
Reduction of nosocomial pressure ulcers in patients with hip fractures: a quality improvement program

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Keywords

Quality improvement, Nursing, Elderly people, Elder care

Abstract

Pressure ulcers (PUs) continue to be a distressing medical problem. The Nursing Quality Improvement Unit of Israel's Hadassah Mount Scopus Medical Center designed and implemented a quality improvement intervention program to reduce the incidence of nosocomial PUs. Assessing data, it was found that 46.7 percent of nosocomial PUs develop in patients with hip fractures. Following the first audit of all patients with hip fractures, an intervention program was focused on the orthopedic ward and the recovery room. Intervention in the orthopedic ward included providing each patient with a visco-elastic mattress and a specially designed cushion for the elevation of the affected limb. In the recovery room, pressure-relieving practices were introduced. Following the implementation of the intervention program, the second audit revealed a reduction in the incidence of nosocomial PUs from 12.9 percent to 0 percent. Although patients with hip fractures are still at very high risk of developing nosocomial PUs, prevention is feasible.

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Introduction

Pressure ulcers (PUs) continue to be a distressing medical problem. Not only do patients experience pain and discomfort but intensive wound care also incurs considerable costs to both patients and hospitals. Daily PU treatment costs were found to be about 2.5 times the cost of PU prevention (Oot-Giromini *et al.*, 1989). Therefore, the most effective way to face the issue of PUs is by prevention (Armstrong and Bortz, 2001). The first step towards preventing PUs is to reduce local pressure by providing an appropriate mattress and maintaining a repositioning regime.

Hospital nursing teams are especially concerned with the prevention of PUs that develop during hospitalization, i.e. the nosocomial PUs. It is estimated that 95 percent of nosocomial PUs can be prevented (Loader *et al.*, 1994; Findlay, 1996).

Hip fractures increase the risk of incurring PUs (Watts *et al.*, 1998; Stotts *et al.*, 1998; Andrychuk, 1998). In general, patients with hip fractures tend to be elderly people with limited mobility who are likely to have multiple health problems. The emergency operative intervention in these patients adds to their high risk of developing a PU during hospitalization. The reported incidence rates of nosocomial PUs following hip fractures were 19.1 percent-66 percent (Versluisen, 1986; Hofman *et al.*, 1994; Gunningberg *et al.*, 2000).

The first external sign indicating an emerging PU may appear up to nine days from the initial damage to the patient's deep tissues (Scott, 1998; Armstrong and Bortz, 2001). Therefore, it is difficult to clearly define the time and circumstances where PUs emerge. This information is critical for the planning and implementing of a preventive intervention program. The long route from trauma and fracture until mobility is regained includes the time from the fracture until hospital admission, and on through the emergency department (ED), pre-operative (pre-op) orthopedic department stay, operating room (OR), recovery room, and post-operative (post-op) orthopedic department hospitalization, until the first mobilization. It is

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important to learn where along this route PUs tend to develop.

Background

In 1997, the Nursing Quality Improvement Unit of Israel's Hadassah Mount Scopus Medical Center, a teaching hospital of 300 beds located in Jerusalem, Israel, decided to address the issue of the prevention and treatment of PUs. In order to evaluate the magnitude of the problem, a regular reporting system was enforced in the hospital for all relevant wards. These reports included all PUs identified in the hospital, those present on admission and those that developed during hospitalization. At the beginning of 1999, as a result of newly detected needs, "reason for admission" was added to the reporting form.

When the data relevant to nosocomial PUs was assessed at the end of the first half of 1999, it was found that 60 percent ($n = 18$) of all nosocomial PUs occurred in the orthopedic ward. Of these, 77.8 percent ($n = 14$) occurred inpatients with hip fractures. These findings led us to concentrate on these orthopedic patients in our attempt to reduce the number of nosocomial pressure ulcers in our hospital.

Normally, a patient with a hip fracture arrives at the emergency room where diagnostic procedures, including X-ray and blood tests are done. Following diagnosis, the patient is admitted to the orthopedic department for stabilization, evaluation and preparations for the operation, which is performed as soon as possible. Following the operation, the patient is watched in the recovery room for several hours, and then is returned to the orthopedic department. At the time of discharge, from the orthopedic ward, rehabilitation is offered to every patient who was mobile and independent before the fracture occurred.

Our hypotheses were:

- H1. A delay in a patient's arrival at the hospital increases the risk of developing PUs due to immobilization.
- H2. Since the emergency department (ED) and the operating rooms (OR) only use regular mattresses and since there is no repositioning regime maintained, the length of stay in these departments becomes a risk factor for PUs.

