was more often carried out than the PAC programmes in the other wards. And in spite of the poor general condition of the patients in ICU on admission, no patient was seen to develop pressure sores, however, this does not indicate that patients in this unit can not develop skin breakdown. Four out of seven ICU patients did develop red skin during the first week of the study,before they were transferred to another hospital.

The difference in the average initial Norton Score for hospital patients seems important in assessing the patients and satisfying their needs. However, we cannot prescribe an interval between care and a total time for pressure area care for hospital patients, as patients have different needs concerning the individual pressure area care and initial Norton Score. Hence, assessing the patient on the first day of admission to the hospital is important rather than leaving it until he has been in hospital for their first week. An individual care plan is needed, i.e. frequent pressure area care which includes changing the patient's position and lifting him if needed, in association with aids to relieve the effect of localised pressure on the affected site. Besides this, nurses examine and assess the patient each time he is given pressure area care.

Furthermore, in relation to the frequency of pressure area care, although 21 patients developed red skin, no one of these patients seemed to receive pressure area care within an interval time of less than 2 hours. 26 of the total number of patients developed superficial skin breakdown, although the majority of these patients were receiving care within a range interval time of more than 2 hours daily, while 41 patients remained with good and intact skin throughout the study period, although the majority were receiving care within a range interval time of 2-4 hours daily (Table 6.50). Meanwhile, this is in agreement with Hibbs (1982) that all superficial skin breakdown can be reduced to 4% when we turn the patient every 1-2 hours daily and may be hourly, according to the patient's general condition.

Range of intervals between pressure area care in hours	Skin redness	Superficial skin breakdown	Good and intact	Total number
Less than 2			1	1
2 - 4	16	14	28	58
5 - 7	4	10	7	21
8 - 10	1	1	5	7
11 - 13				
14 +		1		1
Total	21	26	41	88

Table 6.50 Range interval between pressure area care in hours in relation to the condition of the skin area.

6.3.7 Anatomical distribution in relation to the outcome of pressure area care

A high percentage of patients (42.3%) did develop pressure sores at the site of sacrum and buttocks. (Table 6.51), where the skin was more likely to break down (Petersen and Bittman, 1971; Nyquist and Hawthorn, 1985; David et al., 1983). The majority of patients who developed at this site were females who received pressure area care within an average interval of less than 4 hours daily (Table 6.52). However, the average whole interval between pressure area care applications was 4.6 hours/24 hour, and this seems not sufficient to satisfy patients' needs, and to reduce pressure damage at the site of sacrum and buttock. In orthopaedic wards, frequent traction in use might increase the shearing force and might cause tissue damage as one end of the bed needs to be higher than the other. This may well explain the higher number of patients with sacrum and buttock sores, which mainly started as a severe pain due to shearing pressure force which compresses the tissue, causing diminished blood circulation leading to skin breakdown. Even when pressure area care was carried out at a range interval of between 2-4 hourly, 16 patients developed redness of the skin (Table 6.50). This signified deeper damage to the tissue, in particular at the sites of bony prominence; and the skin breakdown resulted in many cases. Site of skin area seems not significant with dependent variable outcome (Table 6.56). However, it emerges from summary discriminant analysis and from canonical discriminant function (Tables 6.57, 6.58) as an important predictive variable discriminant between groups of

Table 6.51 Distribution of pressure sores in relation to patient gender.

Location of pressure sores	Male	Female	Total number	Total %
Sacrum		3	3	11.5
Heels		2	2	7.7
Elbows	1	1	2	7.7
Buttocks		2	2	7.7
Sacrum and buttocks	3	8	11	42.3
Sacrum and hips		2	2	7.7
Sacrum and heels		2	2	7.7
All		1	1	3.8
Ankle	1		1	3.8
Total	5	21	26	100

Location of pressure sores	Average interval between PAC in hours	Skin breakdown	%
Sacrum	4.1	3	11.5
Heels	3.7	2	7.7
Elbows	4.8	2	7.7
Buttocks	6.4	2	7.7
Sacrum and buttocks	3.8	11	42.3
Sacrum and hips	5.2	2	7.7
Sacrum and heels	6.8	2	7.7
All	6.2	1	3.8
Ankle	6.8	1	3.8
Total		26	100

Table 6.52 Distribution of average interval between pressure area care in relation to the location of skin breakdown.

variables.

6.3.8 Patient body type

The body type of the patient can affect the distribution of pressure over the body's surface and this might cause tissue damage (Lindan et al., 1965).

The hospital sample shows that 43 (48.8%) out of 88 were thin patients, mostly female patients (Table 6.53); 24 (27.3%) were with normal body build; and the remaining 21 (23.9%) were obese patients. 13 out of 43 thin patients developed pressure sores with an interval between pressure area care of 3.9 hours daily, whilst, amongst obese patients, 7 out of a total of 21 developed pressure sores with an interval between pressure area care of 4.6 hours daily. In contrast, the average interval in hours between pressure area care seems less for the group who did not develop sores (Table 6.54). This strongly suggests that thin patients require more frequent pressure area care than others, in order to dissipate the pressure over the body's surface and thus prevent tissue damage.

Body type	Number of patients Male	Female	Total number	%
Thin	9	34	43	48.8
Normal	7	17	24	27.3
Obese	4	17	21	23.9
Total	20	68	88	100

Table 6.53 Distribution of body type among the hospital patients.

Body type	No.	Patients developing pressure sores Average interval between *PAC in hour	No.	Patients not developing pressure sores Average interval between *PAC in hour	Total number
Thin	13	3.9	30	3.4	43
Normal	6	8.8	18	4.1	24
Obese	7	4.6	14	3.7	21
Total	26		62		88

Table 6.54 Range of intervals in hours between pressure area care in relation to the outcome of pressure area care and patient body type.

*PAC = Pressure area care

No. = Number of patients

6.3.9 Methods used for pressure area care and nurses attention to the sites of skin area

Relieving the patient of the pressure seems crucial because an increase in nursing time and patient suffering will be incurred if a pressure sore becomes established, (Barton and Barton, 1981). Therefore, to achieve pressure sore prevention, various methods for relieving the pressure were used in the hospital, in association with regular nurses' observations according to an individual patient care plan.

A) Methods used for relief from pressure

Pressure area care comprised methods of manual relief; cleaning solutions used for the skin, and pressure-relieving devices.

B) Nurses' regular observation

This includes observation of the site of skin area attended to and checking the condition of the skin area.

The pressure area care the patient received was to depend upon many factors, the foremost of which should be the degree to which he was capable of doing things for himself (i.e. degree of his independence). It is necessary to recognise both that an elderly patient's rehabilitation might be impeded by having too much done for him and that it is possible for a patient to receive insufficient care, particularly when his capacity is impaired. Therefore, in hospital the nursing staff tried various pressure area care measures according to the individual needs of each patient. Table 6.55 shows various measures used for prevention at the

Outcome of pressure area care	Turning position				* Skin cleaning solution				Pressure relieving device					
	Turning by assistance	Self-turning	Self-lifting free	Turning & lifting free	Soap & water	Soapy water	Soap & others	Soap & water & soapy water	Sheepskin	Water bed	Monkey pole	Flotation cushion	Sheepskin & water bed	Sheepskin & ripple mattress
Group developing pressure sores	8	1	5	12	0	2	16	8	7	3	13	1	2	0
Group not developing pressure sores	6	16	21	19	2	3	33	24	31	1	21	0	3	6

Table 6.55 Preventive methods used in relation to the outcome (Hospital Sample).

* NB This classification of methods in relation to the use of soap and water is based on direct observation of nurses' practice. Some nurses applied the bar of soap directly to the skin and then they used water for rinsing; others diluted the soap with water and applied the mixture to the skin; and another application, e.g. talcum powder, was applied after drying.

hospital. The majority of patients who developed sores required turning, positioning and lifting free by the nurses, whilst the group that did not develop sores appear to have been self-turning and mostly independent.

With respect to the pressure relieving devices, the group that did not develop pressure sores mainly used sheepskin on the first day of patient admission to the hospital, whilst 7 out of the 26 patients who developed sores were using a relieving device the day after admission or when the skin became red.

6.4.C Case study

During the course of the project the researcher's attention was drawn to the following cases of patients which show the effect of total time and interval of pressure area care in relation to patient's initial Norton Score.

Case A

A patient aged 82 years and suffering from fractured neck of femur had a history of rheumatoid arthritis for which, 13 years ago he had received prolonged steroid therapy. In addition to arthritis the patient had long-standing bronchitis and had received physiotherapy for his chest. The patient was plump and flabby and heavy to lift. On the theatre table he was lifted by poles and spreaders. On admission the patient was anxious, restless, breathless, with poor appetite and with an initial Norton Score of 11. He developed a pressure sore towards the eighth postoperative day of his fractured neck of femur operation. This was when his general condition had deteriorated and his Norton Score had dropped to 10 from the initial level of 11.

During the first day of the patient's admission, no preventive mechanical aids were used on him, whilst 3 to 4-hourly manual turning of his position was instituted using pole and spreaders. Other relieving devices such as sheepskin, pillows and a monkey pole were used on the second day, when the patient's sacrum started to become red. He complained of pain at the site of his sacrum after his operation (24 hours after surgery in particular) and the

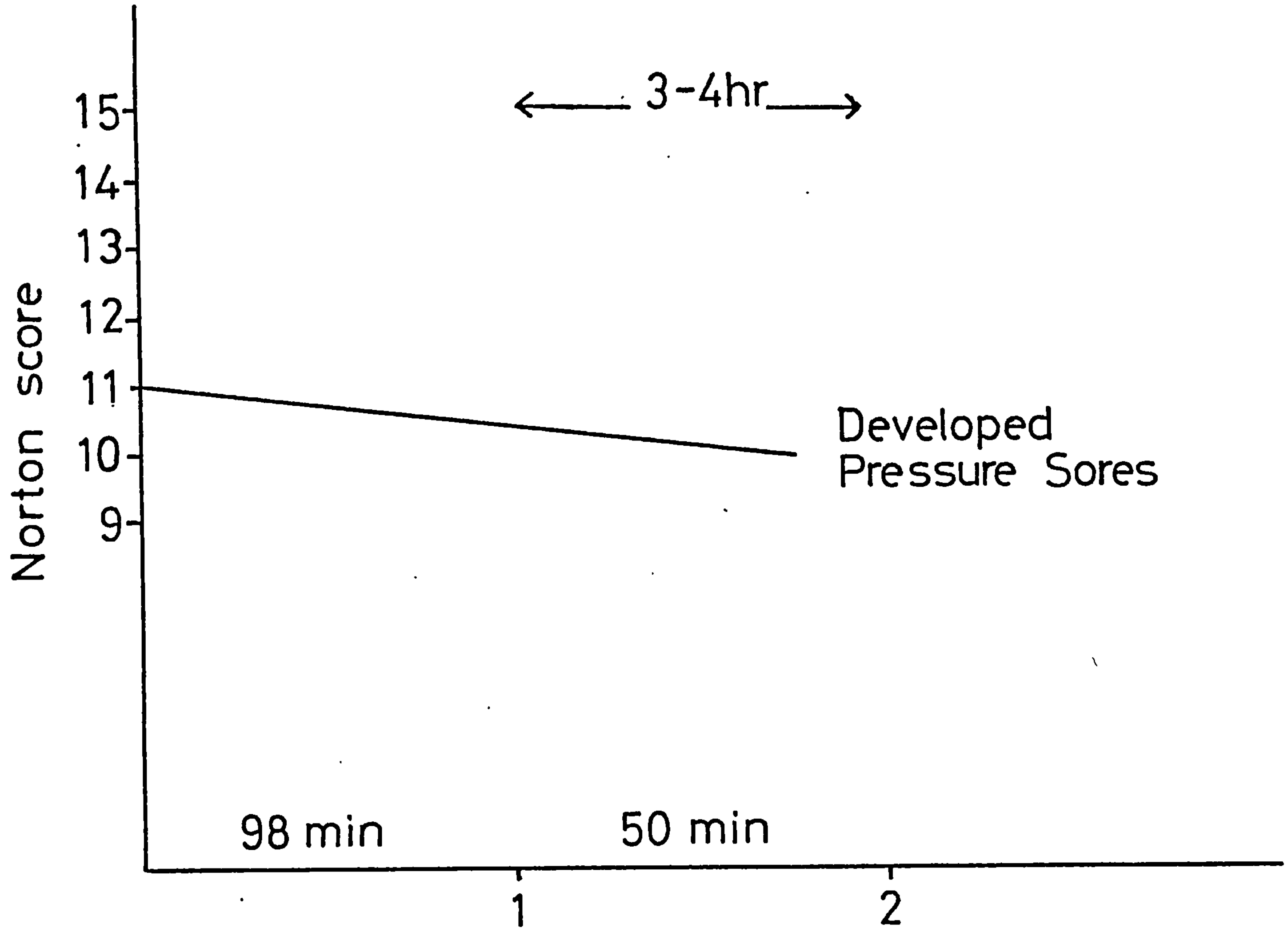


Fig A Total time for P.A.C in min/week

pain was described as going down the path of the sciatic nerve, across the sacrum and the buttocks. It was extremely distressing, being more severe than the pain from the operation site. Pain-killers were given and on the sixth day after the operation, skin breakdown appeared on the site that the patient had complained about (Fig A).

Case B

A female aged 77 years was suffering from diabetes and chest infection. She was in poor general condition on admission with poor appetite and incontinence of urine and faeces. Her initial Norton Score was 9. Nursing attention using preventive aids was started on the first day of the patient's admission to the hospital. A sheepskin and a bed cradle were used with regular turning of the patient 2 to 3-hourly. This was continued for the first week, with a total time spent on pressure area care of 436 min for the first week. For the second week, pressure area care continued after regular intervals of 3 to 4-hours with continued use of sheepskin, bed cradle, lifting the patient from chair or bed (momentarily) and cleaning the skin area with soap and water. At the end of the third week the patient's Norton Score was 14, after an initial Score of 11 for the second week, and 9 on admission (Fig B). Her general condition gradually improved, she started to help herself by turning and lifting, and by walking with zimmer frame around the ward. However, at the end of third week patient was discharged from the hospital with pressure areas intact.

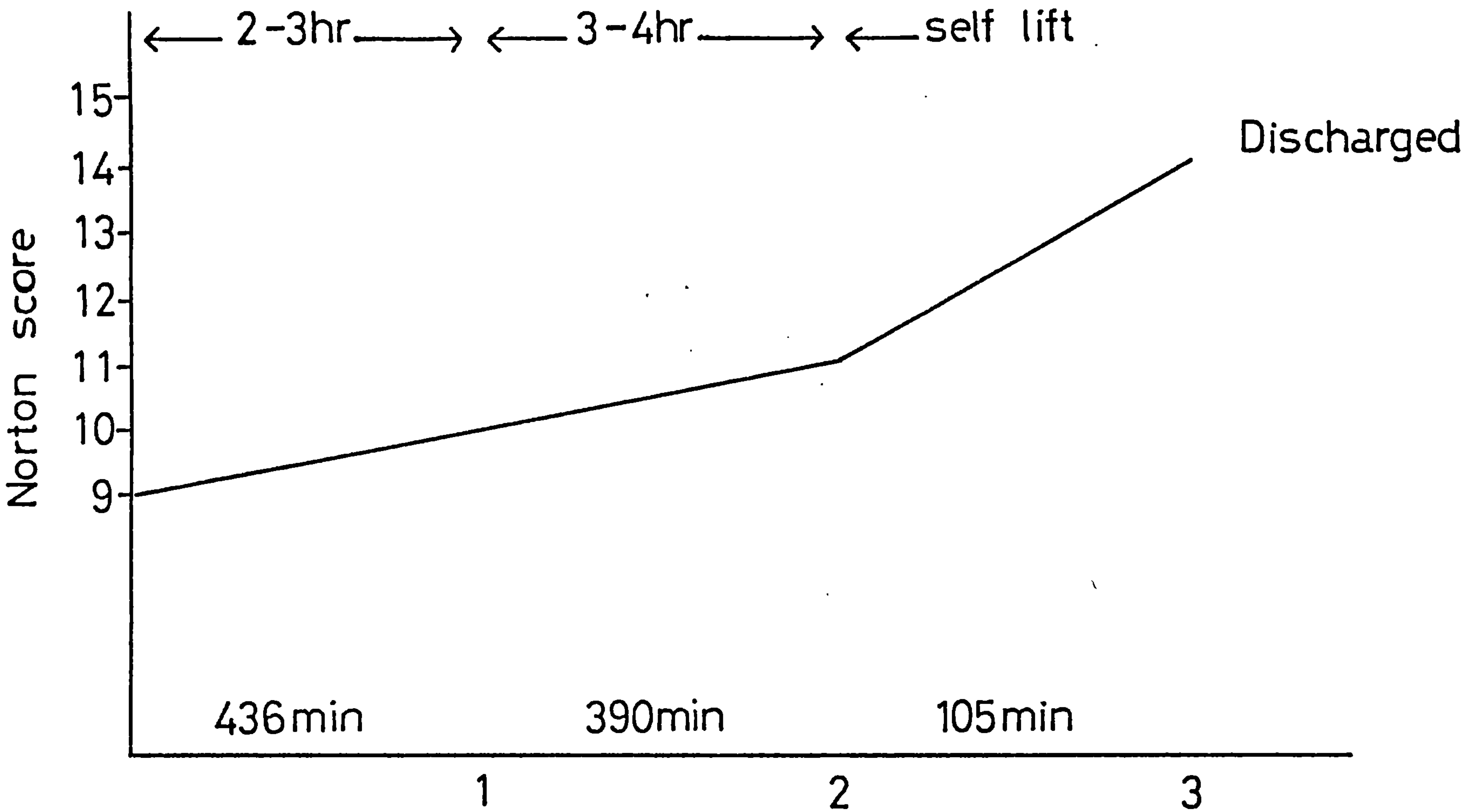


Fig B Total time for Pressure Area Care in min/week

Case C

A female patient aged 82 years whose diagnosis on admission was cancer of the stomach and rheumatoid arthritis, was readmitted to the hospital twice into the geriatric ward. She was in poor general condition and suffered from incontinence of urine. Her initial Norton Score was 9 and by the end of the first week went up to 10 and then dropped to 8 in the second week (Fig C). The patient had a sheepskin and bed cradle and was surrounded by pillows. 1 to 2-hourly intervals lapsed between each application of pressure area care.

During the second week 2 to 3-hourly turning was carried out with cleaning the skin with soap and water and with continued use of mechanical devices. The patient died without skin breakdown.

Case D

A female patient aged 88 years was admitted to the hospital with fractured shaft of femur. Her general condition on admission was very poor. Her initial Norton Score was 10, and dropped during the second week to 9 as her general condition gradually deteriorated during the postoperative period. She was doubly incontinent, drowsy and confused, with poor appetite, and complained of pain at the site of the sacrum as a result of traction. At the end of the second week this patient had developed skin breakdown at the site of sacrum and buttocks. Two days later she died with extensive skin breakdown at the site of sacrum and buttocks.

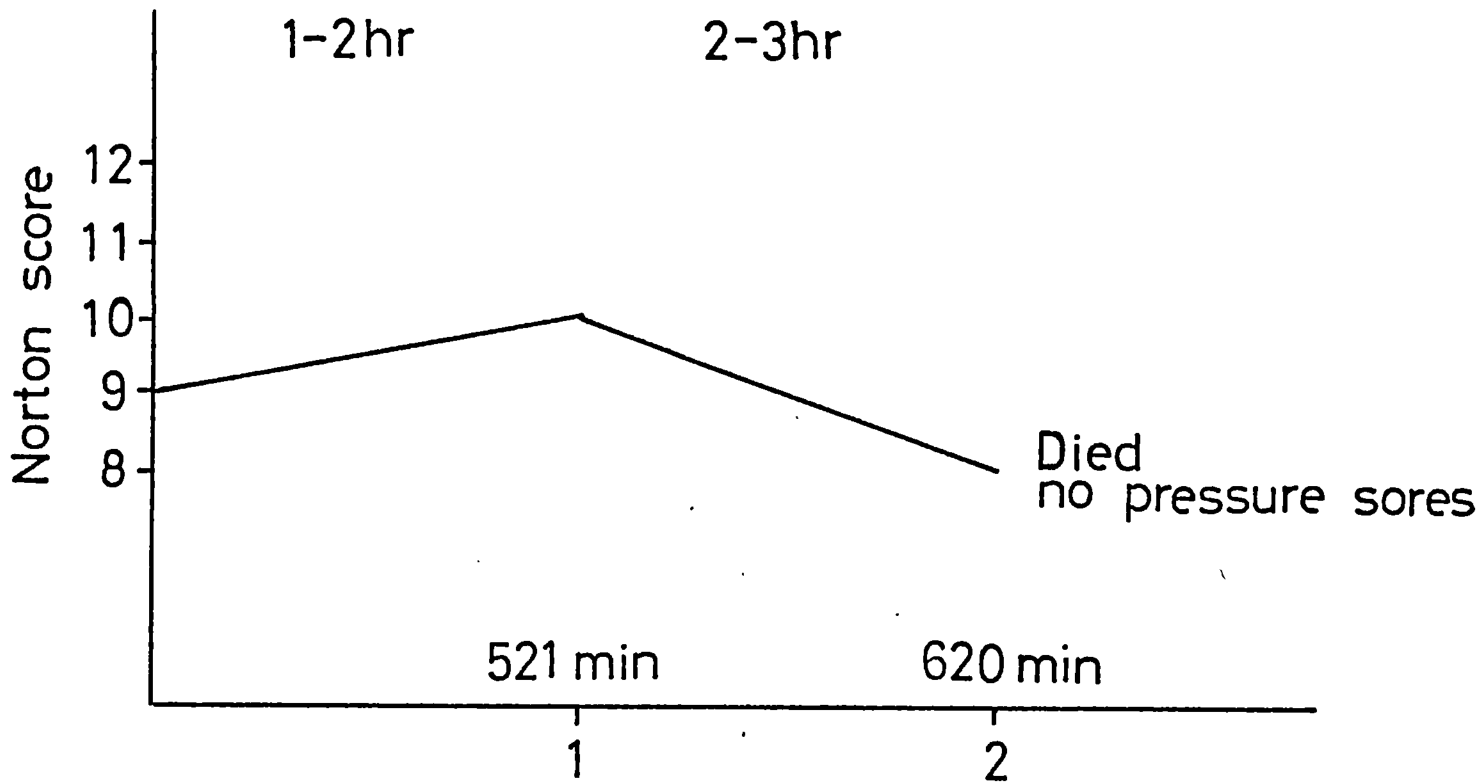


Fig C Total time for P.A.C in min/week

Pressure area care used for Case D

During the first week of the patient's admission to the study, the pressure area care was carried out at an interval of 2.7 hours daily. This interval increased during the second week to 3.8 hours within an interval range between 2-4 hours daily. Care was by turning the patient with assistance and lifting her off the bed and the chair, encouraging her to lift up her buttock using the monkey pole, and other preventive aids such as ripple mattress, sheepskin and pillow were used when the buttock site became red in colour. The average total time spent on pressure area care for this patient was 64.2 min a day, but with the variation in total man-hours, it was given during both day and night hours. The patient developed skin breakdown at the sacrum and died two days later with extensive breakdown (Fig D).

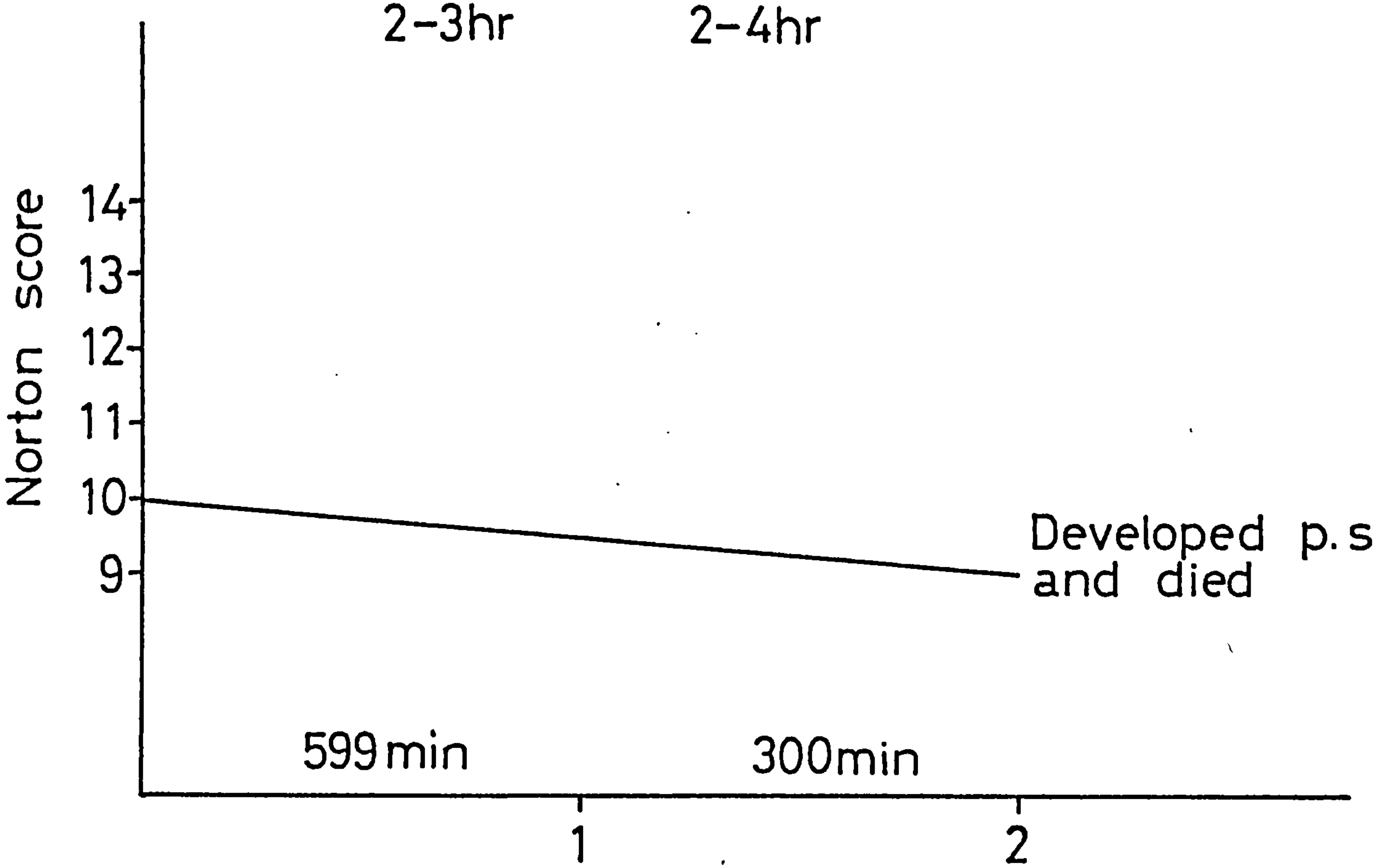


Fig D Total time for P.A.C. in min/week

A correlation analysis was carried out between the independent variables. The highest correlation is:

0.67329 Site of skin area and pressure relieving device

The other next highest correlations are:

0.57671 Length of stay in hospital and physical condition;

0.55081 Length of stay in hospital and mental state;

0.54433 Change in skin area and pressure relieving device;

0.53194 Length of stay in hospital and mobility of patient;

0.51438 Pressure relieving device and condition of skin area;

0.48049 Mean total time for pressure area care and the ward designation;

0.46083 Mean total time and frequency of pressure area care;

0.45200 Length of stay in hospital and patient activity;

0.41328 Length of stay in hospital and final Norton Score;

0.38348 Pressure relieving device and ward designation;

0.38164 Ward designation and category of care given.

The rest of the correlations seem low (Appendix 3). Moreover, the independent variables related to pressure area care methods of prevention used was not significantly related to the dependent variable outcome, $P > 0.05$ (Table 6.56). Further, with regard to the regular nursing observation the independent variable change of skin area is related very significantly to outcome $P = < 0.001$.

Variable	Hospital group Significance level
Age	0.1025
Sex	0.7583
Diagnosis	0.0015 *
Length of stay in study	0.8679
Initial Norton Score	0.0892
Final Norton Score	0.0003 *
Mean total time spent on care	0.0017 *
Method of manual relief of pressure	0.1267
Skin-cleaning solution used	0.4699
Pressure-relieving device used	0.1753
Site of skin attended to	0.8410
Observed condition of skin	0.5537
Change in condition of skin during study	0.0000 *
Appetite at start of study	0.8305
Appetite at the end of the study period	0.0000 *
Category of person giving care	0.6453
Frequency of care given	0.0448 *
Ward designation	0.0008 *
Physical condition	0.2091
Mental state	0.3916
Activity	0.0713
Mobility	0.8442
Incontinence	0.0934

Table 6.56 Results of analysis using Wilks Lamda and F statistic.

* Statistically significant P = Less than 0.05

Table 6.57 Summary of discriminant analysis

1.	Change in the condition of the skin
2.	Site of skin area
3.	Average daily total time on care/24 hr
4.	Pressure-relieving device
5.	Observed conditon of the skin
6.	Physical condition
7.	Mobility
8.	Final Norton Score
9.	Ward designation
10.	Age
11.	Diagnosis
12.	Skin-cleaning solution used
13.	Appetite at the end of the study.

1.	Change in skin area
2.	Pressure-relieving device used
3.	Observed condition of skin
4.	Average daily time on pressure area care
5.	Final Norton Score
6.	Physical condition
7.	Mobility
8.	Age
9.	Site of skin area
10.	Ward designation
11.	Diagnosis
12.	Appetite at the end of the study
13.	Skin-cleaning solution used

Table 6.58 Standardised canonical discriminant function coefficients for independent variables in Hospital Study.

CHAPTER SEVEN

Results and Discussion
of the
Community Sample

7.1 Community sample : results and discussion

This will cover

(A) Pressure sore distribution in relation to

1. Patient age.
2. Patient sex.
3. Patient diagnosis.
4. Length of patient stay in study, time of developing pressure sore.
5. Norton Score.
6. Appetite.

(B) Nursing intervention

1. Time spent on pressure area care in relation to the outcome of the study.
2. Time spent in relation to age, sex, Norton Score, diagnosis, length of stay in the study.
3. Frequency of pressure area care.

(C) Status of patient, (living alone/with relatives/ friends).

For the purpose of this study, patients who received no nursing care at all from relatives or friends were defined as living alone.

(D) Methods used for prevention of pressure sores.

(E) Case Study.

A) Pressure sore distribution

7.2 Patients distribution

A total of 30 patients fulfilled the criteria of the study. The average age of these 30 patients was 67.26 years, (Table 7.1). The youngest patient among the group of community patients was a male aged 36 years and the oldest patient was a female aged 94 years. 19 of the patients were aged 70 years and above. The remaining 11 patients were aged less than 70 years, (Table 7.3).

7.2.1 Age and outcome of pressure area care

Distribution of the patients in relation to the outcome of pressure area care shows a total of 6 (20%) out of all the 30 patients developed sores, whilst the remaining 24 (80%) did not develop. (Table 7.4). Close inspection of the diary sheets shows that 5 out of 6 patients who did develop pressure sores were aged 70 years and above (Table 7.3). However, other patient who developed sores were less than 70 years of age. The average age of the patients who developed sores was 75.33 (Table 7.2). On the other hand, 14(58.33%) of the patients who did not develop pressure sores were aged 70 years and above and 10 (41.66%) were aged less than 70 years. The average age for this group of patients, however, was 63.66 years, i.e. lower than the average of the age group who did develop pressure sores (Table 7.2). This might confirm the finding of earlier research, that the incidence of pressure sores was more likely in elderly patients (Norton et al., 1962, 1975; Petersen and Bittman, 1971; Jordan et al., 1977; Ek and Boman, 1982.

Patients' sex	Average age	S.D.
All patients	67.26	
Males	63.6	16.79
Females	69.1	18.55

Table 7.1 Age of patients in relation to gender.

Outcome of pressure area care	Average Age	S.D.
Group who did develop pressure sores	75.33	9.24
Group who did not develop sores	63.66	24.

Table 7.2 Average age of community patients in relation to the outcome of pressure area care.

Table 7.3 Age of patients in relation to the outcome of pressure area care.

Age group	70 years and above			Below 70 years of age			Total number
	Developed sores	Did not develop	No.	Developed sores	Did not develop	No.	
0 - 39					3	3	3
40 - 49					4	4	4
50 - 59				1		1	1
60 - 69					3	3	3
70 - 79	3	8	11				11
80 - 89	2	3	5				5
90 +		3	3				3
Total	5	14	19	1	10	11	30

No. = Number of patients

Table 7.4 Distribution of patients in relation to the outcome of pressure area care: Community Study.

Outcome of pressure area care	Total number	Total %
Group developing pressure sores	6	20.0
Group not developing pressure sores	24	80.00
Total	30	100

Outcome of pressure area care	Male	Female	Total number	Total %
Group developing pressure sores	2	4	6	20.0
Group not developing pressure sores	8	16	24	80.0
Total	10	20	30	100

Table 7.5 Outcome of pressure area care in relation to gender of community patients.

7.2.2 Gender distribution of patients studied in community

Amongst the community patients admitted to the study there were 20 (66.66%) female and 10 (33.33%) male patients (Table 7.5). Four out of the 20 female patients and 2 out of the 10 male patients developed pressure sores. This might indicate that the female pressure sore sufferers were more in numbers than the male patients and this was in agreement with: Norton *et al.*, 1962, 1975; Barbenel *et al.*, 1977; Versluysen, 1983; Nyquist and Hawthorn, 1985).

The average age of patients in relation to gender shows the females' average (69.1) to be higher than that of the male patients (63.6) years (Table 7.1). Bearing in mind that females have a longer life than males (i.e. female patients live longer than male patients), more female patients seem likely to develop pressure sores than male patients (Table 7.5). The youngest patient who did develop pressure sores was a female aged 59 years, whilst the oldest was a female aged 87 years.

7.2.3 Diagnosis of all admissions to the study

Eight out of 30 patients admitted to the study were diagnosed as "chest infection patients". 6 were diagnosed as "multiple sclerosis", 5 were diagnosed as "cancer", 3 were diagnosed as "stroke", 3 were diagnosed as "cerebro-vascular accident", 3 were diagnosed as "senile dementia" and the remaining, 2 were 1 "fractured neck of femur" and 1 "spinal cord injury" (Table 7.6).

Patient diagnosis	70 years of age and above		Below 70 years of age		Total number
	Male	Female	Male	Female	
Stroke		3			3
Chest infection	4	3	1		8
Fractured neck of femur		1			1
Multiple sclerosis			2	4	6
Spinal cord injury				1	1
Cancer	2	3			5
Cerebro-vascular accident			1	2	3
Senile dementia		3			3
Total	6	13	4	7	30

Table 7.6 Diagnosis of the community patients in relation to age and gender.

7.2.3.1 Diagnosis in relation to age and sex

Patients who were suffering from chest infection were 5 males and 3 females, all above 70 years of age, except for one male. The patients diagnosed with stroke were 3 females aged above 70 years. Two males diagnosed as cancer of the stomach, and prostate and the rest of the three female patients, diagnosed as cervical cancer and stomach cancer were all above 70 years of age. The patient with spinal cord injury was a female aged 38 years, while the fractured neck case was also a female but aged above 70 years. Patients diagnosed as CVA were two females aged below 70 years of age and one male aged 36 years. Patients diagnosed as senile dementia were mostly females aged 90 and above (Table 7.6).

7.2.3.2 Diagnosis in relation to the outcome of pressure area care

3 (50%) of the patients who developed pressure sores were diagnosed as "chest infection", 2 (33.33%) had "cancer" and the remaining patient (16.66%) had "multiple sclerosis". The fact that 50% of patients who did develop pressure sores had chest infections might be attributable to their poor general condition, most of them being immobile, restless with poor appetite and incontinent. On the other hand, the patients who did not develop pressure sores included 3 with stroke, and 5 with chest infection, 1 with fractured neck of femur, 5 with multiple sclerosis, 1 with spinal cord injury, 3 with cancer, 3 diagnosed as "CVA", and the remaining 3 were cases of senile dementia (Table 7.7). The group of patients who did not develop pressure sores were in a better general condition and with a higher Norton Score and mostly lived with relatives throughout the period of the study.

7.2.4 Length of stay in care in relation to age and sex of the group who developed pressure sores and the group who did not develop sores.

Of the group of 4 female patients who did develop pressure sores, 3 were aged 70 years or above, and one was below 70. The development of the sore was within a period of 3-13 days. However, the two males of this group were above 70 years of age and developed pressure sores in the third week of their admission to the study (Tables 7.8, 7.9).

Patient diagnosis	Outcome of pressure area care			
	Patients developing pressure sores		Patients not developing pressure sores	
	Number	%	Number	%
Stroke			3	12.5
Chest infection	3	50	5	20.83
Fracture of neck of femur			1	4.16
Multiple sclerosis	1	16.66	5	20.83
Spinal cord injury			1	4.16
Cancer	2	33.33	3	12.5
Cerebro-vascular accident			3	12.5
Senile dementia			3	12.5
Total	6	100	24	100

Table 7.7 Patients' diagnoses in relation to outcome of pressure area care.

Table 7.8 Time of developing sores and sex of the patients.

Sex	Less than 7 days	7-13 days	14-20 days	21-27 days	28-34 days	35-42 days	42+ days	Total number	Total percentage
Male			2					2	33.33
Female	2	2						4	66.66
Total	2	2	2					6	100

Age of the patients	Less than 7 days	7-13 days	14-20 days	21-27 days	28-34 days	35-42 days	42+ days	Total number	Total percentage
70 or more than 70 years of age	1	2	2					5	83.33
Below 70 years of age	1							1	16.66
Total	2	2	2					6	100

Table 7.9 Time of developing sores in relation to age of the patients.

The average length of time for developing skin breakdown for this group of the patients was 9 days, which seems crucial for skin breakdown formation. On the other hand, the average length of stay in the study for the group who did not develop pressure sores was 34.04 days (Table 7.10). It must be noted that throughout the period of the study a total of 6 out of 30 patients died, three of them were females and three were male. Two patients (one male and one female) died a few days after skin breakdown appeared and when the general condition of the patients had deteriorated.

7.2.4.1 Length of time community patients stayed in the study

The mean length of stay in care for the community patients was 28 days, a range of (3-44 days). A higher number of 14 patients stayed for a range of 35-42 days. 6 patients stayed for a range of 14-20 days. 3 stayed for a range of 7-13 days. Meanwhile, 3 patients stayed for less than 7 days and another 2 for more than 42 days (Table 7.11). Of the remaining 2 patients, 1 stayed for a period within the range of 21-27 days and the other for within 28-34 days).

7.2.4.2 Length of time for patients who developed pressure sores

One striking feature was that 2 patients developed sores within 7 days of admission to the study and a further 2 developed sores from 7-13 days after admission. This

	Mean	S.D.
Time of developing pressure sores	9 days	5.09
Length of stay in the study for the group who did not develop pressure sores	34.04 days	12.23

Table 7.10 Mean length of time for developing pressure sores and the mean length of stay in the study for group who did not develop pressure sores.

Number of days	Time of patients developing pressure sores	Group not developing: length of stay in the study	Total number
Less than 7 days	2	1	3
7 - 13	2	1	3
14 - 20	2	4	6
21 - 27		1	1
28 - 34		1	1
35 - 42		14	14
42+		2	2
Total	6	24	30

Table 7.11 Length of time for community patients stay in the study and the time of developing pressure sores.

was in agreement with: Norton et al., 1962, 1975; Warner, 1982; Versluysen, 1983. The first two weeks that the patient was in care was a crucial time for pressure sores development. The remaining 2 patients who developed sores showed skin breakdown within a range of 14-20 days of the study period (Table 7.11).

Patient Appetite	Group developing pressure sores		Group not developing pressure sores	Total number	Total %
On admission to the study	Good	1	17	18	60.0
	Fair	0	1	1	3.3
	Poor	5	6	11	36.6
Total		6	24	30	100
At the end of the study	Good	0	19	19	63.3
	Fair	0	0		
	Poor	6	5	11	36.6
Total		6	24	30	100

Table 7.21 Appetite on admissions to the study and at the end of study period in relation to the outcome of pressure area care.

Patient appetite	70 years of age and above		Less than 70 years of age		Total number	Total %
	Male	Female	Male	Female		
Good	3	7	3	6	19	63.3
Fair	0	0	0	0	0	0
Poor	3	6	1	1	11	36.66
Total	6	13	4	7	30	100

Table 7.22 Appetite at the end of the study in relation to age and sex of the patients.

It is widely recognised that nutrient deprivation in community patients can lead to a variety of clinical or subclinical behavioural symptoms. One of the causes of nutrient deficiency symptoms has been identified as loss of appetite. This might be attributed to many predisposing factors such as alcoholism, loneliness, ignorance, low income and drugs, as it is widely recognised that elderly patients are the largest consumers of drugs in this country. In addition, there are factors such as isolation and habit, and some patients may have special metabolic demands for certain nutrients which may not easily be met. Although research on the relationship between nutrition and developing pressure sores in elderly patients is scanty, it is nonetheless suggestive.

Further, in relation to body type, thin patients with poor appetite developed pressure sores (Table 7.23). However, most of the thin patients who did not develop pressure sores were in good appetite (Table 7.24), ($P = < 0.015$) (Table 7.25), (Fisher exact probability). Five out of six patients who developed pressure sores were thin with poor appetite when skin breakdown appeared. However, one obese patient with poor appetite at the end of the study was in the group who did develop pressure sores (Table 7.26).

Body type	Appetite at the end of the study		Number of patients
	Good	Poor	
Thin		5	5
Normal		0	0
Obese		1	1
Total		6	6

Table 7.23 Body type and appetite at the end of the study group who did develop pressure sores.

Body type	Appetite at the end of the study		Total number
	Good	Poor	
Thin	9	4	13
Normal	5	0	5
Obese	5	1	6
Total	19	5	24

Table 7.24 Body type and appetite at the end of the study for the group of patients who did not develop pressure sores.

Outcome of pressure area care	Appetite at the end of the study Good	Poor	Total number
Group who developed pressure sores	0	5	5
Group who did not develop pressure sores	9	4	13
Total	9	9	18

Table 7.25 Appetite at the end of the study in relation to the outcome of pressure area care for thin patients.

$P = < 0.015$ (Fisher exact probability)

Outcome of pressure area care	Appetite at the end of the study Good	Poor	Total number
Group who developed pressure sores	0	1	1
Group who did not develop pressure sores	5	1	6
Total	6	2	7

Table 7.26 Appetite at the end of the study of obese patients in relation to the outcome of the study.

Not significant $= P > 0.05$

B. Nursing intervention

7.3 Time in minutes/24 hours spent on pressure area care in relation to the outcome of pressure area care

The community sample of patients received an average of 58.7 minutes/patient/24 hours. The group of patients who developed sores had received a higher average of time spent in pressure area care (70.2 minutes/patient/24 hours) than the group who did not develop pressure sores (55.8 minutes/ patient/24 hours) (Table 7.27). However, this difference was not statistically significant (Table 7.19). In relation to the sex groups, the 10 male patients in the study received an average of 49.6 min/patient/daily. This is a lower figure than the 63.25 min/patient/daily average total time in minutes/24 hours spent on the 20 females (Table 7.29). In relation to the outcome, the 2 male patients with sores received less average time than the group of females who developed sores.

On the other hand, for the group who did not develop pressure sores, the 8 male patients received less average time than the 16 female patients of the same group (Table 7.29).

Outcome of pressure area care	Number of patients	Average time spent for pressure area care	S.D.
Group developing pressure sores	6	70.2	24.19
Group not developing pressure sores	24	55.8	26.85

Table 7.27 Average total time in minutes/24 hours for pressure area care in relation to the outcome.

Outcome of pressure area care	Average total time on care	S.D.	Average initial Norton Score	S.D.
Group who did develop pressure sores	70.2	24.19	10.5	2.29
Group who did not develop sores	55.8	26.85	13.25	1.96

Table 7.28 Average total time in minutes/24 hours spent for pressure area care in relation to initial Norton Score of the community sample.

Outcome of pressure area care	Male		Female	
	Total No.	Average time in min.	Total No.	Average time in min.
Group who did develop pressure sores	2	47	4	81.75
Group who did not develop pressure sores	8	50.25	16	58.62
Total	10	49.6	20	63.25

Table 7.29 Time in minutes/24 hours spent on pressure area care and the sex of community patients in relation to outcome of the study.

7.3.1 Pressure area care time in minutes/24 hours spent in relation to the Norton Score

The group of patients who did develop pressure sores and had lower than average initial Norton Scores received more nurses' and relatives' man-hours of pressure area care than the group who did not develop sores with a higher initial Norton Score. Three females and one male patient of the group who did develop pressure sores were within the score range below 12; the remaining one female and one male of this group had Norton Scores of 13 and 14 respectively. Therefore, the lower the Norton Score, the more the patient was at risk of developing pressure sores (Norton, et al., 1962, 1975), and the more time was spent on pressure area care. In the same way, the better the patient's general condition, the higher the Norton Score and the higher the number of patients found with self-care and independence, the less time nurses spent on pressure area care (Table 7.28).

7.3.2 Pressure area care time spent and patient diagnosis

Concerning the patients' diagnoses 2 out of 3 patients diagnosed as chest infection who developed sores received less than 60 minutes of pressure area care time/daily on average and the remaining one received more than 80 min/day. Two of the patients who had cancer and had received pressure area care time of less than sixty minutes daily did develop pressure sores. Meanwhile, one patient with multiple sclerosis who lived with her husband and who relied entirely upon nursing services did develop pressure sores (Tables 7.30, 7.31), although the average total time devoted on pressure area care was over 81 minutes/daily.

7.3.3 Pressure area care time in minutes/24 hours spent in relation to the time of developing pressure sores and the length of stay in the study

Pressure sores were more likely to appear during the first two weeks of the patient's being at home. Table 7.32 shows that the average time spent on pressure area care for the group of patients who did develop pressure sores seems high during the first week of admission to the community. It is also higher than the average time spent on the group who did not develop pressure sores, bearing in mind that no patients in this group showed skin breakdown during a period of more than 20 days. This might suggest that the group who did develop pressure sores needed more time and attention, as five out of these 6 lived alone and depended on community nurses' help with regard to the prevention of pressure sores.

On the other hand, the patients of the group who did not develop pressure sores were more independent, in addition to receiving the help of their relatives' and community nurses' services. Thus, they stayed in the study for a longer period than the group who did develop pressure sores.

Diagnosis	Time spent on pressure area care in min/24 hr						Total number	Total %
	<20	20-40	41-60	61-80	81-100	101+		
Stroke		1			1	1	3	10
Chest infection	1	3	3		1		8	26
Fractured neck of femur				1			1	3
Multiple sclerosis		2	2		1	1	6	0
Spinal cord injury					1		1	3
Cancer	1	1	2	1			5	16
Cerebro-vascular accident		2	1				3	10
Senile dementia		2		1			3	10
Total	2	11	8	3	4	2	30	100

Table 7.30 Range of total time in min/24 hours of pressure area care in relation to patient diagnosis.

7.2.5 Norton Score in relation to age and sex of community patients

Inspection of the diary sheets shows that the average initial Norton Score for all patients admitted to the study was 12.76, whilst the final Norton Score for all patients who entered the study was 13.6. In relation to patient age (Table 7.12), eight of the patients aged 70 years and above showed Norton Scores below 12, and 7 out of 19 patients in the same age group were within a Norton Score range of 12-14. The remaining 4 patients initial Norton Score within a range of 15-17. On the other hand, one patient aged below 70 years was within a Norton Score range below 12. 8 of the patients within this same younger group were within a Norton Score range of 12-14, whilst 2 were within the range of 15-17. During this study and from personal observation, no patients were noted within a Norton Score range of 18-20, (Table 7.12). This might confirm the findings of Norton _et al_. (1962, 1975) that elderly patients were more likely to have low Norton Scores. Thus, we can say that community nursing service was needed less by patients with high Norton Scores.