Following a quality-improvement model, an intervention plan was designed, implemented and evaluated.

Methods

The project was planned according to the dynamic standard setting system (DySSSy), a quality improvement model that was developed at the Royal College of Nursing in the UK (Kitson *et al.*, 1996). The quality improvement cycle consists of three main stages:

- (1) *Defining quality*: defining the area for improvement, the rationale for choosing it, and setting the standard, namely defining the project's target.
- (2) *Measuring and comparing*: measuring existing practice and comparing it with the expected level of performance.
- (3) *Taking action to improve*: making improvements in the areas where deficiencies have been identified. Ongoing evaluation should take place to evaluate whether or not improvement has been achieved. In this way, quality improvement becomes an ongoing, continuous process.

The project plan

1. *Defining quality, July 1, 1999-August 31, 2000*
Based on the results reported at the first half of 1999, it was decided to address the problem of nosocomial PUs among patients with hip fractures.

The main objective was to decrease the number of nosocomial PUs among hip fracture patients without skin breakdown at the time of admission. The literature was reviewed and an audit tool was developed.

The audit tool was used to collect data on length of stay, mattresses and repositioning provided to patients in each of the following hospital wards: ED, orthopedics department prior to the operation, OR, recovery room and orthopedics department for the postoperative stay until first ambulation. This audit tool included demographic data as well as data on the modified norton scale (MNS) for evaluation of a patient's risk of developing a PU. A score of 16 or less indicates increased risk for developing a PU. The audit tool also included data on accompanying medical conditions, i.e. continence, diabetes, heart insufficiency and peripheral vascular diseases. Continence means that a patient has full control on urine and feces. Inserting a Foley catheter into the bladder can bypass the problem of urine incontinence. In case of urine incontinence, continued contact between skin and urine weakens the cell wall and may alter the skin pH, making it more susceptible to breakdown.

2. Measuring and comparing, September 1, 1999-February 28, 2000

First audit and data analysis. Included were all patients admitted to the hospital with hip fractures and no skin breakdown during a six-month period. One nurse collected the data, using the audit tool. The information sources were patients' records, interviews with patients and/or patients' families, and nurses.

3. Taking action to improve, March 1-June 31, 2000
Preparing and implementing the intervention program.

First evaluation of the intervention program, December 1, 2000-May 31, 2001

Retrospective data collection of all patients with hip fractures.

Second evaluation of the intervention program, May 1-October 31, 2002

A second audit, using the same audit tool as the first audit, was conducted. A second nurse, other than the one at the first audit, collected the data.

Implementation

Findings of the first audit

A total of 77 patients were admitted with hip fractures during the six-month period. All of them were included in the survey. Ten of these patients (12.9 percent) developed nosocomial PUs.

Patients without nosocomial PUs arrived at the hospital in a mean time of 25.6 hours while those with nosocomial PUs came to the hospital in a mean time of 10.5 hours.

Pre-op stay in the orthopedic ward was associated with the development of PUs. Length of stay among patients who developed PUs compared with those who did not was significantly greater (mean: 126.7 vs. 28.6, respectively; $p = 0.005$).

Mean time in the recovery room was similar, comparing patients with PUs and patients without PUs, and it exceeded 12 hours.

The intervention program

An intervention program was developed based on these findings, and it is detailed in Table I. The program was prepared as an addition to the basic nursing practice that is common for bedridden patients.

Briefly, this intervention program focused on the orthopedic ward in the pre-op stage and the recovery room in the post-op stage. Intervention in the orthopedic ward included providing each patient with a visco-elastic mattress and a specially designed cushion for the elevation of the affected limb. In the recovery room, good basic nursing

practices regarding pressure relief were implemented.

Results

Overall evaluation of the intervention program

First evaluation

This data collection was done five months after the intervention started in order to evaluate its effectiveness. According to data drawn from the OR records during this six-month period, 78 patients had operations for hip fractures. Three of them (3.8 percent) were reported to have nosocomial PUs.

Second audit

A second audit identical to the original one was performed to verify the effectiveness of the intervention program. During the six months of the audit, 70 patients were admitted with hip fractures, six (8.6 percent) were excluded due to a PU at admission. None (0 percent) of the remaining 64 developed PUs.

The characteristics of the two audits groups are presented in Table II. In the first audit, ten of the 77 patients developed a PU. In the second audit, none of the 64 patients developed a PU. No differences, regarding age and MNS scores, were found between the two patient populations. The proportion of females was increased in the second audit.