Further, in relation to patients' sex it can be seen that both males and females were at risk of developing pressure sores, because both groups had an average initial Norton Score below 14. The average initial Norton Score for the male patients was 13.6. This was higher than the initial average score of 12.2 for the female patients. Moreover, male patients had an average final Norton Score of 14.1 (Table 7.13), which again was higher than the 13.35 final Norton Score for the female patients. Norton _et al_.

Range of initial Norton Score	Patients 70 years of age and above	Patients below 70 years of age	Total No.
Less than 12	8	1	9
12 - 14	7	8	15
15 - 17	4	2	6
18 - 20			
Total	19	11	30

Table 7.12 Range of initial Norton Score and patient age.

Average Norton Score	Male	S.D.	Female	S.D.
Initial Norton Score	13.6	2.11	12.2	4.96
Final Norton Score	14.1	3.95	13.35	3.29

Table 7.13 Average initial and final Norton Score in relation to sex of the patients.

(1962, 1975) suggested that female patients were more likely to develop skin breakdown than male patients.

7.2.5.1 Norton Score and development of pressure sores

Examination of the diary sheets has shown expected results, as there is a lower average initial Norton Score amongst patients who subsequently developed sores than for those whose skin remained intact throughout the study. In addition, the average final Norton Score for the group of patients who did develop pressure sores is lower than the initial score for this group. Conversely, the group of patients who did not develop pressure sores have a higher Norton Score on average at the end of the study period than at the beginning (Tables 7.14, 7.15).

Thus, there is a big difference between the average final Norton Scores for the two patient groups categorised by outcome than existed at the start of the study (Tables 7.14, 7.15). Moreover, the initial Norton Score seems to be a significant variable among the independent variables. Besides, (Table 7.19) the final Norton Score seems statistically significant in relation to the outcome as it was associated with skin breakdown appearance. Within the group of patients who developed sores the male patients have a higher average of Norton Score than female patients both initially and finally. This might explain the reason for the higher number i.e. 4 of the female patients who developed pressure sores in comparison with 2 of the male patients who developed pressure sores.

Outcome of pressure area care	Average initial Norton Score	S.D.
Group developing sores	10.5	2.29
Group not developing sores	13.25	1.96

Table 7.14 Average initial Norton Score in relation to the outcome of pressure area care.

Outcome of pressure area care	Average final Norton Score	S.D.
Group developing sores	9.3	2.84
Group not developing sores	14.66	2.69

Table 7.15 Average final Norton Score in relation to the outcome of pressure area care.

Furthermore, within the group of patients who did not develop pressure sores, the male patients had a higher average and final Norton Score than the female patients, while both males and females showed an increase in the final Norton Score at the end of the study (Table 7.16).

7.2.5.2 Norton Score and time of developing sores

There is a good correlation between the initial Norton Score and the time of developing sores. The lower the Norton Score, the more rapid the pressure sores formation (i.e. pressure sores appeared in fewer days when the initial Norton Score was low), (Table 7.17).

7.2.5.3 Components of the Norton Score in relation to the outcome of pressure area care

For assessing community patients it seems interesting to study the detailed components of the Norton Score (Goldstone and Goldstone, 1982).

Inspection of the different means among Norton Score components for the group who developed pressure sores and the group who did not (Table 7.18) shows that the average Norton Score of all component variables was higher on average within the group who did not develop sores. However, the variables physical score, and incontinence seems significantly associated with the outcome of the pressure area care, (Table 7.19). The rest of Norton Score components appear not to be significant. Further, most of the community patients who did develop pressure sores were females with poor physical condition, confused, chairfast, and mostly immobile and incontinent (Table 7.20).

Outcome of pressure area care	Sex	Average initial Norton Score	S.D.	Average final Norton Score	S.D.
Group developing pressure sores	M	12	2.82	9.5	3.5
	F	9.75	2.36	9.25	2.06
Group who did not develop pressure sores	M	14	12.57	15.25	2.86
	F	12	5.06	14.37	2.73

Table 7.16 Average initial and final Norton Score in relation to sex and outcome of pressure area care.

Outcome of pressure area care	Average initial Norton Score	S.D.	Average time of developing pressure sores	S.D.
Group who did develop pressure sores	10.5	2.50	9 days	5.09
			Length of stay in the study	
Group who did not develop pressure sores	13.25	6.13	34.04	12.23

Table 7.17 Initial Norton Score in relation to time of developing pressure sores and the length of stay in study of the group who did not develop pressure sores.

Norton Score Components	Group developing P.S.		Group who did not develop P.S.	
	Average Score	S.D.	Average Score	S.D.
Physical	2	0.000	2.4766	0.51177
Mental	2.33	0.816	2.9523	1.0235
Activity	1.66	0.816	1.8571	0.727
Mobility	1.66	0.816	1.9523	0.80475
Incontinence	2.833	1.329	3.8095	0.51177

Table 7.18 Norton Score components in relation to the outcome of the pressure area care, Community sample.

*
P.S. = Pressure sores

S.D. = Standard deviation

Variables	Level of significance
Age	0.5012
Sex	0.8300
Diagnosis	0.6011
Length of stay in the study	0.0001 *
Initial Norton Score	0.0266 *
Final Norton Score	0.0010 *
Mean total time spent on care	0.8508
Method of manual relief of pressure	0.0718
Skin-cleaning solution used	0.2462
Pressure-relieving device used	0.8360
Site of skin area attended to	0.2053
Condition of skin area	0.6028
Change of skin area during study	0.0001 *
Appetite at start of study	0.0922
Appetite at the end of the study	0.0001 *
Category of care given	0.2750
Frequency of pressure area care given	0.0003 *
Status of living	0.0674
Physical state	0.0337 *
Mental state	0.1870
Activity	0.5860
Mobility	0.4516
Incontinence	0.0095 *

Table 7.19 Results of analysis using Wilks LAMDA and F statistic (community sample).

* Statistically significant P = Less than 0.05

Component of initial Norton Score		Group developing pressure sores F	M	Total No.	Group who did not develop pressure sores F	M	Total No.	Total number of patients
Physical								
Very bad	1	0	0	0	0	0		
Poor	2	4	2	6	8	3	11	17
Fair	3	0	0	0	8	4	12	12
Good	4					1	1	1
Mental								
Stupor	1							
Confused	2	4	1	5	9	2	11	16
Apathetic	3		1	1				1
Alert	4				7	6	13	13
Activity								
Bedfast	1	1	1	2	4	3	7	9
Chairfast	2	3	1	4	9	3	12	16
Walks/help	3				3	2	5	5
Ambulant	4							
Mobility								
Immobile	1	3	0	3	7	2	9	12
V. limited	2	1	1	2	5	4	9	11
S/limited	3		1	1	4	2	6	7
Full	4							
Incontinence								
Doubly	1	1	0	1	0	0		1
Usually urine	2	1	1	2	1		1	3
Occasionally	3	1	0	1	2		2	3
None	4	1	1	2	13	8	21	23

Table 7.20 Components of Norton Score in relation to the outcome of pressure area care.

7.2.6 Appetite in relation to the outcome of pressure area care

There was an obvious variation in patients' appetite regarding the outcome of pressure area care. Five patients out of six who did develop pressure sores had poor appetite on admission to the study. On the other hand, only 6 out of 24 of the group of patients who did not develop pressure sores had poor appetite on admission (Table 7.21). However, appetite on admission was not significantly associated with the outcome (Table 7.19). Besides, it did not emerge from summary discriminate variables as an important variable, (Table 7.43). Meanwhile, with regard to the outcome of the study the variable appetite at the end of the study seems significant ($P < 0.05$), indicating a general worsening of the condition of these patients who did develop pressure sores (Table 7.19 and Appendix 4). Further, all of the six patients who did develop pressure sores had poor appetite at the end of the study period, three of them being females aged 70 years and above (Table 7.22). Thus, the aging factor might be considered as a factor reducing patients' appetite.

On the other hand, within the group of patients who did not develop pressure sores 19 out of 24 had a good appetite. 5 out of these 24 patients had a poor appetite at the end of the study. In other words, a higher percentage (63.3%) of patients who did not develop pressure sores had a good appetite at the end of the period of study (Table 7.21).

Patient diagnosis	Time spent on pressure area care in min/24 hr						Total number
	<20	20-40	41-60	61-80	81-100	101+	
Chest infection		1	1		1		3
Cancer		1	1				2
Multiple sclerosis					1		1
Total		2	2		2		6

Table 7.31 Diagnosis in relation to the time in minutes/24 hours spent on pressure area care for the group who did develop pressure sores.

The length of patient's stay in study	Group developing pressure sores		Group who did not develop sores		
	No.	Average time spent before developing pressure sores (in min)	No.	Average time spent on PAC (in min)	Total number
Less than 7 days	2	97.5	1	19	3
7 - 13	2	66	1	18	3
14 - 20	2	47	3	65	5
21 - 27			1	57	1
28 - 34			1	35	1
35 - 42			15	55.93	15
42+			2	88.5	2
Total	6		24		30

Table 7.32 The time in minutes/24 hours spent on pressure area care and the outcome in relation to the time of developing pressure sores and the length of stay in the study.

7.3.4 Frequency of *PAC for community sample

The frequency with which pressure area care was given was able to be identified from the data collected. This was calculated as the interval between care applications. The average interval between applications for the first two weeks and for the whole period of the study were entered separately into the computer in order to see the difference in average interval of pressure area care, between the two.

Among the community sample there was a very high level of significance (P = 0.0003) (Table 7.19) between frequency of care for those patients who did develop sores and those who did not. This variable, interestingly, seems a highly powerful predictor of the development of pressure sores (Table 7.44). The community data have been examined for these 30 patients, and the mean interval between care applications for the first two weeks emerges as 8.5 hours. For those patients who did develop sores it was 13.3 hours. However, for patients who did not develop sores the interval between pressure area care was 7.3 hours.

For comparison, it is worth mentioning the total interval between pressure area care throughout the whole period of the study. Interestingly, there was not a big difference in mean interval, as 8.8 hours was the mean interval for the total community sample. A difference also emerges between the group who did develop pressure sores, with an interval of 13.53 hours, and the group who did not, for which it seems that 7.7 hours was the interval between care. However, the researcher focused on the first two weeks of the study period to check the intervals between pressure area care applications and to test the validity of the community nurses' complaint that a high number of patients had come from the hospital with either red skin or existing sores. Also, personal observation showed that no educational pressure sores programme had been given to the relatives to alert them to the pressure sites, in particular at the time of the patients' discharge from the hospital. In addition, most of the nurses were not aware of the condition of skin areas. Some of them ignored the redness of pressure sites and had not been given a full detailed record from the hospital nurses. In particular, this applied to those patients who lived alone and who were discharged with red skin at the pressure sites and at risk of pressure sore development.

These findings seem clear when we examine the diary sheets and see the patients' status of living. In fact, there is a significant difference - ($P = < 0.05$) using Fisher's exact probability - between the intervals care of those who received care from both relatives and nursing services, and those patients who had to rely entirely upon the nursing service (Tables 7.33, 7.34, 7.35). The latter patients received a low frequency of pressure area care, although not all of them lived alone. Some lived with relatives who were themselves ill, not available during day hours, handicapped, or very old, and these were thus unable to help.

In relation to the site of skin area affected in the patients who did develop superficial skin breakdown, 2 patients developed sores at the heel, and 1 at the elbow. The remaining 3 developed sores at sacrum and buttocks

Outcome of pressure area care	Interval of care (in hours) <5	5-10	10.1-15	≥15	Total number	Total %
Patients in group developing pressure sores	1	1	1	3	6	20
Patients in group not developing pressure sores	7	13	4	0	24	80
Total	8	14	5	3	30	100

Table 7.33 The interval between pressure area care in relation to the outcome.

Category of care given	Interval of care (in hours) <5	5-10	10.1-15	>15	Total number	Total %
Group receiving care from nurses alone	1	6	3	3	13	43.33
Group receiving care from relatives and nurses	7	8	2		17	56.66

Table 7.34 Average interval between pressure area care in hours in relation to category of care given: Community sample.

Category of care given	Interval of care (in hours) <10	>10	Total number
Group receiving care from nurses alone	7	6	13
Group receiving care from relatives and nurses	15	2	17
Total	22	8	30

Table 7.35 Data from above Table as a two x two table P 0.05 (Fisher's exact probability).

(Table, 7.36). It must be borne in mind that 2 of them were bedfast and the other four were chairfast patients. In relation to the interval between pressure area care and the condition of the skin area, 2 out of 30 patients showed red skin. 1 of these 2 received care within the range interval of 5-10 hours, whilst the other received care with an interval above 10 hours. This emphasises the importance of shorter intervals between care applications where skin redness is present. However, 22 patients remained with good and intact skin throughout the period of the study, 7 receiving care with an interval of less than 5 hours, another 12 with an interval of more than 5 hours, and the other 3 with an interval of 10.1-15 hours. However 3 out of 6 patients who received care with an interval of more than 15 hours a day showed superficial skin breakdown (Table 7.37). Only one who showed a worse skin condition than on admission received care within a range interval of less than five hours daily. This suggests that the longer the interval between pressure area care, the worse the condition of the skin, in particular patients at risk of developing pressure sores (Table 7.37, 7.38).

Site of skin area	Group of patients developing P.S.	Group of patients not develop.	Total numbers
Sacrum	0	2	2
Heels	2	0	2
Elbows	1	1	2
All the sites	0	19	19
Sacrum and buttocks	3	1	4
Heels and elbows	0	1	1
Total	6	24	30

Table 7.36 The site of skin area in relation to the outcome of pressure area care.

Condition of skin	Intervals of PAC (in hours) < 5	5-10	10.1-15	> 15	Total number
Red skin		1	1		2
Superficial skin breakdown	1	1	1	3	6
Good and intact	7	12	3		22
Total	8	14	5	3	30

Table 7.37 Condition of skin area in relation to the range interval of pressure area care given to the patients.

Change in skin area	Intervals of PAC (in hours) < 5	5-10	10.1-15	> 15	Total number
Static	6	13	5	1	25
Improved	1				1
Worse	1	1		2	4
Total	8	14	5	3	30

Table 7.38 Change in condition of patient skin in relation to the frequency of pressure area care.

C. Status of patients' support in living accommodation

The higher percentage of the community sample were living with their relatives. Tunstall (1966), defined patient living alone as "a person who lives in the same house as others but does not share house-keeping and at least one main meal". However, for the purpose of this study and as mentioned earlier, a patient living alone is defined as a patient who received no nursing care at all from relatives or friends. The persons living alone were either single, widowed, married, or divorced. Therefore, it is important to discriminate between loneliness and aloneness; aloneness is often enjoyed by the elderly for periods of time, many of them preferring to live alone, especially if they can see their children and relatives regularly. On the other hand, loneliness means isolation even in company. It seems that many of the elderly who complain of loneliness are found in residential care or in day hospitals, where they are in no way alone. But not all people who live alone are socially isolated. Many single people are more likely than other old people to live alone and to be socially isolated but not lonely. Therefore, according to the definition of aloneness, 6 (20%) out of all the patients in this study lived alone (Table 7.39).

Examination of the diary sheets shows that 13 out of the 30 patients were receiving care from nurses - alone, and the other 17 patients received care from both relatives and nurses (Tables 7.40, 7.41). It must be borne in mind that 5 out of 6 patients who did develop pressure sores had to rely entirely upon the community nursing services for care. The other patient who did develop pressure sores

Table 7.39 Patients distribution according to the status of living.

Status of living	Total number	%
Patient living alone	6	20
Patient living with relative(s)	24	80
Total	30	100

Outcome	Receiving care from nurses alone	Receiving care from relatives and nurses	Total number	Total %
Group who developed pressure sores	5	1	6	20
Group who did not develop pressure sores	8	16	24	80
Total	13	17	30	100

Table 7.40 Category of care given in relation to outcome of pressure area care (community sample).

lived with her husband (Table 7.40). On the other hand, from the group of patients who did not develop pressure sores 8 out of 24 patients also received care from the nursing services alone, while 16 patients of the same group relied upon both the community nursing services and their relatives for pressure area care. However, some of the patients lived with relatives who were themselves handicapped or very old, or not available during day hours and thus unable to help. Within the community group itself, the results in relation to the time and category of care-giving was expected. It seems that a higher average of nursing time was devoted to pressure area care for the group of patients who did develop pressure sores, than the group who did not, in terms of care from both nurses and relatives. However, the community patients received more time for prevention of pressure sores when both relatives and nurses shared the care (Table 7.41) than when care was given by nurses alone.

Outcome of pressure area care	Average time received from community nurses only			Average time received from both nurses and relatives		
	No	Average	S.D.	No	Average	S.D.
Group who developed pressure sores	5	54.2	34.18	1	95	0
Group who did not develop pressure sores	8	33.9	14.52	16	66.81	29.55
Total	13			17		

Table 7.41 Time in minutes/24 hours spent on pressure area care and the category of care given in relation to the outcome of pressure area care.

(D) For prevention of pressure sores

In the district nursing service there are both qualified nurses and nursing auxiliaries whose work they supervise. The quxiliaries are sometimes called 'home nurses' and they visit the patients at home and offer both practical and psychological help. No doubt in this study the preventive measures used for pressure sores relied on many factors. The most obvious one was the patient's general condition and his Norton Score, but a second factor seems to be the nurse's knowledge and experience in selecting and using the aids. The majority of the community nurses did not assess the patients according to the Norton Score. Further, according to Norton et al. (1962, 1975) nurses can not discriminate between those patients who are most at risk and those who are not, without a scoring system for risk calculation. Most of the nurses' knowledge of assessment method comes from their colleagues, which seems likely to lead to care given according to traditional methods. Whatever the case, very rarely did the community nurses' sheets record the first sign of erythema or redness over the pressure sites.

Preventive community measures for pressure sores were numerous. But, in spite of using these methods, 6 out of 30 patients developed pressure sores. The preventive measures used were mainly: turning the patient's position, skin cleaning, and use of a relieving device. For manual turning of position, 3 of the group of patients who did develop pressure sores were turned by assistance and 3 were turned and lifted free of bed or chair by the community nursing services (Table 7.42). In fact, the community

Outcome of pressure area care	Changing-position				Skin cleaning solution used				Pressure-relieving device						
	Turning by assistance	Self-turning	Self-lift free	Turning and lift free	Soap and water	Soapy water	Soap and spirit	Soap and soapy water	Sheepskin	Water bed	Monkey pole	Flotation cushion	Other	Sheepskin and water bed	Sheepskin and ripple mattress
Group developing pressure sores	3			3	4	1	1		4	1			1		
Group not developing sores	2	1	3	18	10	9	0	5	18		1	1		3	1
Total	5	1	3	21	14	10	1	5	22	1	1	1	1	3	1

Table 7.42 Preventive measures used and the outcome of pressure area care (community sample).

service is very much busier in winter than in summer, since more patients need regular help; but no more nurses are employed, and the nurses themselves, of course, may be ill during winter. There is less help available at the weekends than during the week. But, if an older patient is very disabled and has no family to help, the nursing service will probably pay two visits daily, although the older patients may have to adjust their time of rising and going to bed to fit in with the nurses' schedule. The majority of patients who did not develop pressure sores were mostly with relatives who shared care with the community nurses, in addition to the day-hospital care which patients attended twice a week, this service being used mostly for the relief of the family tension and work.

From the above (Table 7.42) it seems clear that patients who needed assistance and help in turning and lifting their body were within the group who did develop pressure sores and who were most at risk. Meanwhile, the group who did not develop pressure sores were self-dependent and self-caring.

E. Case study

A few examples of case studies from the community have been drawn from to show the effect of the total time spent and frequency of pressure area care and its contribution in pressure sores prevention.

Case A

This was a female patient aged 70 years suffering from cancer of the cervix whose general condition was very poor. She was reluctant to stay at the hospital, although her case needed extra care. She was confused, bedfast, doubly incontinent with poor appetite. She was living with her husband who gave her no care at all. She seemed alone and lonely all the day and night hours because her husband was not available except for sleeping some hours at night, as he was an alcoholic addict and out of control. However, although there was a family problem the patient refused to go to hospital. For that reason a twice-daily community nurse's visit was arranged, but in spite of this arrangement the patient's general condition deteriorated during the end of the first week and her initial Norton Score of 8 dropped to 7 and on the eighth day she died, with extensive skin breakdown over the pressure site of her right elbow, sacrum, right buttock and left heel.

The preventive measures which were used were first, manual turning of the patient's position with a time interval of 9.1 hours daily, using soap and water massage with droploen and sprelion spray. In addition, on the second day of her admission to community care a sheepskin rug was introduced. However, a twice-daily visit with an interval between pressure area care of 9.1 hours seems not enough in this case (see Case A).

Case A Patient lived alone

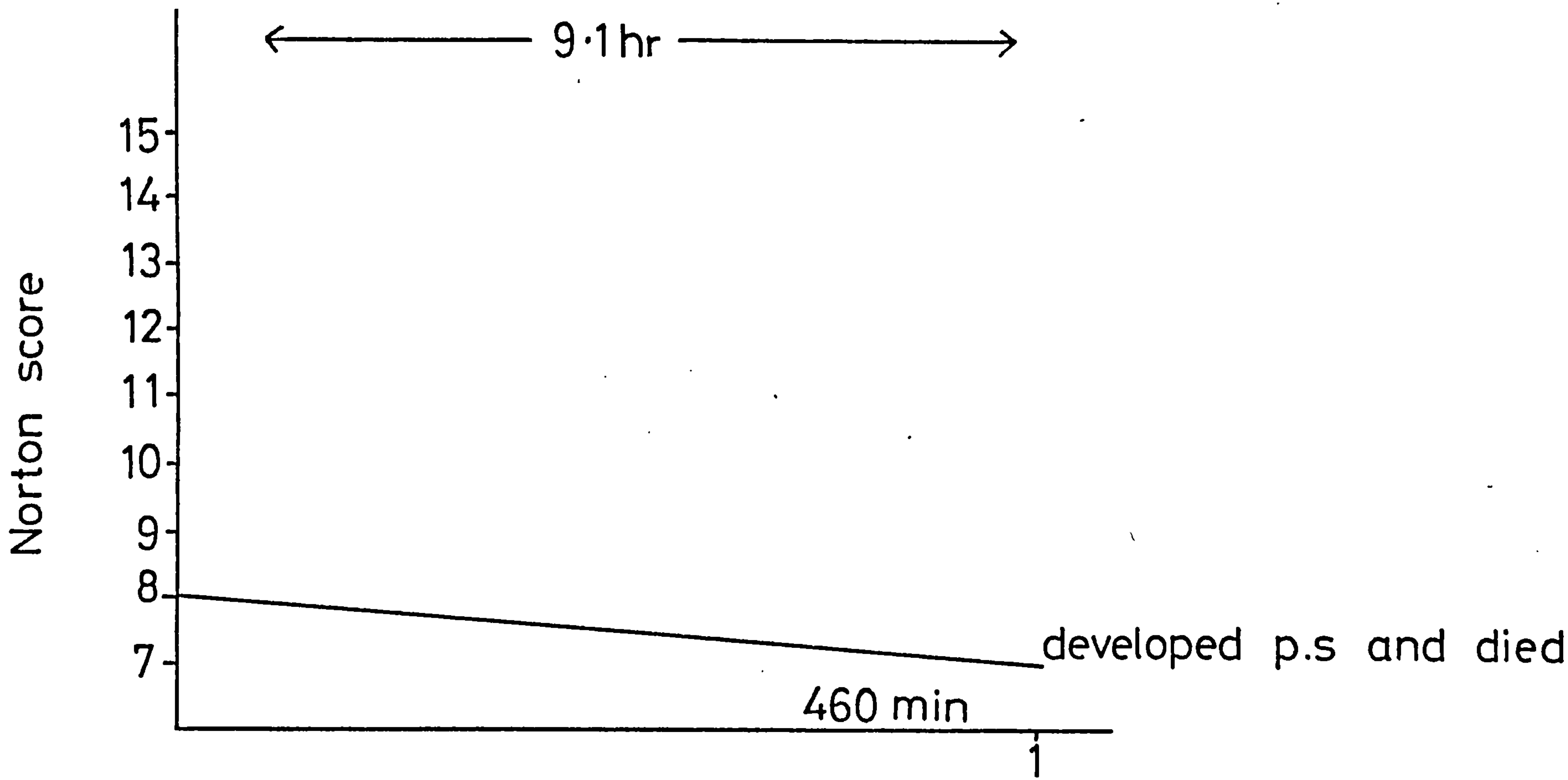


Fig A Total time for P.A.C in min/week

Case B

A male patient aged 63 suffering from chest infection and myocardial infarction was living with his family comprising his wife and five children. The family shared the care with the nurses. The patient had a good appetite when first seen. However, 20 days later his general condition had deteriorated and he seemed to be confused and with poor appetite. Hence, his Norton Score dropped to 9 from an initial level of 13 and 2 days later he died with intact skin at the pressure site.

The care pattern was recorded as a 9 hours daily average interval between the pressure area care of lifting the patient from the bed to the chair (and vice versa) with using soap and water for the pressure site. Sponge and flotation cushions were used to relieve the pressure. His sacrum remained red but did not progress to skin breakdown (see Case B).

Case C

A male patient aged 66 was suffering from multiple sclerosis. He was very thin, bedfast with poor appetite on admission and lived with his wife, who was a nurse. The patient received pressure area care from community nurses during the day hours and from a private nurse during night hours, in addition to his wife's care. In fact he received an average time for pressure area care of 113.04 min daily, with an interval of care of 2.1 hours. His Norton Score rose to 15 from an initial level of 12.

Case B Lived with family

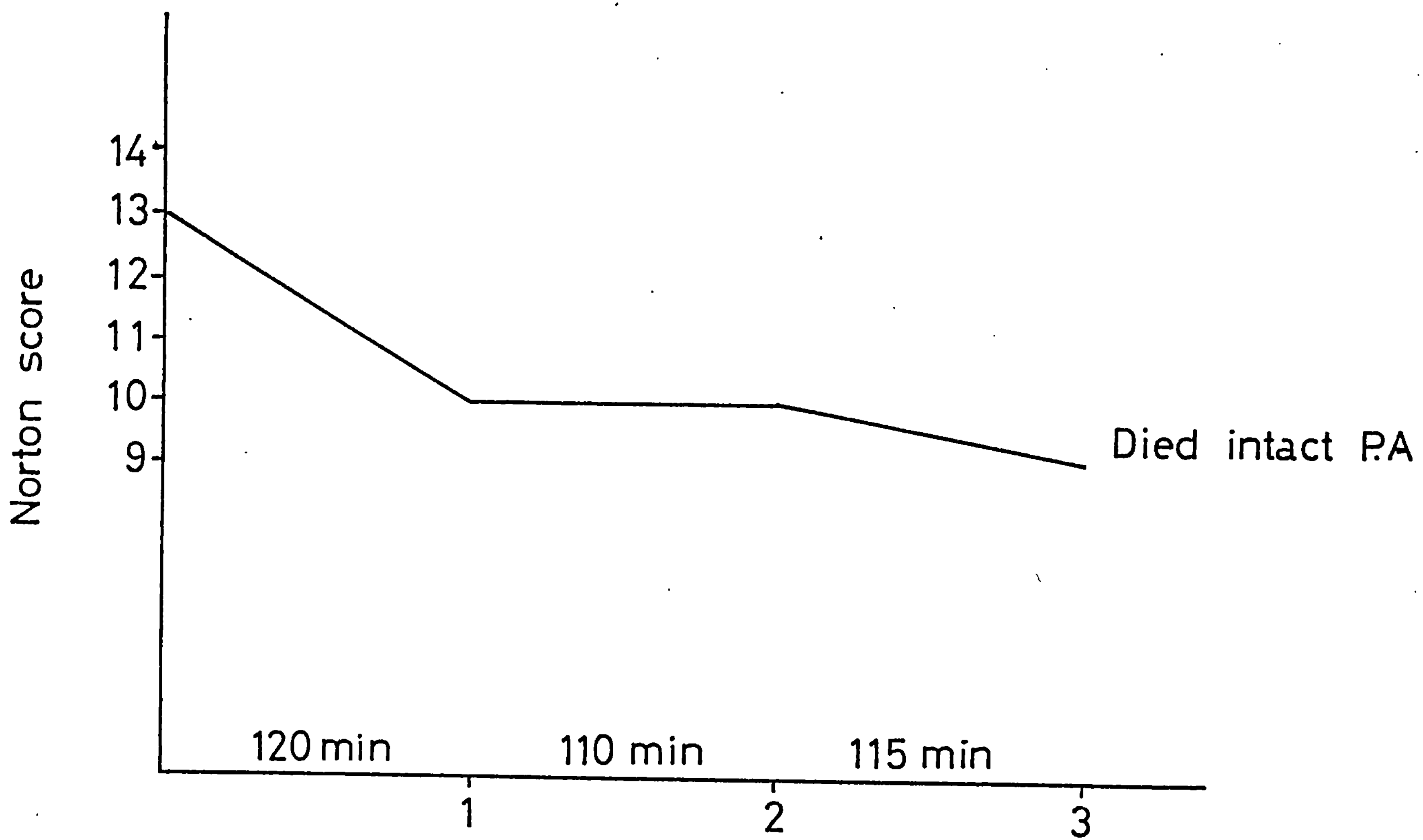


Fig B Total time for P.A.C in min/week

Case C

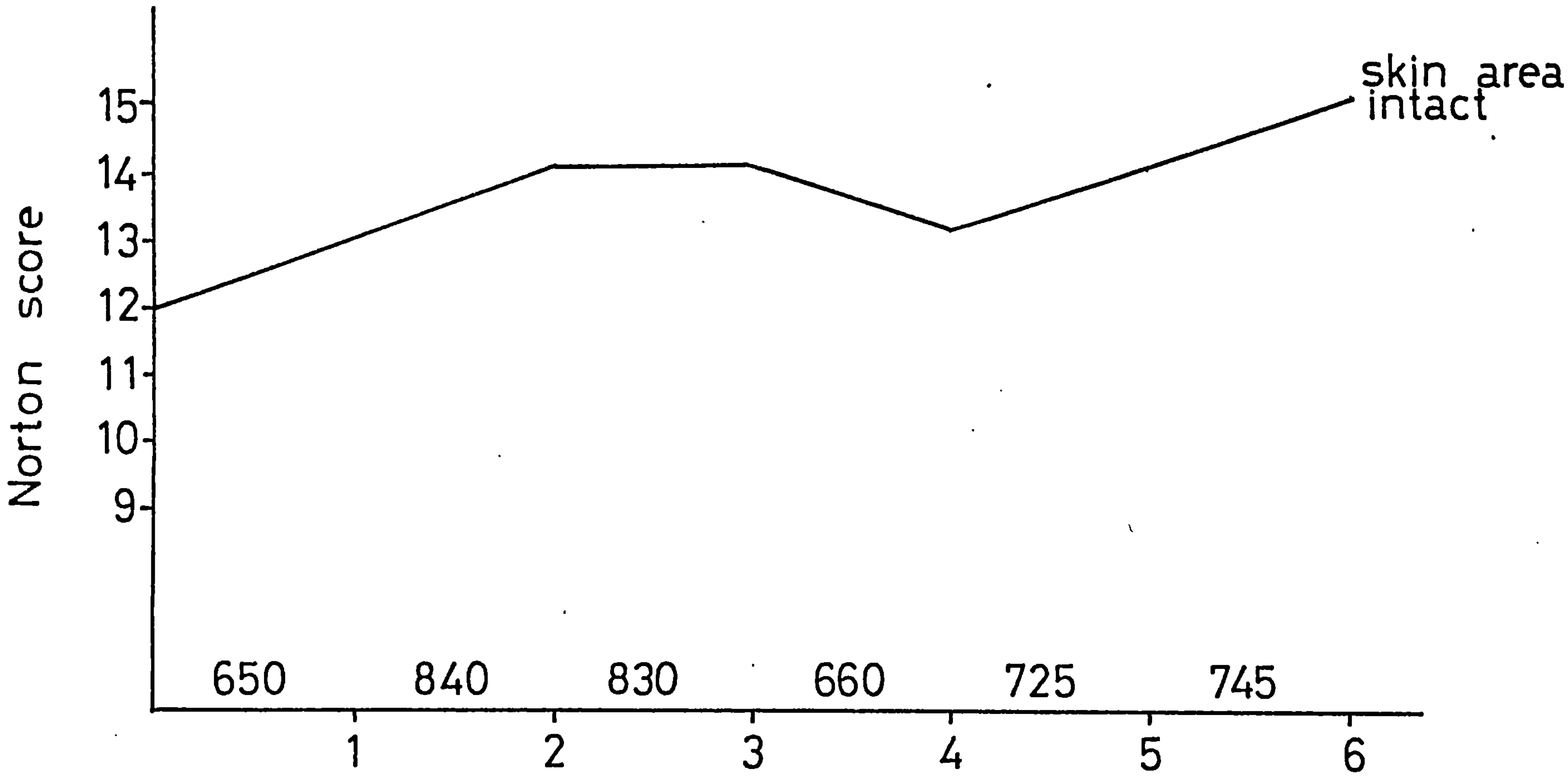


Fig C Total time in min/week

The patient was turned twice hourly by his wife and community nurses, with frequent cleaning of skin with soap and water. A sheepskin rug and water bed were used, and in addition a 'para pad' was applied to his heels to prevent redness. A blister at the site of one buttock appeared. However, two days later it had healed completely, with no further redness, and the skin remained good and intact over all the pressure sites at the end of the study period (see Case C).

Case D

A female patient aged 59 was suffering from multiple sclerosis. She lived with her husband, who was retired, and he was looking after her and shared her care with the community nurses. On discharge from the hospital, the patient had red skin at the site of her sacrum and buttocks. In addition, she had a poor appetite throughout the study period. She was confused, incontinent of urine and faeces, and bedfast. She had continuous diarrhoeia during the 3 days following her admission to community care, and by the end of that time her Norton Score had dropped from 10 to 9. Her general condition continued to deteriorate, and she developed skin breakdown at the site of sacrum and buttocks.

The patient's position was changed by her husband and community nurses every 3.5 hours on average, the skin being cleaned with soap and water. A water bed was used to relieve the pressure at the site of her sacrum and buttocks. However, her skin redness became worse and skin breakdown appeared at the sacrum and buttocks (see Case D).

Case D Lived with her husband

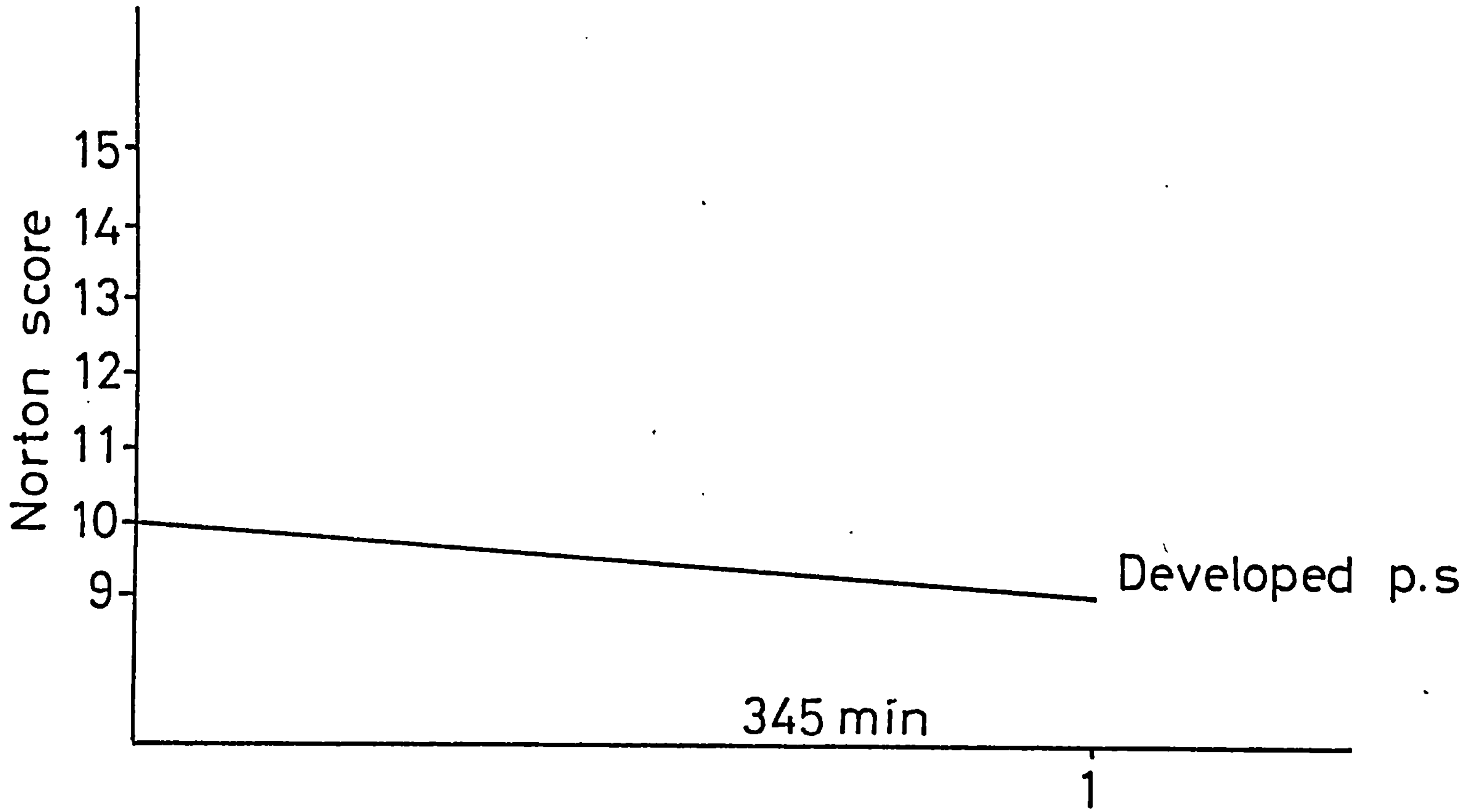


Fig D Total time in min/week

The group's correlation matrix between the independent discriminant variables with highest correlation are:

0.86772 The condition of skin area and appetite at the end of the study

The next highest correlations are:

0.64078 Mean total time and frequency of pressure area care

0.58983 Final Norton Score and appetite at the end of the study

0.58521 Initial Norton Score and activity

0.58259 Mean total time spent on pressure area care and skin solution used for cleaning

0.57208 Initial Norton Score and patient's physical condition

0.50737 Patient's sex and appetite at the end of the study.

The rest of the correlations seem low. Correlations which were not computed show as 99.0 in the computer's output (Appendix 4). The independent variables which were related to the pressure area care methods used for prevention seem not significant with dependent variable outcome. $P > 0.05$ (Table 7.19). Meanwhile, concerning the nursing observation, the independent discriminant variable 'change in skin area' seems very significant with the outcome: $P < 0.001$.

The summary of the discriminant analysis shows that for community patients the variables which best predicted the outcome were:

1.	Appetite at the end of the study
2.	Condition of skin area
3.	Frequency of care given
4.	Incontinence
5.	Change in the skin area
6.	Patient's age
7.	Patient's diagnosis
8.	Patient's physical condition
9.	Patient's final Norton Score
11.	Length of stay in the study.

Table 7.43 Summary of discriminant analysis.

1.	Frequency of pressure area care given
2.	Incontinence
3.	Appetite at the end of the study period
4.	Patient's diagnosis
5.	Change in skin area
6.	Patient's age
7.	Final Norton Score
8.	Condition of skin area
9.	Physical condition of the patient
10.	Length of stay in the study.

Table 7.44 Standardised canonical discriminant function coefficients of community group.

CHAPTER EIGHT

General Discussion of Hospital and Community Results

8. General Discussion

This will include a comparison between hospital and community results and cover the points set out below:

1) Patients distribution in hospital and community study
2) The development of the pressure sores
3) The Norton Score
4) The Patient appetite
5) The Nursing intervention
6) The frequency of pressure area care
7) The discriminant analysis results
8) Prevention of pressure sores.

8.1 Patients distribution in hospital and community study

The patient samples in both the 'hospital and the community' were predominantly elderly, with a greater number of females than males (Table 8.1). The average age of the hospital patients was higher than that of the community patients. The female hospital patients were older on average than both the males of the same group and the males and females of the community group taken together (Table 8.2). Moreover, there will be an increase in the proportion of the aged (65 years and over) in the near future. Of particular significance is the steady increase which will occur in age groups 75 and over - up to 41%, and 85 and over - up to an enormous 120% (Clarke, 1984). This increase in percentage of elderly patients is expected to be a great burden on the resources of the national health service.

8.2 The development of the pressure sores

According to the definition of a pressure sore used for the study, 26 out of the 88 hospital patients studied, i.e. 29.5% developed sores, whilst this happened with 6 out of 30, or 20% of the patients studied in the community. This supports the findings of the Danish study done by Petersen and Bittman (1971), and Glasgow Health Board area Pressure Sores Survey, (Jordan et al., 1977), in which the prevalence of pressure sores amongst the patients in the hospital was higher than that amongst patients in the community. Moreover, the pressure sore prevalence increases with increasing patient age (Norton et al., 1962, 1975).

Sex of the patients	Hospital patients	Community patients
Males	20	10
Females	68	20
Total	88	30

Table 8.1 Gender distribution of patients studied

	Hospital patients Average	S.D.	Community patients Average	S.D.
All patients	75.57		67.26	
Males	64.1	18.42	63.6	16.79
Females	78.3	7.2	69.1	18.55

Table 8.2 Age of patients in relation to gender

In both the hospital and community studies the average age of the patients who developed pressure sores was higher than the average age of those who did not. Also, the hospital group of patients who did develop pressure sores were older on average than the community patients studied (Table 8.4).

This finding seems to correspond with our knowledge of the aging process of the skin, which is mainly associated with the changes in its morphology and includes dryness of the skin - by which is meant roughness, wrinkling, laxity and a reduction of elastin and fibrin. This is accompanied by a reduction in the subcutaneous fat and muscles. Therefore with advancing age the skin's ability to withstand traumatic pressure is reduced.

For the hospital patients the mean length of stay in care was 14 days with a range of 3-42 days, whilst it was 28 days with a range of 3-44 days for patients in the community. The length of stay in care of the community patients seems significant (P = $<$ 0.01) (Table 8.12), although not for the hospital patients. In addition, this independent variable has potential predictive ability (Table 8.13, 8.14). It is possible to attribute this significance, to the generally longer period of care given to the community patients compared with the hospital patients. This allowed the community data to reflect the fact that those who developed sores were excluded from the study at that point. The generally short hospital stay prevented such a distinction becoming apparent (Table 8.5). The majority of those who developed sores in the community did so in less than 20 days after admission, except for one

Outcome of *PAC	Hospital patients		Community patients	
	*No.	%	No.	%
Group developing pressure sores	26	29.54	6	20
Group not developing sores	62	70.45	24	80
Total	88	100	30	100

Table 8.3 Distribution of pressure sores in both studies, Hospital and Community.

*No. = Number of patients

% = Percentage of patients

PAC = Pressure area care

Outcome of *PAC	Hospital patients Average	*S.D.	Community patients Average	S.D.
Group developing sores	80.31	10.54	75.33	9.24
Group who did not develop sores	74.18	15.75	63.66	24.0

Table 8.4 Age of the patients in relation to the outcome of pressure area care.

*PAC = Pressure area care

S.D. = Standard deviation

hospital patient who developed after more than 20 days (Table 8.5). This shows that the first two weeks of the patients' stay in care was critical in relation to the development of sores (Norton et al., 1962, 1975; Versluysen 1983). Moreover, the number of patients who developed sores in the hospital was more than the number of the patients who developed them in the community (Table 8.3). This might be associated with the age of the patients in the hospital, since they were older, with more problematic diagnoses (Table 8.6) and in a poorer state of health. They also received less time on pressure area care, particularly the group who developed sores (Table 8.8). Furthermore, the difference in mean total time in minutes between hospital and community was statistically not significant (Appendix 5). It is important to remember here that this present study is not an incidence or prevalence study (Table 8.3).

Time of developing pressure sores/length of stay in hospital (in days)	Number of days							Total number of patients
	<7	7-13	14-20	21-27	28-34	35-42	42+	
Group who developed P.S. (Hospital sample)	8	14	3			1		26
Group who did not develop P.S. (Hospital sample)	11	26	18	1	3	3		62
Group who developed P.S. (Community sample)	2	2	2					6
Group who did not develop P.S. (Community sample)	1	1	4	1	1	14	2	24

Table 8.5 Length of time patients stayed in study.

*P.S. = Pressure sores

	Patient Diagnosis	Hospital: Patients developing sores	Hospital: Patients not developing sores	Hospital: Total number	Community: Patients developing sores	Community: Patients not developing sores	Community: Total number of patients
	Stroke	0	2	2		3	3
	Chest infection	3	7	10	3	5	8
	Total hip replacement	1	1	2	0	0	0
Orthopaedic patients	Fractured neck of femur	19	21	40	0	1	1
	Spinal cord injury	0	2	2	0	1	1
	Cancer	0	2	2	2	3	5
	Cerebro-vascular accident	2	13	15	0	3	3
	Senile dementia	0	2	2	0	3	3
	Myocardial infection	0	4	4	0	0	0
	Hemiplegia	0	2	2	0	0	0
Orthopaedic patients	Back pain	1	4	5	0	0	0
	Arthritis & Rheumatism	0	2	2	0	0	0
	Multiple Sclerosis	0	0	0	1	5	6
	Total	26	62	88	6	24	30

Table 8.6 Distribution of patients' diagnoses in both studies, Hospital and Community.

8.3 The Norton Score

In both studies, the hospital and community, the Norton Score was used as a pressure sore predictor. The Norton Score data have been summarised in two ways: firstly, considering the score on admission to the study and secondly, at the end of the study period of the patient concerned. Thus the final Norton Score for patients who developed sores is their score at the time when the skin breakdown became apparent.

Comparing the hospital and the community, the average initial and final Norton Scores for the hospital patients who developed pressure sores are slightly higher than the initial and final scores of the community patients who also developed sores. However, in both samples the initial Score remained below 12. The average Norton Score of those hospital patients with sores at the end of the study period had fallen, whilst the average score of the hospital patients without sores had risen, showing a difference between these groups. But the hospital patients still had a final score higher than the group of community patients at the time when skin breakdown appeared (Table 8.7).

On the other hand, if we consider the groups of patients who remained with intact skin throughout the study period (i.e. both the hospital and the community patients), the community group (Table 8.7) had initial and final scores higher than the hospital patients and higher than both groups (the hospital and the community patients) who developed pressure sores. However, this might indicate that the community patients who did not develop pressure

Outcome of Pressure area care	Hospital sample				Community sample			
	Initial Norton Score		Final Norton Score		Initial Norton Score		Final Norton Score	
	Average	*S.D.	Average	S.D.	Average	S.D.	Average	S.D.
Group developing pressure sores	11.5	2.39	11.3	2.56	10.5	2.29	9.3	2.84
Group who did not develop pressure sores	11.43	2.63	14.25	3.29	13.25	1.96	14.66	2.69

Table 8.7 Initial and final Norton Score in relation to outcome of pressure area care.

*S.D. = Standard deviation

sores were in good general condition at the end of the study compared with the same group of patients from the hospital study.

The components of the Norton Score, the physical score and the incontinence score in the community study were significantly associated with outcome of pressure area care (P = less than 0.05) (Table 8.12). But the component variables of all the Norton Scores in the hospital study seem not to be significantly associated with the outcome of pressure area care, in spite of a potential predictive ability of the component variables, the physical score and the mobility score among the hospital sample (Table 8.13, 8.14).

8.4 The Patient appetite

In both settings, hospital and community, the independent variable appetite at the end of the study seems to be significantly associated with the outcome of pressure area care (P = less than 0.01) (Table 8.12). In the community study this variable seems a potential predictive variable and comes at the first step of the summary discriminant analysis. In the hospital study, appetite at the end of the study is the last discriminant variable (Table 8.13) to emerge from the analysis. Clearly, this variable indicates a general worsening of the condition of those who developed sores.