Regarding time spent in each ward (Table III), there was a decrease in the length of stay in all the wards except for ED, where an increase was recorded.

The use of air and "egg" mattresses was stopped (Table IV). An increase was recorded in the use of the visco-elastic mattresses at the pre-op stage from 41.6 percent to 70.3 percent and at the post-op stages, from 58.7 percent to 89 percent. The information regarding mattress type in the recovery room was incomplete and therefore inconclusive (data not shown).

Accompanying medical conditions

There was an increase in the frequency of continent patients from 25.9 percent to 53.1 percent. There was an increase in incontinent patients, from 10.4 percent to 21.8 percent. A decrease was recorded in the number of patients who had a urinary catheter from 55.8 percent to 20.3 percent (Table V).

Table I The intervention program

The pre-op orthopedic ward	The recovery room
A visco-elastic mattress is supplied to every patient with a hip fracture on admission to the ward, at any hour of the day. The same mattress stays with the patient, at least, until ambulation	Basic nursing practices include repositioning, skin massage and the provision of dry and unwrinkled linens were implemented
The affected limb is elevated on a specially designed cushion, which is U-shaped, 5 cm thick, made of foam. It protects the heel and ankle from friction while supporting the lower leg (from ankle to knee) from local pressure. Meanwhile, it enables the patient to move from side to side without the leg slipping off the cushion. Both the cushion and the mattress are stored in the orthopedic ward	The visco-elastic mattress and the special cushion arrive in the recovery room with the patient. In cases when the patient has not been admitted via the ward, it is the responsibility of the recovery room nurse to make sure that these items will be available for the patient
Pain killers are given around the clock. Pain reduction enables the patients to maintain minimal movements that are crucial for reducing pressure and allowing blood perfusion	All bodily areas are padded to avoid friction (e.g. the thighs where an abduction pillow is necessary)
A dietitian reviews patients' nutritional intake. If necessary, supplements are given to improve nutritional status	Normal body temperature is maintained in order to avoid peripheral vasoconstriction. All fluids are provided at body temperature and external warming is added when necessary

Table II Characteristics of patient populations of the two audits

	Audit 1 (n = 77)	Audit 2 (n = 64)
Age, (year) mean (range)	78.2 (39-99)	77.5 (25-98)
Gender – F (%)	50.0 (65)	47.0 (73.4)
MNS ^a at admission	16.9 (10-24) (n=56)	16.8 (11-22)

Note: ^aMNS – modified Norton scale

Table III Time duration, by stages in the route of hip fracture patients from trauma until mobilization, according to the two audits

Time – hours mean, (range)	Audit 1 (n = 77)	Audit 2 (n = 64)
From fracture until admission	25.6 (0-500 ^a)	11.8 (1-170)
Emergency department	5.6 (0-20)	8.2 (1.5-25)
Orthopedics, pre-op	40.1 (0-720)	27.0 (0-160)
Operating room	3.1 (1-7)	2.4 (1-7)
Recovery room	13.2 (0-60)	9.3 (1-22)
Orthopedics, post-op	13.9 (2-75)	10.9 (0.5-30) (n=62)

Note: ^aOne patient with a stable fracture was admitted 500 hours (21 days) after the fracture

Table IV Numbers and proportion of the different mattresses supplied to patients with hip fractures in the orthopedics department during the pre and post-operative stays, according to the two audits

Type of mattress no.	Audit 1		Audit 2	
	n	%	n	%
Orthopedics pre-op n = 77				
Air	12	15.6	0	0
Egg	12	15.6	0	0
Visco-elastic	32	41.6	45	70.3
Regular	10	12.9	3	4.7
Unknown	11	14.3	16	25
Orthopedics post-op n = 67				
Air	14	18.7	0	0
Egg	16	21.3	0	0
Visco-elastic	44	58.7	57	89
Regular	1	1.3	4	6.3
Unknown	0	0	3	4.7

Table V Accompanying medical conditions

Urinary continence	Audit 1 (n = 77)		Audit 2 (n = 64)	
	n	%	n	%
Continence	20	25.9	34	53.1
Incontinence – diapers	8	10.4	14	21.8
Incontinence – urethral catheter	43	55.8	13	20.3
Incontinence – penrose drain	3	3.9	0	0
Unknown	3	3.9	3	4.7
Diabetes	16	20.7	20	31.3
Heart insufficiency	14	18.1	13	20.3
Peripheral vascular disease	2	2.6	2	3.1

Discussion

In the first audit, 77 patients with hip fractures were included and 64 in the second audit. Regarding age and MNS scores there were no differences between the two groups. However, in the first audit ten (12.9 percent) patients had a nosocomial PU. In the second audit, after the implementation of the intervention program, not one patient had a nosocomial PU.