In both studies, patients who developed sores had a poor appetite. Moreover, there were more patients with good appetite than without, among those who did not develop pressure sores, although there is a variation in the sample size among the patients at the hospital and in the community. In fact, most patients with poor appetite were elderly. This was expected, as elderly patients are subject to many factors which influence food intake, such as the type of the food and its manner of preparation, the extent of a carer's knowledge of the patient's capabilities, the attitude of the nurses and the manner of the attention given, and the feelings of loneliness in hospital even though the patients joined others during dinner time. This might be particularly the case amongst those patients used to eating with family or spouse. However, in the community poor appetite might be due to shortage of money, as most of the elderly people in this study were receiving pensions which they thought were not enough to buy what they liked to eat. Besides, many people living alone find it too much of an effort to cook, and have no incentive to feed themselves (Exton-Smith and Caird, 1980). But given that elderly patients within the community sample frequently had relatives who were elderly, frail and/or disabled, the fact that shops were some distance away may also have played a part. Further, this group of patients were more likely to have poor appetite due to psychological effects of the aging process. Hence, assessing patients' nutritional status on admission is crucial in pressure sores prevention as it indicates the early signs of appetite which might provide good prognostic information.

Nutritional assessment can be carefully performed by four methods (Moghissi and Boore, 1983):

1. Interview with the patient (recording his/her history).
2. Physical examination, including anthropometry.

3. Biochemical tests.
4. Tests of immune function.

Parr (1979) mentioned the use of a higher protein calorie diet to promote pressure-sore healing, but highlighted also the reluctance of patients to continue with this regime. Hamilton (1976) argued that tissue damage was more likely when dehydration of the skin appeared as a result of patients at risk being without food for unnecessarily long periods. Furthermore, it was noted during the period of the study that the nutritional status (i.e. patient appetite) declined within two weeks of hospitalisation, which might increase the possibility of pressure sores formation. Thus, a good patient assessment with good communication and cooperation from many service departments is necessary (e.g. dietetic services, as well as food production and distribution services are essential), all these working closely with the clinical section in order to establish an efficient and successful system of feeding for elderly patients. To assist this, more research will be needed to evaluate the patient at risk, the nutritional status, and the nutritional behaviour, so as to eliminate patient nutritional problems which might contribute to pressure sores development.

8.5 The Nursing intervention

The time devoted to the pressure area care of the patients in the community was found to be greater, with an average of 58.7 min/patient/24 hours, than the average 51.5min/patient/ 24 hours for the hospital patients (Table

Outcome of the *PAC	Hospital patients				Community patients			
	Average total time in minutes/ 24 hours	*S.D.	Average initial Norton Score	S.D.	Average total time in minutes/ 24 hours	S.D.	Average initial Norton Score	S.D.
Group who developed pressure sores	45.98	23.80	11.5	2.39	70.2	24.19	10.5	2.29
Group who did not develop pressure sores	54.8	24.83	11.43	2.63	55.8	26.85	13.25	1.96

*PAC = Pressure area care

*S.D. = Standard deviation

Table 8.8 Average total time in min/patient/24 hours spent on PAC in relation to initial Score and the outcome of the PAC in the hospital and in the community.

	Average total time in minutes/ patient/24 hours	S.D.
Hospital	51.5 min	26.3
Community	58.7 min	20.5

Table 8.9 Average total time in minutes spent on pressure area care in hospital/community.

8.9), as the relatives shared the care with the community nurse at home. Moreover, there is a difference in the total time of pressure area care between the hospital and the community with regard to the outcome and the sample size. Amongst the hospital patients, those who developed pressure sores received fewer man-hours on average than those patients in the community who developed pressure sores, bearing in mind, that the greater time devoted to pressure area care on average amongst the group who developed sores in the community was weighted by just one case who received care from nurses and her husband (see Chapter 7, Table 7.41) higher than in the group of hospital patients. On the other hand, the time devoted for the hospital group who did not develop pressure sores was 54.8min/patient/24 hours and this was lower than the average of 55.8/patient/24 hours for the community patients who did not develop sores. In addition, amongst the patients who did not develop sores, the initial Norton Score was lower in the hospital patients (Table 8.8). However, this variable was not statistically significant with the outcome in hospital as it shows in the community (Table 8.12). Further, the time devoted to nursing care seems more effective in the prevention of pressure sores in the hospital than in the community. This is supported by the significant difference of this variable among the group of hospital patients with regard to the outcome of the study P = less than 0.05 (Table 8.12), as well as by its predictive ability (Tables 8.13 and 8.14) in the hospital group of the patients, bearing in mind that not all the patients were the same; certain patients consumed considerably more nursing time than others (Barr, 1967; Scottish Home and Health Department, 1969; and Barr _et al_., 1973). We can say that the time factor with regard to the prevention of pressure sores seems vital if the nurses perceive the importance of this factor in saving nursing time in the long run (Barton and Barton, 1981) and in saving money (Hibbs, 1987). However, since the proportion of elderly patients in the local population is predicted to increase until at least the year 2000, it may be expected that the number of elderly patients potentially with pressure sores in the hospital and the community will continue to increase, and this makes prevention of greater importance.

8.6 The frequency of pressure area care

The independent variable frequency of the pressure area care given has been calculated as the average interval between the applications of pressure area care. This independent variable seems significantly associated with the outcome of the pressure area care in both studies (P = less than 0.05). But the predictive ability of this variable shows only with the community study (Tables 8.13, 8.14). This might show that the group who developed sores were subject to a longer average interval between times of care than those who remained free of sores at the end of the study period (Table 8.10). It was noted that in the community, the interval between the times of pressure area care was probably associated with the lack of relative's attention, and in particular with the low Norton Score of patients who lived alone. Furthermore, the interesting result from the discriminant analysis (Table 8.13) shows that in relation to community nursing intervention, the greater interval between the times of pressure area care was a potential predictive variable of the development of pressure sores. Similarly, amongst the hospital patients the average nursing time spent on pressure area care in minutes/patient/24 hours had good potential for predicting the development of the pressure sores.

Outcome of the pressure area care	Hospital			Community		
	Number of patients	Average interval between pressure area care in hours	*S.D.	Number of patients	Average interval between pressure area care in hours	S.D.
Group who developed pressure sores	26	5.25	3.956	6	13.3	6.41
Group who did not develop pressure sores	62	4.1	2.7	24	7.3	3.32

*S.D. = Standard deviation

Table 8.10 Average interval between pressure area care in hours at the hospital and in the community study.

The mean difference in pressure area care time

It is interesting to show the difference in average total time which has been drawn from the hospital and community group of patients. However, this difference (X - X) is a linear combination of two random variables that are independent. The variance of 5.995 has been calculated by using a general formula of standard error deviation (Appendix 5); the standard error of 5.995 seems lower than the difference between average pressure area care time means (i.e. hospital and community). However, using a t-test, this mean difference is not statistically significant. Nor is the mean difference for the variable average frequency of pressure area care between hospital and community.

Further, the confidence interval which is defined as "A range of values that with a specified degree of probability, is thought to contain the population value", seems useful in showing the population of mean difference. Therefore, with 116 (df) the 99% confidence intervals shows that the data will be consistent with the population of mean differences, which lies within (-8) - (+22) limits... (Appendix 5).

8.7 The discriminant analysis

As mentioned earlier, in Chapter Five, the total number of the hospital sample used for the analysis was 88 cases. Of these, 82 cases were used for the discriminant analysis while 6 cases had one missing discriminant variable and were excluded from this analysis. However in the community the total number of community cases was 30 were used for the analysis.

The proportion of cases were correctly classified in the hospital and community studies as shown in Table 8.11.

The result of the discriminant analysis of the data through the computer shows the statistical significance of the independent variables with the outcome, using Wilks and F statistic.

For the hospital data these independent variables were:

1) Diagnosis
2) Final Norton Score
3) Average daily total time of care
4) Change in the skin condition
5) Appetite at the end of the study period
6) Frequency of care given
7) Ward designation.

Hospital Study	Predicted group membership		
		Develop	Not develop
Actual group membership	Developed sores	23	0
	Did not develop sores	2	57
	Percentage of cases correctly classified = 97.56%		

Community Study	Predicted group membership		
		Develop	Not develop
Actual group membership	Developed sores	6	0
	Did not develop sores	0	24
	Percentage of cases correctly classified = 100%		

Table 8.11 Classification results in the hospital and in the community studies

For the community study the significant variables were:

1) Length of stay in the study
2) Final Norton Score
3) Appetite at the end of the study period
4) Frequency of pressure area care given
5) Physical condition
6) Incontinence
7) Change in the skin condition at the site of pressure area throughout the study period
8) Initial Norton Score.

The summary of the discriminant analysis concerning the community sample shows that for these patients the variables which predicted the outcome were:

1) Appetite at the end of the study
2) Condition of the skin area
3) Frequency of pressure area care
4) Incontinence
5) Change in the skin area
6) Age of the patient
7) Patient diagnosis
8) Patient physical condition
9) Final Norton Score
10) Length of stay in the study.

The above predictive variables were slightly different for the hospital group of patients and there were rather more in number. These were:

1) Change in the condition of the skin area

2) Site of the skin area
3) Average daily total time on care
4) Pressure-relieving device
5) Observed condition of the skin
6) Physical condition
7) Mobility state
8) Final Norton Score
9) Ward designation
10) Age
11) Patient diagnosis
12) Skin-cleaning solution used
13) Appetite at the end of the study.

In the two studies the potential power and importance of the independent variables for discriminating between the groups of patients seems dissimilar (Tables 8.13, 8.14).

Table 8.12 Results of analysis using Wilks Lambda and F statistic

Variable	Hospital Group	Community Group
Age	0.1025	0.5012
Sex	0.7583	0.8300
Diagnosis	0.0015*	0.6011
Length of stay in the study	0.8679	0.0001*
Initial Norton Score	0.0892	0.0266*
Final Norton Score	0.0003*	0.0010*
Average daily total time of care	0.0017*	0.8508
Method of manual relief of pressure	0.1267	0.0718
Skin-cleaning solution used	0.4699	0.2462
Pressure-relieving device used	0.1753	0.8360
Site of skin attended to	0.8410	0.2053
Observed condition of skin	0.5537	0.6028
Change in skin condition	0.0000*	0.0001*
Appetite at start of study	0.8305	0.0922
Appetite at end of the study	0.0000*	0.0001*
Category of person giving care	0.6453	0.2750
Frequency of care given	0.0448*	0.0003*
Ward designation	0.0008*	
Status of living		0.0674
Physical condition	0.2091	0.0337*
Mental state	0.3916	0.1876
Activity	0.0713	0.5860
Mobility	0.8442	0.4516
Incontinence	0.0934	0.0095*

NB

* Statistically significant P = less than 0.05

Hospital	Community
1. Change in the condition of the skin	Appetite at the end of the study
2. Site of skin area	Condition of the skin area
3. Average daily total time on care/24 hr	Frequency of pressure area care
4. Pressure-relieving device	Incontinence
5. Observed condition of the skin	Change in skin area
6. Physical condition	Age of the patient
7. Mobility state	Patient diagnosis
8. Final Norton Score	Patient physical condition
9. Ward designation	Final Norton Score
10. Age	Length of stay in the study
11. Diagnosis	
12. Skin-cleaning solution used	
13. Appetite at the end of the study	

Table 8.13 Summary of discriminant analysis of variables accounting for and discriminating between outcome groups.

	Community	Hospital
1.	Frequency of care	Change in skin area
2.	Incontinence	Pressure-relieving device used
3.	Appetite at the end of the study	Observed condition of skin
4.	Diagnosis	Average daily time on PAC
5.	Change in skin area	Final Norton Score
6.	Patients age	Physical condition
7.	Final Norton Score	Mobility state
8.	Observed condition of skin	Age
9.	Physical condition	Site of skin area
10.	Length of stay in the study	Ward designation
11.		Diagnosis
12.		Appetite at the end of the study
13.		Skin-cleaning solution used

Table 8.14 Standardised canonical discriminant function coefficients for independent variables in hospital and community.

8.7.1 Discussion of discriminant analysis results

There are some differences between the hospital and community patients in the results of the discriminant analysis, and it is interesting to explore these differences.

For the hospital patients one important variable which was significantly related with outcome was diagnosis (Table 8.12). On examination of the table 6.13 we find that of the 26 patients who developed sores no fewer than 19 had a fractured neck of femur and one had undergone hip replacement. This is compatible with research showing that pressure sore development is strongly linked with low trauma fractured neck of femur in the elderly (Versluysen, 1985). Indeed recent evidence suggests that such patients are kept waiting on trolleys in the Accident and Emergency Department; and have their operations delayed after the preoperative fasting period has begun and well beyond the normal fasting period. Furthermore operations may be delayed even after the premedication has been given (RCP, 1989). These factors greatly increase pressure sore risk, through the nature of the trolley surfaces; the age of the patient; poor nutritional status and lack of movement due to pain and sedation.

Patients with fractured neck of femur were nursed in orthopaedic wards and the emergence of ward designation as a significant variable is really an extension of the variable in 'diagnosis'. The proportion of pressure sores occurring was greater on the orthopaedic wards (Table 6.12) especially among elderly patients than in the medical wards for the elderly.

Another finding which can be linked to the elderly orthopaedic patient is the importance of pressure relieving devices since patients who have an injury as well as those who have undergone operations are relatively immobile. This increases the importance of pressure relieving devices, another important variable emerging from the analysis. Mobility level was also a discriminating factor amongst the hospital group of patients.

The average total time devoted daily to pressure area care also discriminated between outcome groups. It is interesting the orthopaedic patients had less average time per 24 hours spent on them in pressure area care than the patients in wards for the elderly.

Community Sample

Amongst community patients one of the important discriminating factors was frequency of care. This finding could be expected. It will be recalled that the total average daily time spent in pressure area care was greater for community patients than hospital patients. However there is an inverse relationship between frequency of care and the length of time a part of the body is exposed to pressure when patients are unable to move themselves easily. It is worth noting that sores arose within community patients who were predominantly reliant upon the district nursing service for care. Whilst such care is no doubt thorough, it is unlikely to be as frequent as that given when the carers are resident with the patient.

Incontinence also emerges as a discriminating characteristic in this group of patients probably for much the same reason: i.e. frequency of attention. Other discriminating factors are more or less common to both groups although their importance varies.

Factors Affecting Both Samples

An interesting finding is the importance assumed by appetite in discriminating between those who develop sores and those who do not. A poor nutritional state clearly will affect healing of existing sores and help to predispose to the development of sores. However nutritional assessment is a problematic area, and to carry it out properly demands a great deal of time (Coates, 1982). The measure of appetite used in this study is simple to apply and proved to be reliable in a preliminary study. Depression in appetite is also an early warning sign compared with a change in nutritional status which takes time to develop and even longer to reveal itself. This finding is well worth following up.

Other factors discriminating between outcome of care are as expected. The Norton score was intended to be a predictor of risk and it confirms the importance of this measure that the final Norton score for those who developed sores was that recorded at the time the sore appeared.

A change in the condition of the skin is clearly the first symptom of a sore and so it could have been expected that this would discriminate between outcome groups as is shown in the results.

Classification of Patients

The relative high proportion of orthopaedic patients amongst those hospital patients developing sores has been discussed above. Clearly these patients influence the results for the hospital group of patients.

It was thought it would be useful to analyse the data for these patients separately. On reflection, the classification of patients into hospital and community can be seen as arbitrary since it is basically a classification based on the identity of the carer rather than patient characteristics. It could be considered that patients in wards for the elderly not undergoing surgery have more in common with community patients and that the meaningful classification is that between medical and surgical patients.

Accordingly the hospital data were re-analysed dividing them into medical and surgical patients. The results of discriminant analysis can be seen in (Tables 8.15, 8.16).

Interestingly results show that some of the variables which assumed importance in the community sample assume importance amongst the sample for the medical wards for the elderly. One of these is frequency of care and another is incontinence.

Amongst the orthopaedic patients pressure relieving devices is an important discrimination of outcome. This confirms the discussion above and suggests that it is more meaningful to classify patients in terms of intrinsic factors and whether or not they undergo surgery rather than according to their carers when we are considering pressure sore risk.

Orthopaedic	Geriatric
1. Change in skin area 2. Pressure relieving device 3. Appetite at the end of the study 4. Condition of skin area 5. Final Norton Score 6. Average daily total time 7. Physical condition of the patient 8. Length of stay in the study 9. Site of skin area 10. Appetite at the start of the study 11. Category of care given by 12. Initial Norton Score	1. Change in skin area 2. Mean total time 3. Condition of skin area 4. Frequency of pressure area care 5. Skin cleaning solution used 6. Initial Norton Score 7. Incontinence

Table 8.15 Summary of discriminant analysis orthopaedic/geriatric hospital patients.

Orthopaedic	Geriatric
1. Change in skin area 2. Pressure relieving device 3. Condition of skin area 4. Length of stay in the study 5. Physical condition of patients 6. Site of skin area 7. Final Norton Score 8. Average daily total time 9. Appetite at start of study 10. Initial Norton Score 11. Appetite at the end of the study	1. Change in skin area 2. Condition of skin area 3. Frequency of pressure area care 4. Skin cleaning solution used 5. Initial Norton Score

Table 8.16 Standardised Canonical discriminant function coefficient orthopaedic/geriatric hospital patients.

8.8 Prevention of pressure sores

A pressure sore remains a significant problem in a patient at home or in the hospital (Petersen and Bittman, 1971; Jordan et al., 1977; Clark and Crow, 1986; Clarke and Kadhom, 1988). In both the hospital and the community various methods were used in pressure sore prevention. Some patients received only frequent nursing care, whilst other patients received mechanical aids in addition to frequent nursing attention to the pressure sites. Currently, frequency of care and preventive measures in relation to potential pressure sites remain subject to individual nurses judgement. There is also little knowledge of the relative effectiveness of these time factors and methods, as they are mostly planned to meet patients' individual needs and rarely subjected to rigorous evaluation. Therefore, further investigation may be required in future to evaluate these methods and their effectiveness. Most nurses tend to rely on traditional practice rather than on their own assessment of individual patients' needs in order to determine the effective pressure sores preventive measures. Nurses in this study were likely to rely upon ward routine and the ward sister's care plan at the hospital and upon colleagues in the community, due to many suggested reasons. Some are set out below:

1) Shortage of the right equipment and aids to achieve better pressure area care and nurses' unsufficient knowledge about the use of these aids. Some nurses do not utilise aids to their fullest extent, while some regard pressure-relieving devices as being of little

real value (Hulland, 1985).

2) Nurses are often inclined to disregard the importance of the anatomy and physiology behind pathological problems. In particular, they should have some idea of the anatomy and physiology of the skin so as to take action before pressure sores develop.

3) Some nurses found difficulties in making assessment on some of Norton Score components - for instance, physical state and state of incontinence - when recording in the patient care plan. Thus, to initiate early preventive measures, nurses should be aware of the proper way of assessing patients on admission.

4) According to the definition of 'pressure sore' used in this study, the skin breakdown was most likely to develop within the first two weeks of a patient's admission to the study. However, nurses were not aware of this probability, which nevertheless does not mean that skin breakdown may not appear beyond two weeks after the patient is admitted to nursing care. In the present study a higher percentage of orthopedic elderly patients obviously influenced the discriminant analysis, as already discussed, and the striking feature was the definite relationship between time of operation and time of onset of pressure sores for this group of patients. Most postoperative orthopedic elderly patients developed pressure sores during the first week after operation (see Chapter Six, Table 6.22) and this confirms Petersen (1976) and Versluysen (1983, 1985). It also comes as no surprise, because the patients are mostly immobile during this period and

may have suffered prolonged pressure during the operation. Barton and Barton (1981) have shown that pressure sores may appear up to one week after the pressure application because the necrosis starts in the muscles and deep dermis. Versluysen (1983) noticed that there was no relationship between the location of pressure sores and the position of the patient during an operation. Also, patients who developed sores were in hospital twice as long as patients without pressure sores; this was probably not due to the pressure sores alone, but also to the fact that the patients were older and in a poorer state of health. Some of the factors associated with the development of pressure sores in elderly patients with fractured neck of femur are beyond the control of nurses (RCP 1989). However nurses need to be aware of these potential problems and seek to influence medical policy. Clearly nursing precaution methods related to pressure areas must be introduced as soon as the patient is admitted.

5) Nurses seemed not to respond to the early signs of pressure sores (i.e. skin redness, erythema signalling hidden sores) or to take note of bruising and scratching. The latter also contribute to skin breakdown, and if they occur they might be a source of sores appearing some time after admission (Warner, 1982) and thus such sores may be due to nurses' ignorance in this matter. In the present study nurses took no account of any falls when recording in the nursing plan. Nurses need to be pressure-sore-conscious and should know how to discriminate between

patients who are at risk of developing sores and those who are not. Results of the study reported has confirmed the usefulness of the Norton Score for this purpose. The Ward Sister should give a lead in this informing her staff of each patient's individual needs and providing the nursing supervision needed to avoid pressure-sore occurrence and its complications.

The higher percentage of patients developing sores were in the hospital rather than the community (Table 8.3) and they were mainly elderly (Table 8.4). Nevertheless, a proportion of the elderly patients were discharged from hospital before full recovery had taken place, and this is likely to increase. Unfortunately, the evidence from this study suggests that a patient may be discharged from hospital showing the first sign of pressure sore development (namely red skin) but without this being noticed or recorded. This might well lead to skin breakdown within a few days of his admission to the community services if there is no successful pressure area care discharge planning linking the hospital with the community so as to maintain effective care. It must be remembered that nowadays elderly people are the major users of the hospital and community health services, due to lower levels of independence after hospitalisation which require an increase in informal and/or formal care. It was felt by the researcher in this study that the likelihood of dependency in elderly patients increased after a stay in hospital of more than two weeks. The reason why elderly people who häve hospitalisation may be less independent on return home is they are highly dependent upon the environment into which they are discharged. The vulnerability of the elderly patient who is discharged from hospital, and the inadequacy of subsequent after-care, were identified twenty years ago (Brocklehurst and Shergold, 1968). Thus, nurses should encourage and involve the patient as an active participant in self-care rather than as a passive recipient of care with others doing everything for him. Nurses should know that any patient who is immobilised can develop a sore in a few hours if he is left in one position during either his stay in hospital or at home, and they should not leave him with a problem he did not have when he was admitted, and which is likely to result in a need for increased assistance with the activities of daily living. It is not certain whether the need for such help will increase or decrease after return home. It is likely, however, that admission to the hospital and subsequent discharge may increase dependency in elderly people. A further increase in the rate of discharge would have serious implications for district nursing (Vetter et al., 1984). Whatever the case, with supportive circumstances patients do better when discharged, this being probably due to family support. Successful individual care at home for patients at risk can be achieved by continued collaboration with other members of health care teams to meet patients' basic needs, for example through home-delivered meals, the help of informal carers who are mainly relatives, neighbours, friends, and home helps. Caly (1985) points out that

> The inescapable conclusion is that in most cases the answer to the question who in the community is meant to provide care, is families. More

> specifically it is the women in the families who will be expected to act as unpaid and untrained carers.

Female spouses are a major source of help. Children, primarily daughters or daughters-in-law, are major contributers in care as well. (Redfern, 1986). It was noted during the community study that the carers themselves were often old and frail, some suffering from physical and psychological debility, their own health undermined by the constant burden of care as they were becoming the 'hidden patients'. Many have no experience in pressure area care at all, and there are some who do not feel this would be a solution.

Dyson (1978) explains how the involvement of the patients themselves seems vital in the continuity of pressure sores prevention, while most patient studies suggest they have little understanding of their bodies, hospitals, or the special language used by nurses. This is important for a number of reasons. Firstly, much of what is said to patients is likely to be meaningless, although they are often too polite or anxious to say so. Secondly, it will be rapidly forgotten if improperly understood. This makes it difficult for a patient to recall what might be required following discharge. Thirdly, what is remembered is likely to be less than half of the details given, causing further confusion in the mind of the patient. The implication of this is that effective communication with the patient is of crucial importance in the prevention of pressure sores and their treatment, through reassuring him and giving him detailed information on some aspects of the prevention of pressure sores. So the demand exists for educational courses aimed at helping people who look after an elderly person at home, in particular instructing these helpers in pressure area care. It is hoped to make this education a regular contribution to the community care of the elderly and their families. Nevertheless, during patient discharge the nursing staff at the hospital should be aware of their responsibilities regarding patient education, which includes the encouragement to develop new behaviour. For example, wheelchair patients should be encouraged to lift themselves and check and record the information related to the site of his/her bottom currently, as a habit. This could influence the patient practice of good skin care. Maintaining the integrity of the skin depends upon the willingness or motivation of individuals and families to practice skin care and pressure area care activities, and more specifically, to promote the continuity of pressure area care with emphasis on the time and frequency devoted to it.