Although no planned intervention had been implemented to decrease the length of patients' stays, a decrease in the actual length of stay in all wards except the ED was shown (Table III). The increase in the length of stay in the ED may be explained by the presence in the ED of another project focused on pain treatment for patients with

hip fractures that started at the same time as the second audit (unpublished data). Their results indicated a reduction in the severity of pain that patients were experiencing. The outcome, from

our perspective, may be that non-suffering patients require less assistance from the nursing team and so it is less urgent to transfer them to the ward. A patient free of pain is able to keep minimal mobility, which reduces the risk of developing a PU (Reddy *et al.*, 2003).

We could not confirm that a delay in a patient's hospital arrival contributed to the development of a PU. Surprisingly, patients who developed PUs arrived at the hospital earlier than those who did not develop PUs. One explanation for this surprising discrepancy may be related to the number of patients who delayed their admission up to a maximum of two weeks. The delay was mainly due to a stable fracture. Patients with stable fractures experience less pain and can maintain their mobility. Therefore, their decision to get medical assistance was delayed. This implies that those patients who really suffered came to the hospital as soon as they could. Those with limited pain did not rush to the hospital. Mobile patients are not at risk of developing PUs.

The use of air and "egg" mattresses was stopped. From the literature review (Nixon *et al.*, 1998; Brown *et al.*, 2000) and from our own experience, we concluded that the best mattress to release pressure, in patients at high risk, is the visco-elastic mattress. The one we were using was made by TEMPUR. The increase in the use of these mattresses in the pre-op and post-op stages was due to the high awareness of the orthopedic ward nursing staff to the importance of maximal pressure relief while the patient is bedridden and with limited mobility, as well as to the fact that more visco elastic mattresses were purchased for the hospital.

In the recovery room, the data regarding the use of 70.9 percent of the mattresses was not available. The common practice is that patients are kept on the same mattress from admission until ambulation. Therefore patients in the recovery room probably had the same number of visco-elastic mattresses as in the pre and post-op stages. This increase in the use of visco-elastic mattresses is one of the interventions contributing to the reduction in the incidence of PUs.

Incontinence is directly linked to PUs in the sacral area (Findlay, 1996). Although all patients with nosocomial PUs were found incontinent, only half of the PUs were present in this area, the other half was at the foot area. Moreover, a larger proportion of the second audit was incontinent, while none developed PUs. Therefore, incontinence may indicate a certain decrease in the general condition of the patient rather than a direct cause of PUs. This idea is emphasized with the low MNS score given to all patients (mean 13.2 at

admission, MNS below 16 indicates that the patient is at risk).

One of this study's limitations is that two different persons conducted the two audits. This may account for some of the differences recorded and could be a reason for an information bias, especially regarding urinary incontinence. Most patients have a urinary catheter inserted in the OR, which they return with to the ward, where it is taken out as soon as possible. There might have been a difference of interpretation, between the two persons who collected the data, as to whether or not a patient was continent.

Another limitation is the missing data regarding interventions such as the frequency in the use of the cushion for leg elevation, the amount of painkillers given, or body temperatures maintained in the recovery room. Therefore, we are unable to pinpoint which intervention was the most effective. A particular strength of the study was that the same data collection tools were used for the two audits.

Our hypotheses were found to be incorrect. Neither a delay in arrival from home nor length of stay in the emergency room was associated with the development of PUs. The results pinpointed other areas that we did not think of before the project started, namely, the length of time spent at the orthopedic department pre-op and the nursing practice in the recovery room.

The whole project was conducted from a quality improvement viewpoint. We believe that bringing the problem of PUs to the attention of different nursing teams was one of the main contributors to the success of the project. Nurses started to feel a sense of personal failure if a nosocomial PU was detected among their patients.

Today, the same intervention program is being implemented for patients who undergo joint replacement procedures. The effectiveness has not yet been assessed for this population.