Community patients nursed by their families at home seldom develop pressure sores (Bliss and Murray, 1979). This might be due to the continuity of the pressure area care given by the community nurses and patients' relatives. Some long-care patients' relatives in the community emphasised their need for relief care at night, while some suggested an extended use of existing day care and wished it to be extended to cover the nights as well. An adult day-care and night-care centre with facilities for physical and psychological rehabilitation could become a vital link between the hospital and the community. Furthermore, it was noticeable that most of the elderly people, particularly those with low income, were much more likely to live in older, dilapidated property, and thus much more likely to be without hot water and an indoor toilet. In this sample the toilet was mostly upstairs, but a few were outside. However, it seems that a district nurse seldom stops to look at the patient's house and assess his overall needs. Most of the district nurses "pop in" to the old people's homes, usually on a fairly brief visit, for example to give an injection or dress a leg ulcer, and sometimes to give a bed-bath and lift the patient and sit him on a chair. All district nurses should examine the way in which they observe old people in their homes and ensure that they are contributing effectively in improving the quality of life of the elderly through pressure area care.

A proper pressure area care discharge record is vital to maintain the continuity of pressure area care, and this can be achieved by keeping a record or summary of the nurses' assessments to identify those patients at risk of pressure sores on admission and those likely to require community care, in particular patients 70 years of age and over. The record could give a brief picture of the patient's general state of health 24 to 48 hours prior to discharge and his appetite and nutritional status, so as to ensure the continuity of care. This record should accompany the patient if he is transferred or discharged home. If the patient is discharged to his home he should have a copy of this record with him to give to his relative.

A pressure area care record should be precise and concise, and to the point. Thus, a record should include was noticeable that most of the elderly people, particularly those with low income, were much more likely to live in older, dilapidated property, and thus much more likely to be without hot water and an indoor toilet. In this sample the toilet was mostly upstairs, but a few were outside. However, it seems that a district nurse seldom stops to look at the patient's house and assess his overall needs. Most of the district nurses "pop in" to the old people's homes, usually on a fairly brief visit, for example to give an injection or dress a leg ulcer, and sometimes to give a bed-bath and lift the patient and sit him on a chair. All district nurses should examine the way in which they observe old people in their homes and ensure that they are contributing effectively in improving the quality of life of the elderly through pressure area care.

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A pressure area care record should be precise and concise, and to the point. Thus, a record should include clear information as to: where the patient was admitted from and when; the dates and the times when the patient received care and the time when nurses or relatives finished this care; whether the patient was receiving pressure area care from nurses and/or relatives or from the patient himself - in short, a record of lifting and turning of the chairfast and bedfast patient). Further, records should be full and accurate and the nurses should have the writing skills for recording pressure area care. The more complete the pressure area care record, the less chance of a gap in the continuity of pressure area care for the patients at the hospital and in the community. Unfortunately, during data collection in this study it was noticeable that recording the pressure area care and the time of giving care remained a low priority for the hospital nurses and doctors. Current methods of communication with the patient in the hospital do not always achieve the desired outcome, and additional methods of communication need to be explored to ensure the smooth passage for elderly people from hospital to their home. The degree of liaison between nurses, the family and practitioner in the community needs to be far greater.

While in hospital it is important that there are trained nursing staff who should be aware of preventive measures and skilled in recording the information related to the pressure area care, the difference in knowledge between trained and untrained nurses probably matters less than the importance of being 'pressure-sore-conscious'. There could be many reasons why the hospital nurses in this study were reluctant to record the pressure area care and the time devoted to it. One of these reasons was that they were too busy working and the pressure of time might well inhibit making a good record (Hulland, 1985). In addition, it is not always possible to keep the nursing staff on the same ward. A nurse might become less loyal to a ward due to lack of continuity of knowledge about the patients and the ward, or the lack of a patient pressure area care plan for both the day and night; most of the nurses in the study were working part-time on night duty. Other reasons could be the high staff turnover or shorter staff working hours. (Ek and Boman, 1982). Meanwhile, even if sufficient nurses are available in the ward, pressure sores can happen, and this might be due to changing the working shift of the nurses - in particular during the night hours - without emphasising the continuity of a pressure area care plan; or it might be the lack of nurses' skill in observing and recording the early signs of pressure sores. Moreover, care of the elderly at night requires special nursing skills, as was noted in the wards containing more elderly patients. In conclusion, we repeat that the prevention of pressure sores is more important and cheaper than treatment (Hibbs, 1987; Waterlow, 1988b) and saves nursing tasks and time (Barton and Barton, 1981). Further, we can say that the pressure sore ought to be extinct. This might be achieved if all nurses took action in identifying the patient at risk by assessing fully all patients on admission and recording all information in nursing notes which include appetite affecting the patient's nutritional status. This assessment should be done daily, and the patient should also be reassessed if his condition changes. Further, there should be a pressure-area care programme for patient and relative(s), including a follow-up record for each patient, whether he/she is in hospital/community, to maintain the continuity of his/her pressure area care. There is a need for education or re-education for nursing staff with regard to pressure sores complications, and this can be implemented by increasing lectures, seminars, conferences, films etc. to all grades of nurses. As a result, 95% of pressure sores could be prevented in the near future if a pressure sore policy is used throughout hospitals, each ward or unit making a start and having its own policy for making this happen (Hibbs, 1987).

CHAPTER NINE

Conclusion

Conclusion

In this final chapter the conclusions of this study are listed, critical assessment is made of the value of the study and there are suggestions for further work.

9.1 Conclusion

This was intended as an introductory rather than a definitive study. Its concepts, theory and practice present a view from which debate and research can develop into new areas. In fact, this study was a descriptive, comparative study of hospital and community patients to try and discover the relationship between pressure area care effectiveness and the time devoted to such activity. It was aimed to find out the average man-hours of total pressure area care time in minute/patient/24 hours of care designed to prevent pressure sores and to compare the man-hours devoted to this amongst hospital patients compared with the man-hours contributed by relatives and nurses to this activity within the community.

Comparison of the study methods used shows that a descriptive enquiry using two distinct types of diary sheets, was found to be the best method by which the pressure area care time devoted by nurses and relatives could be recorded. The diary sheets were extensive. On reflection this was too ambitious, although the results are useful. More subjects could have been approached and a particular area of alternative health care could have been studied in greater depth, if the range had been narrowed. Discriminant analysis has been used for data analysis.

In the light of a review of the study, the conclusions drawn from the results of this investigation are as follows:

1. The community patients did receive pressure area care man-hours higher on average than the hospital patients, as both relatives and nursing community staff shared the care of the patient.
2. It is obvious from the preceding chapters and the results, that the outcome measure used in the study was whether or not the patient developed a pressure sore. Defining the outcome in this way leads to the identification of the proportion of patients who developed sores out of total number studied.

In both studies, the percentage of patients who did develop pressure sores was higher in hospital, in spite of the fact that care around the clock is easier to organise in hospital, as more staff and more facilities are available to identify the patient at risk of pressure sores, and the onset of pressure sores development.

In this descriptive study the outcome of pressure area care was related to the nursing care given and the intrinsic patient vulnerability to pressure sores. In many ways the study is similar to the important study by Norton et al. (1962, 1975).

Additional information collected within the hospital sample suggests that nutritional state is important information in assessing vulnerability to pressure.

By extending the study to patients in the community it was believed that an important dimension would be explored, since care in the community wherever possible is the official policy.

Further, the study by Norton et al. (1962, 1975) showed the effectiveness of turning the patient in the prevention of pressure sores. The interval between change of position, and the nursing time spent in pressure-area care were not documented for each patient in Norton's nursing intervention study. She does say, however, that the patient's position was changed as frequently as 12 times in 24 hours.

This present study records nursing practice some 26 years after that original study. Clearly Norton's risk-assessment score has had less impact than it should have had, and her recommendation regarding change of position is not being followed currently. In the present study, patients in the community who did develop pressure sores were small in number and most of them relied entirely upon nursing services. On the other hand, the group who did not develop pressure sores in community were mostly independent and received less time devoted to pressure area care than the group who did develop pressure sores. Interestingly, the total time spent in pressure area care in this present study appears to be greater than in Norton's observation study (1962, 1975) i.e. as opposed to her intervention study. Patient appetite in the present study appeared as a significant discriminating variable, in spite of the fact that the measure was a very crude indication of nutritional status. Appetite, even though crude, will detect the patient's change in nutritional status. Moreover, there is no perfect measure of nutritional status, and in particular there are no norms available for anthropometric measures in the elderly. Change in a nutritional status measure takes time to appear; therefore, it might be worth ensuring reliable and valid measures of appetite as an early warning of change in nutritional status and therefore vulnerability to pressure sores.

The Norton Score in this study was very important in both situations studied (i.e. hospital and community).

Good assessment and observation for change in condition of skin area seems very important, for this was a significant discriminating variable which reflected the fact that skin changes are apparent before actual skin breakdown occurs.

The average total time in minute/patient/24 hours was a significant discriminating variable in hospital, whilst the independent variable frequency of pressure area care was the most potential predictive variable among the community group of patients. The preventive measures, used in the hospital and community were numerous (i.e. a great variety of methods for prevention were used on the ward and in the community at home, in the nursing home and in the day hospital). The patients who developed pressure sores were predominantly women over 70 years of age, with limited mobility and with low Norton Scores on admission. They were in poor general condition, had poor appetite and were to a large extent incontinent, mostly bedfast in hospital, and chairfast in the community. We can conclude therefore, that it was possible by the methods used in this study to link nursing activity with the outcomes. The relationship, however, is a complex one. It is believed that this rather limited descriptive study might provide some baseline data for future work and could be usefully followed up.

9.2 Critique and limitations of the study

A. Sample size

In any survey, no matter how well planned or conducted, some error is inevitable. The most significant limitation in this study is the size of the sample used. The small size of the community study (n = 30) imposes severe limitations on the extent to which the findings can be generalised. It will have been noted that a rather small group of patients who developed pressure sores (6) were studied in the community. This was inevitable, given that the scattered nature of the community patients meant that the researcher could study only a small total sample of patients compared with the hospital. Nevertheless, it might draw a baseline of research for the future.

B. Sample selection

In fact the community sample was chosen for the researcher by the community nurses, who deemed whether a patient was suitable for study or not. Some patients could have been excluded by the staff for reasons such as severe confusion, patients' not liking to contribute, communication difficulties, or relatives wishing not to participate in the research; thus narrowing down the choice of the sample even more. There may have been patients who would have been suitable for the study in the view of the researcher, but who were precluded without the researcher being aware of them purely on the basis of subjective judgements of all grades of staff.

C. Environmental factors

Some of the patients in the hospital were affected by environmental factors which were impossible to control. Patients were naturally reluctant to criticise hospital staff, especially if the views they held were negative and if there were staff, patients, or visitors in the immediate vicinity of the interview situation. Personal questions could also be difficult for patients to answer (e.g. questions about continence). On many occasions conversations could be overheard by staff, other patients or visitors.

D. Diary sheets

Another limitation of the study was the reliance upon diary sheets being completed by those giving pressure area care to patients at the hospital. The staff in particular needed frequent reminders, and there was a much greater loss of patients from the study amongst the hospital group due to non-completion of diary sheets than in the community, where relatives and one nurse only were responsible for their completion.

Some of the diary sheets were completed with unclear writing. Unclear writing was identified and the researcher tried to decipher the meaning. However, this was a potential source of bias. Further, the study relied upon the relative and community nurse to record information related to a patient's Norton Score, (particularly if the patient was asleep during a researcher visit). Meanwhile, the design of the diary sheets evokes two main criticisms which were discovered later, and these give rise to the following suggestions for improvement:

i. Firstly

Methods of pressure area care called preventive measures should be separated by a line from the nursing observation about the site of skin area (Appendix I) to make things clear for nurse and relatives and avoid confusion.

ii. Secondly

The design of the methods used should be such that time can be recorded separately for each preventive measures activity to make it easy for analysis, whereas all these amounts of time were combined into man-hours of pressure area care devoted to direct preventive intervention in relation to pressure areas. It must be emphasised that the time recorded is not in itself necessarily a true picture of the time needed for care, because:

1. The time factor is governed by the speed of performance of those providing the attention and gives no indication of the quality of care.
2. The amount of care recorded for each patient was only that which was seen to be given, not necessarily the amount of time which might be considered desirable.

The absence of written, basic, individual nursing instructions (i.e. a pressure area care plan) was noted. This particularly affected the amount of nursing attention given at night for the prevention of pressure sores.

Indeed, written instructions on the basic nursing needs are essential for the maintenance of effective prophylactic measures to be carried out at all times throughout the 24 hours. For instance, the periods during which a severely incapacitated and often irremediable patient spent seated on a chair in the day-time prevented toilet attention to the skin and the regular changing of position which should have been carried out as routine care. The study extends to the community to see the nurses' and relatives' attention and use of facilities in the prevention of pressure sores with special concern as to the total time for pressure area care as a factor influencing pressure sores formation.

Further, the weakness of this study is that it is the work of one researcher and reflects one view. This increases subjectivity. However, the views, models and biases are made overt, so others are able to assess their influence on the results.

9.3 Recommendations

The recommendations which are listed here arise solely out of the results of this study, with all its limitations.

1. Another study similar to this one but utilising a larger sample and if possible drawing patients from a more extensive population within the community, might be done to verify the findings.
2. Further study could investigate the time actually needed for prevention and for treatment after skin breakdown appears.
3. Further research could evaluate patient nutritional status and nutritional behaviour so as to eliminate patient nutritional problems which might contribute in pressure sores development, including patient appetite, body type, height and weight.
4. Exploration might be done of district nurses' and relatives' attitudes towards patients at risk of pressure sores and the methods of assessment.
5. A study could be made of the effectiveness of the time spent on each category of pressure area care in relation to the outcome.
6. Further research needs to be done in order to assess how much knowledge qualified nurses actually have with regard to pressure area care planning and the nursing process, and whether or not this knowledge is accurate. This could be done in conjunction with an observational study to assess the quality of teaching given to learners by these qualified staff. The results of

such a study could have important implications for the planning of future staff development programmes.

<u>Implications of this study for nursing practice and the nursing service</u>

1. A patient educational programme on pressure area care, whilst the patient is in hospital. This could be achieved by teaching the patient how to change his/her position, the importance of checking the most vulnerable sites of the body, and the reason for checking these particular sites.
2. Teaching the programme to patients, family/carers, before the patient is discharged to his/her home.
3. Information from this study used in a sustained intensive in-service education programme for nursing staff (i.e. at the hospital and in the community) and this can be achieved by:
   a) Teaching the nurses in the school of nursing and/or on the wards, how to prevent skin breakdown and how to identify the patient at risk of developing pressure sores.
   b) Reinforcement of this teaching by regular group discussion, seminars and a frequent supply of nursing research journals, to refresh nursing staffs approaches and increase motivation toward pressure sores prevention.

9.4 Some suggestions on using a diary sheet for collecting data for the present study

To collect more reliable data, and with regard to the diary sheet, some suggestions need to be taken into consideration. These are set out below:

1. The diary sheet should be clearly written and have adequate space for recording the required information.
2. Before filling in a diary sheet, the nurses/relatives need to know what is meant by pressure area care and what is skin breakdown, the complications, and the methods of prevention. This knowledge is essential to ensure the cooperation of these carers.
3. A detailed explanation of the diary sheet, and the necessity of filling it is vital for continuity of recording the information.
4. Diary sheets must be attached to the patient's bed, to be filled in by nurses at the hospital, and to be kept with the patient's other sheets in the community, (i.e. at home and in day-hospital) so that they are readily available for nurses/relatives to fill in the information required.
5. In the present study, this method of a diary sheet in collecting data was extremely tiring for only one researcher or observer, and particularly so when new patients were admitted to the study, when they were reassessed and when collecting the full diary sheet. Moreover, in the community it was even more difficult, as patients lived in geographically scattered areas.
6. In doing such a survey using this method, the

researcher has to be a nurse, who therefore understands the population involved, and to avoid the embarrassment likely to be caused by the presence of a non-nursing researcher.

7. It seems useful if the researcher can stay at the hospital throughout the study period, to check the reliability of the data with the staff involved throughout the day/night shifts.

8. Good rapport and good communications should be established between nursing staff, in order to have the diary sheet filled in properly, to achieve the continuity of recording for 24 hours, and to prevent misunderstanding or the lack of information due to a nurse's absences or changes in the shift work. This can be achieved by making clear to the nursing staff that they will not be criticised if one of their patients develops skin breakdown. In practice, in the present study it was possible to obtain the carers' full cooperation in reporting all patients with impending pressure sores.

Therefore, the success of the entire programme depended on building a firm bond of confidence between the nursing staff and the researcher. This took some time, as nurses originally considered the existence of a pressure area care research programme as an infringement on their long-established custom of preventing pressure sores by their own personal methods.

REFERENCES

REFERENCES

Abbott, W.E. & Mellors, R.C. (1943).
Total circulating plasma proteins in surgical patients with dehydration and malnutrition.
Arch. Surg. 46, pp.277 - 288

Abruzzese, R.S. (1985).
Early assessment and prevention of pressure sores.
In Chronic Ulcer of the Skin, B.Y. Lee, ed. McGraw. Hill Brook Co. pp.1 -8

Adams, P., Davies, G.T. & Sweetnam, P. (1970).
Osteoporosis and the effects of ageing on bone mass in elderly men and women.
Quart. J. Med. 39, pp.601 - 615

Agris, J. & Spira, M. (1979).
Pressure ulcers. Prevention and treatment
Clin. Symp. 31, (5), pp.4

Allman, R.M.; Walker, J.M.; Hart, M.K.; Laprade, C.A.; Noel, L.B.; Smith, C.R. (1987).
Air-Fluidised beds or Conventional therapy for pressure sores, a randomised trial.
Ann. Intern. Med. 107, (5), pp.641 - 648

Andberge, M.M., Rudolph, A. & Anderson, T.P. (1983).
Improving skin care through patient and family training.
Topics in Clinical Nursing. 5.(2), pp.45-53

Andersen, K.E., Jensen, O., Kvorning, S.A. & Bach, E.(1982).
Prevention of pressure sores by identifying patients at risk.
Br. Med. J. 284, pp.1370 - 1371

Andrews, G.C. (1973).
Diseases of the Skin. (6th ed.). W.B. Saunders. Philadelphia, pp.55

Apley, A.G. (1977).
System of Orthopaedics and Fractures. (5th ed.). Butterworths. London.

Arnold, H.L. (1983).
Decubitus : The Word. In the Decubitus Ulcer, Parish, L.C., Witkowski, J.A. & Crissey, J.T., ed., Masson. USA, pp.1 - 3

Arnote, N. (1833).
Elements of physics or natural philosophy. V.1, Longman-Ress. Orme. Brown and Green. London

Bailey, B.N. (1970).
Bed sores.
Br. J. Hosp. Med. 32, pp.223

Bailey, B.N. (1971).
Surgical Closure of Sacral Sores.
Proc. R. Soc. Med. 64, pp.1148

Barbenel, J.C., Jordan, M.M. & Nichol, S.M. (1980).
Major pressure of sores.
Health. Soci. Serv. J. 90. pp.1344 - 1345

Barbenel, J.C., Forbes, C.D. & Lowe, G.D.O. (1983).
Pressure Sores.
Macmillan Press Ltd. London

Barbenel, J.C., Jordan, M.M., Nicol, S.M. & Clark, M.O. (1977).
Incidence of pressure sores in the Greater Glasgow Health Board area.
Lancet 2, pp.548 - 550

Bardsely, C. (1977).
Investigation into movement related to the aetiology of pressure sores. Ph.D. Thesis.
Bioengeneering Units. University of Strathclyde. Glasgow

Barr, A. (1967).
Measurement of nursing care.
Operational Research Units. Oxford Regional Hospital Board. Publication No.(9).

Barr, A., Moores, B. & Rhys-Hearn, C. (1973).
A review of the various methods of measuring the dependency of patients on nursing staff.
Int. J. Nurs. Stud. 10. (3), pp.195 - 288

Barratt, E. (1987).
Putting risk calculators in their place supplement pressure sores.
Nurs. Times 83. (6), pp.65 - 70

Barton, A. (1970).
The pathogenesis and inhibition of pressure sore.
M.D. Thesis
University of London. London

Barton, A.A. (1976).
The Pathogenesis of Skin Wounds due to Pressure. In Bed-Sore Biomechanics. Kenedi, R.M., Cowden, J.M. & Scales, J.T. ed. University Park Press. Baltimore. pp.55 - 61

Barton, A.A. (1977).
Prevention of pressure sores.
Nurs. Times 73.(41), pp.1593 - 1595

Barton, A.A. & Barton, M. (1968).
The inhibition of decubitus ulceration with ACTH.
J. Path. Bact. 96, pp.345

Barton, A.A. & Barton, M. (1969).
"ACTH and decubitus ulceration" - an experimental study.
Br. J. Pharmacol. 36, pp.219

Barton, A.A. & Barton, M. (1973).
The medical management of pressure sores.
Queen's. Nurs. J. Oct, pp.148 - 157

Barton, A.A. & Barton, M. (1981).
The management and prevention of pressure sores.
Faber and Faber. London

Beckett, B.S. (1982).
Biology-A Modern Introduction (2nd ed.).
Oxford University Press. Oxford

Bell, F., Ferie, G.R. & Barbenel, J.C. (1974).
Pressure sores : Their cause and prevention
Nurs. Times 70. (20), pp.740 - 745

Bennett, G.C.J. (1983a).
Pressure sores revisited.
Geriat. Med. 13 (5), pp.415 - 418

Bennett, G.C.J. (1983b).
Treating pressure sores.
Geriat. Med. 13 (6), pp.493 - 494

Bereck, K.H. (1975a).
Etiology of decubitus ulcers.
Nurs. Clin. N. America 10.(1), pp.157 - 170

Bereck, K.H. (1975b).
Treatment of decubitus ulcers.
Nurs. Clin. N. America 10. (1), pp.171 - 210

Bergtholdt, H.T. & Brand, P.W. (1975).
Thermography : An aid in the management of insensitive feet and stumps.
Arch. Phys. Med. Rehabil. 56, pp.205 - 209

Bliss, M.R. (1981).
Clinical research in patient support systems.
Care. Sci. Pract. 1. (1), pp.17-36

Bliss, M.R., Mclaren, R. & Exton-Smith, A.N. (1966).
Mattresses for preventing pressure sores in geriatric patients.
Ministry of Health & Public Health, Laboratory Service. 25, pp.238 - 268

Bliss, M.R., Mclaren, R. & Exton-Smith, A.N. (1967).
Preventing pressure sores in hospital : A controlled trial of a large cell ripple mattress.
Br. Med. J. 1, pp.394 - 397

Bliss, M. & Murray, E. (1979).
The use of Ripple beds.
Nurs. Times 75.(7), pp.280 - 283

Brand, P.W. (1976).
Pressure sores - the problem.
In Bed-Sore Biomechanics, Kenedi, R.M., Cowden, J.M. & Scales, J.T. ed., University Park Press Baltimore. pp.19 - 23

Brocklehurst, J.C. & Shergold, M. (1968).
What happens when geriatric patient leave hospital?
Lancet 2, pp.1133 - 1135

Brooks, B. & Duncan, G.W. (1940).
Effects of pressure on tissues.
Arch. Surg. 40, pp.696 - 709

Brown-Sequard, E. (1853).
Experiemental researche, applied to physiology and pathology. Medical Examiner and Record of Medical Science. H. Bailliere. New York.