Conclusions

Although patients with hip fractures are at very high risk of developing a nosocomial PU, it is possible to reduce the incidence of the PUs. Our quality improvement program began with developing an audit tool and performing a six-month audit. The findings of the audit helped in estimating the prevalence of nosocomial PUs among patients with hip fractures and identifying factors associated with increased risk of developing PUs such as length of stay in different wards, mattresses provided to patients and repositioning practices. Following this four-month audit an intervention program was developed and

implemented. The intervention program itself focused on the orthopedic ward and the recovery room. The special intervention procedures in the orthopedic ward included, providing each patient with a visco-elastic mattress and a specially designed U-shaped cushion for the elevation of the affected limb. In the recovery room, pressure-relieving practices were introduced. A year after the intervention program was implemented, a second audit, identical to the first, was conducted during a six-month period.

Overall, the prevalence of nosocomial PUs decreased from 12.9 percent to 0 percent, comparing the results of the first (before intervention) and second (after intervention) audits. Furthermore, during a period of 21 months, from the beginning of the second audit, only one nosocomial PU was recorded among patients with hip fractures.

We cannot pinpoint which of the interventions was the most effective. However, we strongly believe that increasing the awareness of the hospital personnel to the problem of nosocomial PUs was one of the main factors contributing to the success of this project.

References

- Andrychuk, M.A. (1998), "Pressure ulcers: causes, risk factors, assessment, and intervention", *Orthopedic Nursing*, Vol. 17 No. 4, pp. 65-83.
- Armstrong, D. and Bortz, P. (2001), "An integrative review of pressure relief in surgical patients", *AORN Journal*, Vol. 73 No. 3, pp. 645-74.
- Brown, J., McElvenny, D., Nixon, J., Bainbridge, J. and Mason, S. (2000), "Some practical issues in the design, monitoring and analysis of a sequential randomized trial in pressure sore prevention", *Statistics in Medicine*, Vol. 19 No. 24, pp. 3389-400.
- Findlay, D. (1996), "Practical management of pressure ulcers", *American Family Physician*, Vol. 54 No. 5, pp. 1519-28.
- Gunningberg, L., Lindholm, C., Carlsson, M. and Sjoden, P. (2000), "The development of pressure ulcers in patients with hip fractures: inadequate nursing documentation is still a problem", *Journal of Advanced Nursing*, Vol. 31 No. 5, pp. 1155-64.
- Hofman, A., Geeikerken, R.H., Wille, J., Hamming, J.J., Hermans, J. and Breslau, P.J. (1994), "Pressure sores and pressure decreasing mattresses: controlled clinical trial", *The Lancet*, Vol. 343 No. 8897, pp. 568-71.
- Kitson, A., Harvey, G. and Duff, L. (1996), *The Dynamic Quality Improvement Program*, The British Council, Oxford.
- Loader, S., Delve, M. and Hofman, D. (1994), "A consultancy service that pays dividends. Setting up a pressure sore resource group", *Professional Nurse*, Vol. 9 No. 4, pp. 259-60, 264-6.
- Nixon, J., McElvenny, D., Mason, S., Brown, J. and Bond, S. (1998), "A sequential randomized controlled trial comparing a dry visco-elastic polymer pad and standard operating table mattress in the prevention of post-operative pressure sores", *International Journal of Nursing Studies*, Vol. 35 No. 4, pp. 193-203.
- Oot-Giromini, B., Bidwell, F.C., Heller, N.B., Parks, M.L., Prebish, E.M., Wicks, P. and Williams, P.M. (1989), "Pressure ulcer prevention versus treatment, comparative product cost study", *Decubitus*, Vol. 2 No. 3, pp. 2-4.
- Reddy, M., Keast, D., Fowler, E. and Sibbald, R.G. (2003), "Pain in pressure ulcers", *Ostomy Wound Manage*, Vol. 49 No. 4, pp. 30-5.
- Scott, E.M. (1998), "Hospital-acquired pressure sores in surgical patients", *Journal of Wound Care*, Vol. 7 No. 2, pp. 76-9.
- Stotts, N.A., Deosaransingh, K., Roll, F.J. and Newman, J. (1998), "Underutilization of pressure ulcer risk assessment in hip fracture patients", *Advances in Wound Care*, Vol. 1 No. 1, pp. 32-8.
- Versluisen, M. (1986), "How elderly patients with femoral fracture develop pressure sores in hospital", *British Medical Journal*, Vol. 292 No. 6531, pp. 1311-3.
- Watts, D., Abrahams, E., McMillan, C., Santa, J., Silver, R., VanGorde, S., Waller, M. and York, D. (1998), "Insult after injury: pressure ulcers in trauma patients", *Orthopedic Nursing*, Vol. 17 No. 4, pp. 84-91.