Burgess, R.G. (1984).
In the Field : An Introduction to Field Research.
George Allen & Unwin. London

Bush, C.A. (1979).
Study of pressures on skin under ischial tuberosities and thighs during sitting.
Arch. Phys. Med. Rehabil. 50, pp.207 - 213

Caly, T. (1985).
Divide and rule.
Nurs. Times 81. (10), pp.48 - 49

Cantrell, E.G. & Dawson, J. (1983).
Young disabled in the community. In pressure sores. Barbenel, J.C., Forbes, C.D. & Lowe, G.D.O ed., Macmillan Press Ltd. London. pp.103 - 114

Cape, R.D.T., Coe, Rodney, C.M. & Rossman, I. (1983).
Fundamentals of Geriatric Medicine.
Raven press. New York

Carstairs, V. (1981).
Our elders. In The impending crisis of old age : A challenge to ingenuity, Shegog, R.F.A. ed., Nuffield Provincial Hospital Trust Series. Oxford University Press. Oxford

Central Office of Information. (1974).
British Information Services
Health Services in Britain. London

Charcot, J.M. (1879).
Lectures on diseases of the nervous system.
Translated by G. Sigerson. Philadelphia, Lea in J.H. Gibbon and L.W. Freeman. Primary closure of decubitus ulcers.
Am. J. Surg. 124, pp.1149, (1946)

Chrissafis, I. (1981).
Manpower planning by goal programming in two large institutions. Ph.D. Thesis.
Department of Operational Research, University of Strathclyde. Glasgow

Clark, M. (1988).
Measuring the pressure.
Nurs. Times 84.(25), pp.72 - 75

Clark, M. (1984).
Problems of the elderly on epidemiological perspective.
J. Roy Coll. Phys. Lond. 18.(2), pp.128 - 131

Clark, M.O., Barbenel, J.C., Jordan, M.M. & Nicol, S.M. (1978).
Pressure sores.
Nurs. Times 74.(9), pp.363 - 366

Clark, M. & Crow, R.A. (1986).
Prevelance of pressure sores within hospital and community patients : local survey to Guildford. Surrey on 2nd Oct. 1986. Report to the SW. Surrey District Health Authority

Clarke, M. & Kadhom, H. (1988).
The Nursing Prevention of Pressure Sores in Hospital and Community Patients.
J. Adv. Nurs. 13. (3), pp.365 - 373

Coates, V. (1983).
An investigation of the nutritional care given by nurses to acute medical patients, and of the influence that ward organisational patterns may have upon that care. M.Phil. Thesis. University of Hull.

Cotran, R.S. & Majno, G. (1964).
A light and electron microscopic analysis of vascular injury.
Ann. N. Y. Acad. Sci. 116, pp.750 - 764

Constantian, M.B. (1980).
Pressure Ulcers. Principles and Techniques of Management.
Little Brown and Company. Boston

Crow, R. (1979).

Summary and Conclusions.

Proceeding of a Conference at nursing practice research unit.

DHSS. London. pp.35

Crow, R. (1986).

Inaugural lecture Nursing : The place of science in professional practice.

University of Surrey. Surrey

Crow, R., David J. & Cooper, E. (1981).

Pressure sores and their prevention.

Nursing. First series. (26), pp.1139 - 1142

Daniel, R.K., Derek, L. & Wheatley, D.C. (1981).

Etiologic factors in pressure sores : An experimental model.

Arch. Phys. Med. Rehabil. 62, pp.492 - 498

David, J.A. (1981).

The size of the problem of pressure sores.

Care. Sci. Pract. 1. (1), pp.10 - 13

David, J.A. (1982).

Pressure sores treatment : A literature review.

Int. J. Nurs. Stud. 19. (4), pp.183 - 191

David, J.A. (1984).

Tissue breakdown.

Nurs. Mirror Suppl. 158. (10), pp.1 - 6

David, J.A. (1986).

Pressure area care: float like a butterfly ... range of aids which can help prevent them.

Comm. Outlook. 19. pp.21 - 22.

David, J.A., Chapman. R.G., Chapman, E.J. & Lockett, B. (1983).
An investigation for care for the current methods used in nursing care of patients with established pressure sores.
Report of the Northwick Park Nursing Practice Research Unit. University of Surrey

Davidson, S.S. & Passmore, R. (1966).
Human Nutrition and Dietetics.
(3rd ed.). Livingstone. Edinburgh

Davies, L. (1981).
Three score years... and then? A study of the nutrition and well being of elderly people at home.
William Heinemann Ltd. Medical Books. London

Davies, L. (1985).
Nutrition for the elderly : Healthy appetites
Comm. Outlook April, pp.29

Denne, W.A. (1979).
An objective assessment of the sheepskins used for decubitus sore prophylaxis.
Rheumatol. Rehabil. 18, pp.23 - 29

Department of Health and Social Security, Scottish Home and Health Department (1969).
Report of working party on management structure in local authority nursing services. Welsh Office

Dinsdale, S.M. (1970).
Mechanical factors in the pathogenesis of ischemic skin ulcers in swine. Ph.D. Thesis.
University of Minnesota

Dinsdale, S.M. (1973).

Decubitus ulcers in swine : Light and election microscopic study of pathogenesis.

Arch. Phys. Med. Rehabil. 54, pp.51 - 56

Dinsdale, S.M. (1974).

Decubitus ulcers : Role of pressure and friction in causation.

Arch. Phys. Med. Rehabil. 55. April, pp.147 - 152

Dorland's Illustrated Medical Dictionary (1974).

(25th ed.), W.B. Saunders. Philadelphia

Dyson, R. (1978).

Bed sores. The injuries hospital staff inflict on patients.

Nurs. Mirror 146. (24), pp.30 - 32

Edberg, L.E., Cerny, K. & Stauffer, E.S. (1973).

Preventing and treatment of pressure sore

Phys. Ther. 53. (3), pp.247 - 252

Ek, A.C. & Boman, G. (1982).

A descriptive study of pressure sores : The prevelance of pressure sore and the characteristics of patients.

J. Adv. Nurs. 7, pp.51 - 57

Ek, A.C. (1984).

The effect of massage on the local skin blood flow in areas at risk of pressure sores.

Int. Conference. Imperial College of Science and Technology. London

Exton-Smith, A.N. (1976).
Prevention of pressure sores : Monitoring mobility and assessment of clinical condition. In Bed-Sore Biomechanics. Kenedi, R.M., Cowden, J.M. & Scales, J.T. ed., pp.133 - 139

Exton-Smith, A.N. (1987).
(Personal Communication).

Exton-Smith, A.N. & Caird, F.I. (1980).
Metabolic and Nutritional Disorders in the Elderly.
Wright. Bristol

Exton-Smith, A.N., Overstall, P.W., Wedgwood, J. & Wallace, G. (1982).
Use of the air wave system to prevent pressure sores in hospital.
Lancet 1, pp.1288 - 1290

Exton-Smith, A.N. & Sherwin, R.W. (1961).
Prevention of pressure sores : significance of spontaneous bodily movements.
Lancet 2, pp.1124 - 1126

Ferguson, P.M.W. (1977).
Critical assessment of the effects of pressure with special reference to the development of pressure sores. Ph.D. Thesis.
University of Strathclyde. Glasgow

Ferguson, P.M.W., Wilkie, L.C., Reswick, J.B. & Barbenel, J.C. (1980).
Pressure sore prevention for the wheelchair-bound spinal injury patient.
Paraplegia 18, pp.42 - 51

Fernie, G.R. (1973).
Biomechanical Aspects of the Aetiology of decubitus ulcers on human patients. Ph.D. Thesis. University of Strathclyde. Glasgow

Fibricius, H. (1593).
De Gangraene et sphacelo. Tractatus Methodicus. 10th edition (Leyden, J.T. de Bry)

Fisher, R.A. (1936).
The use of multiple measurements in taxonomic problems.
Ann. Eugenics 7, pp.179 - 188

Freed, M.M., Bakst, H.J. & Barrie, D.C. (1966).
Life expectancy, survival rates and causes of death in civilian patients with spinal cord trauma.
Arch. Phys. Med. 47, pp.457

Freeman, B.S. (1947).
The treatment of bedsores in paraplegic patients.
Surgery. St Louis. 21. pp.668

Galpin, J.E., Chow, A.W., Bayer, A.S. & Guze, L.B. (1976).
Sepsis associated with decubitus ulcers.
Am. J. Med. 61, pp.346 - 350

Gerson, L.W. (1975).
Incidence of pressure sores in active treatment Hospitals. Int. J. Nurs. Stud. 12, pp.201 - 204

Goldstone, L.A. & Goldstone, J. (1982).
The Norton Score : An early warning on pressure sores?
J. Adv. Nurs. 7. (5), pp.419 - 426

Gosnell, D.J. (1973).
An assessment tool to identify pressure sores.
Nurs. Res. 22. (1), pp.55 - 59

Gould, D. (1985).
Pressure sore change.
Nurs. Mirror 161. (16), pp.28 - 30

Gould, D. (1987).
Patients and pressure sores.
Nurs. Times 3. (47), pp.48 - 51

Grant, N. (1977).
A method for calculating nursing workload based on individualised nursing care.
University of Edinburgh. Ph.D. Thesis.
Edinburgh

Green, M.F. (1976).
Pressure sores : The team approach.
Nurs. Times 72. (8), pp.292 - 294

Groth, K.E. (1942).
Clinical observations and experimental studies of the pathogenesis of decubitus ulcers.
Acta. Chir. Scand. 87. Suppl. (76), pp.1 - 203

Gruis, M.L., Innes, B. (1976).
Assessment : Essential to prevent pressure sores.
Am. J. Nurs. 76. (7), pp.1762 - 1764

Guttman, L. (1955).
The problem of treatment of pressure sores in spinal paraplegics.
Br. J. Plast. Surg. 8, pp.196 - 213

Guttman, L. (1976).
The prevention and treatment of pressure sores. In Bed-sores Biomechanics, Kenedi, R.M., Cowden J.M. & Scales, J.T. ed., University Park Press. Baltimore. London, pp.153 - 159

Hall, M.R.P., Maclennan, W.J. & Lye, E. (1986).
Medical care of the elderly. (2nd ed.). A Wiley Medical Publication. John Wiley and Sons. New York

Hamilton, S. (1976).
Nil by mouth. Roy. Coll. Nurs. London

Harman, J.W. (1947).
A Histological study of Skeletal Muscle in Acute Ischemia. Am. J. Path. 23, pp.551 - 554

Hibbs, P. (1982).
Pressure sores a system of prevention. Nurs. Mirror 155 (5), pp.25 - 29

Hibbs, P. (1985).
Pressure area care. Taking off the pressure. Nurs. Mirror 160. (13), pp.3 - 6

Hibbs, P. (1987).
Prevention : Can we afford it? Paper presented in the Third Pressure Sore Symposium held in Bath on March 11 -12

Hicks, D.J. (1970).
An incidence study of pressure sores following surgery. Am. Nurs. Assoc. Appleton. Century Crofts. New York

Hodgman's, E.C. (1978).

Student research in service agencies.

Nurs. Outlook 26, pp.558 - 565

Hospital Advisory Service (1983).

Report of the committee on nursing.

Annual Report. HMSO. London

Hubay, C.A. (1957).

Surgical management of decubitus ulcers in the post traumatic patient.

Amer. J. Surg. 93, pp.705

Hulland, S. (1985).

A comparison of nurses actions and beliefs in relation to pressure sore prophylaxis. M.Sc. thesis.

Department of Nursing in the Faculty of Medicine.

University of Manchester. Manchester

Hunt, J. (1981).

Indicators for nursing practice. The use of research findings.

J. Adv. Nurs. 6, pp.189 - 194

Husain, T. (1953).

An experimental study of some pressure effects on tissues with reference to the bed sore problem.

J. Path. Bact. 66, pp.347 - 358

Irvine, R.E., Memon, A.H. & Shera, A.S. (1961).

Norethandrolone and prevention of pressure sores.

Lancet 2, pp.1333 - 1334

Jackson, J. (1983).

Sheepskins - a potential hazard.

Nurs. Times 79. (18), pp.41 - 45

Jacob, S. Francone, C.A. & Lossow, W.J. (1978).
Structure and function in man. (4th ed.)
Hughes. Angus. Philadelphia

Jacox, A.K. (1978).
Research forms vanguard of Nursing Profession
The Am. Nurse. 10.(5), pp.13

Jay, P. (1983).
Choosing the best wheelchair cushion : for your needs, your chair and your life style.
Royal Association for Disability and Rehabilitation
DHSS. London

Jones, E. (1980).
Prevention of pressure sores : The clinical score chart.
Nurs. Times 76. (13), pp.565 - 566

Jones, F. (1979).
Teaching and Equipping the Patient at Risk.
Proceedings of a conference at the Nursing Practice Research Unit. DHSS. London. pp.23 - 25

Jones, J. (1986).
An investigation of the diagnostic skills of nurses on an acute medical unit relating to the identification of risk of pressure sore development in patients.
Nurs. Pract. 1, pp.257 - 267

Jordan, M.M. & Clark, M.O. (1977).
Report on the incidence of pressure sores in the patient community of the Greater Glasgow Health Board Area on 21 January 1976.
Bioengineering Unit and (University of Strathclyde. The Greater Glasgow Health Board. Glasgow)

Jordan, M.M., & Nicol, S.M. (1977).
Report on the incidence of pressure sores in the patient community of the Borders Health Board Area on 13 October 1976
Bioengineering Unit. University of Strathclyde and Borders Health Board. Glasgow

Kenedi, R.M., Cowden, J.M. & Scales, J.T. (1976).
Bed-sore biomechanics.
University Park Press. Baltimore. London

Kennedy, R.H. (1946).
New view point toward spinal cord injuries.
Ann. Surg. 124. Dec, pp.1057

Kerlinger, F. (1973).
Foundations of behavioural research. (2nd ed.)
Holt. Reinehart and Winston. New York

Kerr, J. Sinson, S. & Shanon, M.L. (1981).
Pressure sores. Distinguishing fact from fiction
Can. Nurs. 77. July - Aug, pp.23 - 28

Kleinbaum, D.G. & Kupper, L.L. (1978).
Applied Regression analysis and other multivariable methods.
Duxbury Press. North Scituate, Massachusetts

Knoll Pharmaceutical Co. New Jersey. (1982).
The Knoll Scale of liability to pressure sores.
In Guide to Practice of Nursing.
McFarlane, J. & Castledine, G.A. ed., The C.V.
Mosby. Co. Ltd. St. Louis

Kosiak, M.D., Kubicek, W.G., Olson, M., Danz, J.N. &
Kattke, F.J. (1958)
Evaluation of pressure as a factor in the
production of ischial ulcers.
Arch. Phys. Med. Rehabil. 39, pp.623 - 629

Kosiak, M. (1959).
Etiology and pathology of ischemic ulcers.
Arch. Phys. Med. Rehabil. 40, pp.62 - 69

Kosiak, M. (1961).
Etiology of Decubitus Ulcers.
Arch. Phys. Med. Rehabil. 42, pp.19 - 29

Krouskop, T.A. (1983).
A synthesis of the factors that contribute to
pressure sores formation.
Med. Hypothesis 11. (2), pp.255 - 267

Krouskop, T.A., & Reddy, N.P., Spencer, W.A. & Secor, J.W.
(1978).
Mechanisms of decubitus ulcer formation. An
hypothesis.
Med. Hypothesis 4. (1), pp.37 - 39

Krouskop, T.A., Noble, P.C., Garber, S.L. & Spender, W.A.
(1983).
The effectiveness of preventive management of
reducing the occurrence of pressure sore.
J. Rehabil. Res. Devel. 20. (1), pp.74 - 83

Kumar V.N. & Redford, J.B. (1984).
Rehabilitation of hip fractures in the elderly.
Am. Fam. Physician 29.(1), pp.173 - 180

Lee, B.Y. (1985).
Chronic ulcers of the skin.
McGraw. Hill Book Co.

Leyden, E. (1874).
Klinik der Ruckermarks. Krankheiten. Berlin.
A. Hirschwald. 1, pp.156

Lindan, O. (1961).
Etiology of decubitus ulcers : An experimental study.
Arch. Phys. Med. Rehabil. 42, pp.774 - 783

Lindan, O., Greenway, R.M. & Piazza, J.M. (1965).
Pressure distribution on the surface of the human body. Evaluation in lying and sitting positions using A "Bed of spring and nails".
Arch. Phys. Med. Rehabil. 46, pp.378 - 385

Linn, B.S. (1975).
Chronologic us. Biologic Age in Geriatric patients. in The Physiology and Pathology of Human Aging, (eds.). Goldman, R. & Rockstein, M. ed., Academic Press. New York, pp.9 - 18

Livesley, B. (1986).
Airwaves take the pressure.
Nurs. Times 82, (32). pp.67 - 68, 71.

Lovell, D.L. (1945).
Skin Bacteria. Their Location with reference to skin sterilization.
Surg. Gynecol. Obstet. 80. pp.174 - 177

Lowthian, P. (1970).

Decubitus ulcers : A fresh look at some perennial nursing problems. Parts 1 and 2.

(London Kindy Edwards Hospital Fund Centre)

Lowthian, P. (1971).

Bed sores - Current methods of prevention and treatment.

Nurs. Times 67. (17), pp.501 - 503

Lowthian, P. (1978).

The recognition and definition of pressure sores.

Discussion paper Group "C"

(Personal communication).

Lowthian, P. (1979a).

Pressure sore prevelance.

Nurs. Times 75. (9), pp.358 - 360

Lowthian, P. (1979b).

Turning clocks system to prevent pressure sores.

Nurs. Mirror 148. (21), pp.30 - 31

Lowthian, P. (1982).

A review of pressure sores pathogenisis.

Nurs. Times 78. (3), pp.117 - 121

Lowthian, P. (1983).

Nursing aspects of pressure sore prevention.

In. Pressure Sores. Barbenel, N.C., Forbes, C.D., & Lowe, S.D. ed., Macmillan. London, pp.133 - 141

Lowthian, P. (1987).

(Personal Communication.)

Majno, G. (1975).
The Healing Hand.
Harvard University of Cambridge Press.
Massachusettes.

Marks, J. (1977).
Young physically disabled dependents and their families. A pilot study in parts of Hampshire
Southampton University.

Marshall, R.S. (1971).
Cold therapy in the treatment of pressure sores.
Physiotherapy. 57, pp.372 - 373

McClemont, E.J.W. (1984).
Pressure sore. No pressure. No sore.
Supplement to Nursing Second Series 21.
Nursing (Oxford). 2.(21), pp.1 - 3

McFarlane, J., & Castledine, G. (1982).
A Guide to the Practice of Nursing using the Nursing Process.
C.V. Mosby Co. London

Meissner, J.E. (1980).
Which patient on your unit might get a pressure sore?
Nursing 80, pp.64 - 65

Merlino, A.F. (1969).
Decubitus ulcers : Cause, prevention and teatment.
Geriatric 24. (3), pp.119 - 124

Mikulic, M.A. (1980).
Treatment of pressure ulcers.
Am. J. Nurs. 80, pp.1125 - 1128

Miller, M.E. & Sachs, S.M. (1974).
About bed sores. What you need to know to help prevent and treat them.
Lippincott Co. Philadelphia

Moghissi, K. & Boore, J.R. (1983).
Parenteral and Enteral Nutrition for Nurses.
Heinemann Medical. London

Montagna, W. (1974).
The Structure and Function of the Skin. (3rd ed.)
Academic Press. London

Montes, L.F., & Wilborn, W.H. (1970).
Anatomical location of normal skin flora.
Arch. Dermatol. 101, pp.145 - 159

Moolten, S.E. (1972).
Bed Sores in the Chronically ill Patient.
Arch. Phys. Med. Rehabil. 53, pp.430 - 438

Morley, M.H. (1973).
Decubitus ulcer management. A team approach.
Can. Nurs. 69. (10), pp.41 - 43

Mulholland, J.H., Tui, C. & Wright, A.M. (1943).
Protein metabolism and bed sores.
Ann. Surg. 118, pp.1015 - 1023

Munro, D. (1940).
Care of the back following spinal cord injuries.
Consideration of bed sores.
N. Eng. J. Med. 223. (11), pp.391 - 398

Newman, P. & Davis, N.H. (1981a).
Thermography as a predictor of sacral pressure sores.
Age and Aging 10, pp.14 - 18

Newman, P. & Davis, N.H. (1981b).
Thermography as a screening technique.
Nurs. Times 77, pp.81 - 84

Nicholson, P.W., Leeman, A.L., O'Neill, C.J.A., Dobbs, S.M., Deshmukh, A.A., Denham, M.J., Royston, J.P. & Dobbs, R.J. (1988).
Pressure sores : Effect of Parkinson's Disease and congitive function on spontaneous movement in bed.
Age and Aging 17, pp.111 - 115

Nightingale, F. (1859).
Notes of Nursing : What it is. What it is not.
Stern. Philadelphia. Stern. 1946. Originally published. Harrison. London

Nightingale, F. (1866).
Notes on Nursing, (1980) ed.
Churchill. Livingstone. Edinburgh

Norton, C. (1986).
Nursing for continence.
Beaconsfield Ltd. Beaconsfield, Bucks. England.

Norton, D. (1979).
Extent and nature of the problem in DHSS.
Prevention of pressure sores.
Proceedings of a Conference held at Nursing Practice Research Unit. Northwick Park

Norton, D., Mclaren, R. & Exton-Smith, A.N. (1962).
An investigation of geriatric nursing problems in hospital. National Corporation for care of old people. Republished 1975.
Churchill Livingstone. London

Nyquist, R. & Hawthorn, P.J. (1985).
The prevelance of pressure sores within an area health authority. Nursing Studies Unit Medical School, University of Nottingham. Nottingham

Nyquist, R. & Hawthorn, P.J. (1987).
The prevalence of pressure sores within an area health authority.
J. Adv. Nurs. 12, pp.183 - 187

Oppenheim, A.N. (1966).
Questionnaire Design and Attitude Measurement.
Heinemann. London

Paget, J. (1873).
Clinical lecture on bed sores. Students
J. Hosp. Gazette. London. 1, pp.144

Parish, L.C. & Joseph, A.W. (1983).
Decubitus Ulcer : How to Intervene Effectively.
Drug. Ther. Hosp. 8. (2), pp.95 - 98

Parish, L.C., Witkowski, J.A. & Crissey, (1983).
The Decubitus Ulcer.
Masson. USA

Parr, E. (1979).
A patient with pressure sores.
Nurs. Times 75. (9), pp.369 - 372

Pecora, D.V., Landis, R.E. & Martin, E. (1968).
Location of Cutaneous Microorganisms.
Surgery 64, pp.1114 - 1118

Perkash, A. & Brown, M. (1982).
Anaemia in patients with traumatic spinal cord injury.
Paraplegia 20, pp.235 - 236

Petersen, N.C. (1976).
The development of pressure sores during hospitalisation. In Bed-sore Biomechanics, Kenedi, R.M., Cowden, J.M. & Scales, J.T. ed., Macmillan. London. pp.219 - 224

Petersen, N.C. & Bittmann, S. (1971).
The epidemiology of pressure sores.
Scand. J. Plast. Reconstr. Surg. 5, pp.62 - 66

Pinel, C. (1976).
Pressure Sores.
Nurs. Times 5, pp.172 - 174

Price, P.B. (1938).
The Bacteriology of normal skin : A new Quantitative test applied to a study of the bacterial flora and the Disinfectant action of mechanical cleansing.
J. Inf. Dis. 63, pp.301 - 318

Pritchard, V. (1986).
Calculating the risk.
Nurs. Times 82. (8), pp.59 - 61

Ramsay, B.M. (1979).
Pressure sores in para. and tetraplegic patients.
Nurs. Times 75. (9), pp.361 - 364

RCP, (1989).
Fractured neck of femur - prevention and management.
The Royal College of Physicians. London.

Rebell, G., Pillsbury, D.M. de Saint Phalle. M. & Ginsburg, D. (1950).
Factors affecting the rapid disappearance of bacteria placed on the normal skin.
J. Invest. Dermatol. 14, pp.247

Redfern, S. (1986).
Nursing Elderly People.
Churchill. Livingstone. Edinburgh

Reichel, S. (1958).
Shearing force as a factor in decubitus ulcers in paraplegics.
J. Am. Med. Assoc. 166, pp.762 - 763

Roberts, B.V., Goldstone, L.A. (1979).
A survey of pressure sores in the over sixties on two orthopaedic wards.
Int. J. Nurs. Stud. 16, pp.355 - 364

Robertson, J. (1987).
Counting the costs.
Nurs. Times 83. (39), pp.56

Roddey, M.P. (1983).
Decubitus ulcers. Principles of prevention and management.
Geriatrics 38. July, pp.55 - 57

Rook, A.W., Wilkinson, D.S. & Ebling, F.J.G. (1979).
Textbook of Dermatology (2nd ed.),
Blackwell. Oxford.

Roper, N. (1982).
Principles of Nursing. Text (3rd ed.)
Chirchill. Livingstone. London

Rubin, C.F., Dietz, R.R. & Abruzzese, R.S. (1974).
Auditing the decubitus ulcers problem.
Am. J. Nurs 74. (10), pp.1820 - 1821

Rudd, T.N. (1962).
Pathogenesis of decubitus ulcers.
J. Am. Geriat. Soci. 10, pp.48 - 53

Rushmer, R. (1970).
Cardiovascular Dynamic. (3rd ed.).
W.B. Saunders Co. Philadelphia. pp.136

Sather, M.R., Weber, C E.J.R. & George, J. (1977).
Pressure sores and the spinal cord injury patient.
Drug. Intell. Clin. Pharm. 11, pp.154 - 169

Scales, J.T. (1976).
Pressure on the patient. In Bed-Sore Biomechanic.
Kenedi, R.M., Cowden, J.M. & Scales, J.T, ed.,
Macmillan. London, pp.11 - 17

Scales, J.T. Lowthian, P.T., Poole, A.G. & Ludman, W.R. (1982).
Vaperm patient support system : A new general purpose hospital mattress.
Lancet 2, pp.1150 - 1152

Scales, J.T., & Hopkins, L.A. (1971)
Patients support systems using low pressure air.
Lancet 2, pp.885 - 888

Schilling, J.A. (1968).
Wound Healing.
Physiol. Rev. 48. (2), pp.374 - 423

Scott, C.J. (1986).
The ill elderly patient - is he dehydrated too?
Geriat. Med. 16. (5), pp.59 - 61

Scottish Home and Health Department (1969).
Nursing workload per patient as a basis for staffing.
HMSO. Edinburgh. 9, pp.41

Selye, H. (1956).
The Stress of Life.
MacGraw. Hill Book Col. New York

Selye, H. (1967).
Ischemic Necrosis : Prevention by stress.
Science 156, pp.1262

Shaw, J. & Hughes, A. (1985).
Pressure sores and the orthopaedic traction yet another skin area to protect.
Nat. News. Sept, pp.34 - 36

Shea, J.D. (1975).
Pressure sores classification and management.
Clin. Orthopaed. Related. Res. 112, pp.89 - 100

Simon, J. (1978).
Basic Research Methods in Social Science (2nd ed.).
Random House. New York

Skilleter, R. & Complin, M. (1986).
Nursing the elderly at night.
Geriat. Nurs. Home Care Nov - Dec, pp.14 - 17

Spence, W.R., Burk, R.D., & Rae, J.W. (1967).
Gel support for prevention of decubitus ulcers.
Arch. Phys. Med. Rehabil. 28, pp.283 - 288

Spira, M., Moore, J., Hardy, S.B. & Aron, F. (1969).
Care of decubitus ulcer patient.
Gen. Pract. 39.4, pp.78 - 89

$SPSS_x$. (1983).

User's Guide

McGraw-Hill Book Company. U.S.A.

Stapleton, M.F. (1978).

Prevalence of Pressure Sores in One Health District. Worthing Health District. 3rd edition.

Steger, H.G. (1979).

Understanding the psychogenic factors in rehabilitation in Carfield C.A. (ed)

Stress in Survival C.V. Mosby Co. St. Louis

Stevens, B.J. (1975).

The Nurses as Executive.

Contemporary Wakefield. Massachusetts

Stock, P.E., Majno, G. (1969).

Vascular responses to experimental tourniquet ischemia.

Surg. Gynecol. Obstet. 129, pp.309 - 318

Thompson, R.J. (1961).

Pathological change in mumies.

Proc. Roy. Soci. Med. 54, pp.409

Tilton, C.N., & Maloof, M. (1982).

Diagnosing the problems in stroke.

Am. J. Nurs. 83. (4), pp.596 - 601

Torrance, C. (1981).

The perennial pressure sore 2. Predisposing factors : The at risk patient.

Nurs. Times 77. (8), pp.v - viii

Torrance, C. (1983).

Pressure sores. Aetiology. Treatment and prevention.

Croom. Holm. London & Canberra.

Treece, E., & Treece, J. (1973).

Elements of Research in Nursing. (2nd ed.)

C.V. Mosby. Co. St. Louis

Tunstall, J. (1966).

Old and alone : A sociological study of old people.

Routledge and Kegan. Paul. London

Turton, P. & Orr, J. (1985).

Learning to care in the Community.

Hodder and Staughton. London

Van Ort, S. (1981).

Research Design : Pilot Study. In Readings for Nursing Research. S. Krampitz & N., Pavlovich Eds.

C.V. Mosby.

St. Louis. pp.49 - 53

Vera, D.H. & Rogers, J. (1986).

Research for Practising Nurses.

Macmillan. M. Education Ltd. London

Versluysen, M.C. (1983).

Pressure sores in an orthopaedic population : An epidemiological survey.

City and Hackney Research Papers. (1).

St Bartholomews Hospital. London

Versluysen, M.C. (1985).

Pressure sores in elderly patients. The epidemiology related to hip operations.

J. Bone. Joint. Surg. 67B, pp.10 - 13

Vetter, N.J., Jones, D.A. & Victor, R. (1984).
Projected use in two general practices of services by the elderly at home.
Br. Med. J. 289, pp.1193 - 1195

Walden, R.H., Gorge, F., & John S. (1971).
Inoperable pressure sores.
J. Med. 71, pp.657 - 662. New York

Waldron, I., & Johnson, S. (1976).
Why do women live longer than men?
Human Stress 2, pp.2 - 13

Warner, U. (1982).
Pressure sores, prevelance at a general hospital and policy for prevention (unpublished).
Community Medicine and Nursing Research Unit.
St. Mary's Hospital. London

Waterlow, J.A. (1985).
A risk assessment card.
Nurs. Times 81. (48), pp.51 - 55

Waterlow, J.A. (1987).
Calculating risk.
Nurs. Times 83. (39), pp.58 - 60

Waterlow, J.A. (1988a).
Towards a pressure sore policy.
Care. Sci. Pract. 6. (1), pp.8 - 12

Waterlow, J.A. (1988b).
Prevention is cheaper than cure.
Nurs. Times 84. (25), pp.69 - 70

Westaby, S. (1982).
Wound Care.
Medical Book (ed.). William. Heinemann. London

Wheatley, D.C. (1982).
Assessment of movement in the elderly during sleep with reference to pressure sore prevention.
Ph.D. Thesis. Bioengineering Unit. University of Strathclyde. Glasgow

Wheeler, R. (1986).
Better houses for the elderly.
Comm. Outlook Feb, pp.11 - 14

Wilfred, F. (1967).
Second class aged : Too few nurses in geriatric wards.
The Daily Telegraph. Thur. July 20

Williams, A. (1972).
A study of factors contributing to skin breakdown.
Nurs. Res. 21. (3), pp.238 - 243

Wilms Kretschmer, K., & Majno, G. (1969).
Ischaemia of the skin.
Am. J. Path. 54. (3), pp.327 - 353

Wolcott, L.E., Wheeler, P.C., Hardwicke, H.M. & Rowley, B.A. (1969).
Accelerated healing of skin ulcers by electrotherapy. Preliminary Clinical Results.
Southern. Med. J. 62, pp.795 - 801

Wood, E.J., & Bladon, P.T. (1985).
Studies in Biology No. 164.
The Human Skin.
Edward Arnold Ltd. London

Woodbine, A. (1979).

A survey in Macclesfield. Recording incidence and management of pressure sores.

Nurs. Times 75. (27), pp.1128 - 1138

Wyllie, F.J., Mclean, N.R. & McGregor, J.C. (1984).

The problem of pressure sores in a regional plastic surgery unit.

J. Roy. Coll. Surgeon. Edinburgh. 29, pp.38 - 43

APPENDICES

Appendix A Nurse's/ Relatives letter

Institute of Nursing Studies
The University of Hull HU6 . 7RX

Director. Miss Margaret Clarke, SRN, RNT, B Sc. M Phil. Tel (0482) 46311

Dear Nurse/Relative,

I will visit you in hospital/community(at your home), over a period of six weeks to collect data using a diary sheet. The aim is to identify patients at risk from the development of pressure sores, and to evaluate the preventative measures which nurses/ relatives carry out and the time spent in giving the preventive care. The way of doing this is using a diary sheet. May I ask you to kindly complete the diary sheet and I will collect it twice a week.

The diary sheet which I enclose is divided into columns giving space to record time at start of care, either am/pm in hr/min, time at finish of the care, type of care given, including turning position; cleaning of skin; use of relieving aids; then your observations whilst carrying out the care for skin area; condition of skin area; any change in skin area. I would be very grateful if you would complete this form every time you carry out any care directed at the patients pressure areas, and sign it.

I will visit you twice a week to collect diary sheets, give new ones and to see generally how the patient. is getting on. You are very welcome to ask me questions or to get in touch with me at any time.

I should like to assure you that any information given either by diary sheet or by interviewing or observation will be strictly confidential, in the sense that no patient, relative or nurse will be identified .

Yours sincerely,

Hana M. Kadhom
Research student

Appendix A Nurse's/ Relatives letter

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Yours sincerely,

Hana M. Kadhom
Research student

Appendix 1

Patient Name........ .... Date of admission.............. Ward....................

Age........ .. Sex..... .M/F

Health center................

(A) Turning the patient	(B) Skin cleaning used	(C) Pressure relieving device
I- turning by assistance 2-Self turning 3-Lift free of bed or chair (momentarily) 4-Self lift free of bed or chair (momentarily)	I-Soap and water massaged 2-Soapy water 3- Soap and water spirit 4- Zinc cream preparation 5- Other please specify	I-Sheep skin 2- Ripple mattress 3-Water bed 4- Monkey pole 5- Sorbo ring 6-Flotation cushion 7-Other please specify

(D) Site of skin area	(E) Condition of skin area	(F) Change in skin area
I- Sacrum 2-Heels 3-Hips 4-Elbows 5-Knees 6-Ankle 7-Buttocks 8-Other please specify	I- Skin discoloration redness OF skin erythema 2-Blister 3-Superficial skin break down 4- Good and intact	I-Static 2- Improved 3- Worse

Date	Start time for care	Finish time for care	A	B	C	D	E	F	Signature and grade	Comments

Appendix 1a

DIARY SHEET

Patient Name .... Sex .... Ward ....

Age .... Date of Admission .... Norton Score on Admission .... Health Centre ....

Date	Time Start time	Taken Finish time	Turning the patient	Skin Cleaning used	Pressure relieving device	Site of skin area	Condition of skin area	Change in area	Signature	Comments

Appendix 1b

Turning the patient	Skin Cleaning used	Pressure relieving device	Site of skin area	Condition of the skin	Change in the area
L-R	Soap & Water massage to clean the area	Sheepskin	Sacrum - Sa	(A) skin dis-coloration	Healed
R-L	Soapy water	Cradle	Heels - LH RH	Red-black scab	Improved
L-Bk	Witch hazel	Poly float foam mattress	Hips - LHP RHP	Erythema	Static
Bk-L	Soap & water spirit	Large cell ripple mattress	Elbows- LE RE	(B) Blister	Worse
R-Bk	Zinc cream preparation	Beaufort Beam mattress	Knees - LK RK	(2) Superficial skin break-down	
Bk-R	Other	Water bed	Ankle Lan Ran	(3) Destruction of skin. No cavity	
		Flotation Bed	Buttocks- R L	(4) Destruction of skin with cavity	
L - left		Foam	Occipit		
R - right		Sorbo ring	Other		
B - back		Monkey pole			
		Flotation cushion			
		Other - please specify			

Appendix 2

SUMMARY SHEET

Patient's Name .... Date of Admission .... Ward ....

Age .... M/F .... Transferred .... Health centre ....

Diagnosis .... Discharged ....

.... Died ....

Ht .... Wt .... Initial Norton Score ....

Date	Present Norton Score I	II	III	IV	V	Total Score	Time Spent Daily	Method used A	B	C	Description of the lesion D	E	F	Appetite good/poor	Care given by	Outcome Develop p.s. / not develop p.s.

Appendix 2a

SUMMARY SHEET

Patient Name .... Date of Admission .... Ward .... Health Centre ....

Age .... Norton Score on admission .... Diagnosis ....

Sex .... Wt .... Ht ....

Date	Present Norton Score A	B	C	D	E	Total Score	Time Spent Daily	Method Used	Description of the lesion: Site of skin area	Condition of skin	Change in area	Outcome

Notes

Appendix 3 Correlation matrix between the independent discriminant variables (Hospital Study).

	AGE	SEX	DIAG	LENGTHOF	INITIALS	LASTS	MEANTT	TURNPAT	CLEANSKN	PRD	SITESKN
AGE	1.00000										
SEX	0.09405	1.00000									
DIAG	-0.29324	-0.03568	1.00000								
LENGTHOF	-0.34956	0.08095	0.07870	1.00000							
INITIALS	-0.05295	0.17668	-0.10820	-0.10935	1.00000						
LASTS	-0.33620	0.11943	-0.08065	0.41328	0.20054	1.00000					
MEANTT	0.12488	-0.07947	-0.05620	-0.36487	0.11706	-0.32983	1.00000				
TURNPAT	-0.04507	0.17274	-0.22096	0.24298	0.21185	0.35264	-0.12777	1.00000			
CLEANSKN	0.00579	0.01626	0.02119	0.05864	-0.00903	0.10518	-0.04920	0.18113	1.00000		
PRD	-0.29825	0.03281	0.17712	0.12842	0.01495	0.15647	-0.36609	-0.06417	-0.04293	1.00000	
SITESKN	-0.22892	0.06794	0.14023	0.09487	-0.02478	0.10377	-0.20202	-0.10643	-0.10400	0.67329	1.00000
CONDN	-0.17221	0.03910	0.09950	0.16421	0.09021	0.38602	-0.19390	0.22179	0.04315	0.51436	0.46652
CHANGEA	-0.09508	0.03241	0.10412	-0.08850	0.01333	-0.10037	0.00357	-0.15257	-0.10615	0.54433	0.535[illegible]
ONAPTIE	0.05816	-0.16341	-0.04059	-0.27876	0.04700	-0.09067	0.07327	-0.11567	-0.00829	0.20046	-0.09577
LAPTIE	0.18312	0.04693	0.12665	-0.13998	-0.30403	-0.48078	0.05014	-0.29421	-0.17200	-0.11525	-0.11627
CAREGB	0.00044	-0.29400	0.02702	-0.01876	-0.22483	-0.07724	0.07874	-0.14950	0.10770	-0.13069	-0.0099[illegible]
OUTCOME	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
FROCARE	-0.11600	-0.05172	0.00016	0.30764	0.02410	0.22545	-0.46083	0.04705	-0.04427	0.09405	-0.0167[illegible]
WARD	0.12111	-0.24924	0.10623	-0.25403	-0.18351	-0.40517	0.46049	-0.27373	-0.10630	-0.38546	-0.0535[illegible]
PHYSCO	-0.30606	0.11325	0.06735	0.57071	-0.06081	0.23730	-0.25473	0.12695	0.06672	0.15150	0.1005[illegible]
MENTALS	-0.32751	0.11814	0.10293	0.55081	-0.03214	0.30527	-0.37155	0.20419	0.02347	0.25385	0.1356[illegible]
ACTIVITY	0.00067	-0.08440	-0.20014	0.45200	-0.05189	0.31649	-0.19749	0.26094	-0.00147	-0.04381	0.0594[illegible]
MOBILITY	-0.20357	-0.09969	0.04725	0.53194	-0.05383	0.37495	-0.15816	0.15561	0.15843	0.09027	-0.0441[illegible]
INCONTI	-0.14321	0.12896	0.02774	0.56359	-0.10610	0.05161	-0.17107	0.00421	0.00343	0.07130	0.1394[illegible]

	CONDN	CHANGEA	ONAPTIE	LAPTIE	CAREGB	OUTCOME	FROCARE	WARD	PHYSCO	MENTALS	ACTIVIT
CONDN	1.00000										
CHANGEA	0.05095	1.00000									
ONAPTIE	-0.28260	0.03991	1.00000								
LAPTIE	-0.31531	0.03405	0.10825	1.00000							
CAREGB	-0.07246	-0.05789	0.06147	0.04470	1.00000						
OUTCOME	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000					
FROCARE	0.04067	-0.11925	-0.17535	0.00107	0.03617	99.00000	1.00000				
WARD	-0.30699	0.00207	0.28714	0.07473	0.38164	99.00000	-0.33969	1.00000			
PHYSCO	0.15855	0.19724	-0.15714	-0.12027	-0.15121	99.00000	0.17661	-0.27501	1.00000		
MENTALS	0.18455	-0.04209	-0.07159	-0.04143	-0.22160	99.00000	0.11822	-0.41441	0.30912	1.00000	
ACTIVITY	0.09840	-0.08958	-0.16238	-0.17200	0.19164	99.00000	0.28869	0.01217	-0.00067	0.00046	1.00000
MOBILITY	0.05197	-0.13475	-0.17584	-0.23127	-0.02330	99.00000	0.20509	-0.29542	0.32461	0.30696	0.249[illegible]
INCONTI	0.05371	-0.02217	-0.04522	-0.01107	0.07640	99.00000	0.04205	0.17411	-0.06977	0.07329	0.0069[illegible]

	MOBILITY	INCONTI
MOBILITY	1.00000	
INCONTI	-0.23675	1.00000

Appendix 4 Correlation matrix between the independent discriminant variables (Community Study).

	AGE	SEX	DIAG	LENGTHOF	INITIALS	LASTS	MEANTT	TURNPAT	CLEANSKN	PRD	SITESKN
AGE	1.00000										
SEX	-0.09691	1.00000									
DIAG	0.02805	0.31601	1.00000								
LENGTHOF	0.02309	-0.17052	0.26574	1.00000							
INITIALS	-0.10071	-0.04811	0.23192	0.14111	1.00000						
LASTS	-0.15177	0.04481	0.12713	-0.04454	0.28459	1.00000					
MEANTT	-0.12397	0.09772	-0.11776	0.08424	-0.33850	-0.41081	1.00000				
TURNPAT	-0.21089	0.26660	-0.19308	-0.05028	-0.21308	-0.51990	0.14115	1.00000			
CLEANSKN	0.14070	-0.06536	-0.32418	-0.00033	0.03515	-0.21150	0.50259	0.04073	1.00000		
PRD	-0.39640	-0.35355	-0.08722	0.12874	0.14200	-0.10746	0.39655	-0.01770	0.05199	1.00000	
SITESKN	-0.06543	0.30456	0.18541	0.04466	-0.12341	0.13698	0.16318	0.06949	0.25106	0.04890	1.00000
CONDN	-0.05378	0.18289	0.46025	0.21456	0.00000	0.49752	0.01720	-0.15008	-0.10599	0.01985	0.46749
CHANGEA	0.11192	-0.19500	-0.20278	-0.06088	-0.13074	-0.26722	0.08851	-0.02607	0.01225	-0.06045	-0.02098
ONAPTIE	0.27074	-0.38380	-0.23976	0.20637	-0.43013	0.01621	0.16606	-0.31193	0.00857	-0.01249	-0.09092
LAPTIE	0.16319	-0.25672	-0.50273	-0.30118	0.00000	-0.58983	0.00344	0.12092	0.23299	0.02795	-0.35739
CAREGB	-0.24771	-0.28489	0.07989	0.25967	0.13605	0.20035	0.01822	-0.07267	-0.27321	0.37750	-0.13475
OUTCOME	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
FROCARE	0.11855	-0.13089	-0.13954	-0.00880	0.47087	0.16784	-0.64078	-0.14608	-0.21820	-0.28417	-0.40714
SOLIVE	-0.09394	-0.15610	0.20457	0.36168	0.32444	-0.19306	0.07987	-0.12941	-0.04941	0.05183	-0.10371
PHYSIS	-0.49692	0.07340	0.20178	0.08611	0.57208	0.18747	-0.27560	0.09506	-0.01117	0.00169	-0.07000
MENTALS	-0.50058	-0.23009	0.10205	0.19370	0.48709	0.06186	0.04906	-0.22960	0.01141	0.35569	-0.10258
ACTIVIS	0.17092	0.19140	0.07210	-0.04129	0.58521	0.45724	-0.39799	0.17506	0.01645	-0.24099	-0.05057
MOBILIS	0.39891	-0.42667	-0.14422	-0.04120	0.45963	0.11472	-0.37107	-0.21568	0.04054	0.07582	-0.13503
INCONTI	-0.24680	-0.15114	0.04933	-0.13709	0.46538	0.29548	-0.25852	-0.30164	-0.15333	0.03717	-0.09057

	CONDN	CHANGEA	ONAPTIE	LAPTIE	CAREGB	OUTCOME	FROCARE	SOLIVE	PHYSIS	MENTALS	ACTIVIS
CONDN	1.00000										
CHANGEA	-0.43122	1.00000									
ONAPTIE	-0.01749	0.51125	1.00000								
LAPTIE	-0.36772	0.50736	0.09484	1.00000							
CAREGB	0.09676	0.06849	-0.00356	-0.17676	1.00000						
OUTCOME	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000					
FROCARE	-0.15208	-0.15049	-0.19640	0.11420	0.01906	99.00000	1.00000				
SOLIVE	-0.18137	0.25451	0.11418	0.15738	0.32512	99.00000	0.33949	1.00000			
PHYSIS	-0.13858	-0.04986	-0.43994	0.02312	0.10857	99.00000	0.13956	0.09280	1.00000		
MENTALS	0.07921	-0.24895	-0.38440	-0.20405	0.35498	99.00000	0.24094	0.38790	0.39687	1.00000	
ACTIVIS	0.03926	-0.07651	-0.30664	-0.06387	0.11995	99.00000	0.31229	-0.05696	0.28457	-0.13475	1.00000
MOBILIS	-0.03023	0.04242	0.18184	0.16394	-0.08374	99.00000	0.29422	-0.01754	-0.10498	-0.11972	0.41158
INCONTI	-0.13008	0.36888	0.03412	0.11287	0.36301	99.00000	0.41392	0.65115	0.22166	0.33230	0.14979

	MOBILIS	INCONTI
MOBILIS	1.00000	

(Appendix 5) Calculation of standard error of the difference (SED) for the average total time of pressure area care spent in the hospital and community studies.

Community Sample = 30 patients

Hospital Sample = 88 patients

Community mean total time = 1761 = X_1

$$\bar{X}_1 = \frac{1761}{30} = 58.7$$

Hospital mean total time = X_2 = 4532

$$\bar{X}_2 = \frac{4532}{88} = 51.5$$

$$\bar{X}_1 - \bar{X}_2 = 58.7 - 51.5 = 7.2$$

$$\text{SED} = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

$$\text{SED} = \sqrt{\frac{842.66}{30} + \frac{691.92}{88}}$$

$$= \sqrt{35.9}$$

$$S\,\bar{X}_1 - \bar{X}_2 = 5.995$$

$$t = \frac{\text{difference in means}}{\text{SED}}$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\text{SED}}$$

$$t = \frac{7.2 - (\mu_1 - \mu_2)}{5.99}$$

$$t = \frac{7.2}{5.99} \quad \text{with } 116 \text{ (df) *}$$

$$t = 1.202$$

(i.e. not significant)

However, the 99% confidence limits will be given by

$$-2.619 \leqslant \frac{(58.7 - 51.5) - (\mu_1 - \mu_2)}{5.995} \leqslant 2.619$$

$$7.2 + 5.995\,(2.619) \geqslant 7.2 - (5.995)\,(2.619)$$

$$22.900 \geqslant \mu_1 - \mu_2 \geqslant -8.500$$

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* (df) = degree of freedom