Implementation of best practice in the prevention of heel pressure ulcers in the acute orthopedic population

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ABSTRACT

To implement and evaluate a heel pressure ulcer prevention program (HPUPP) for orthopaedic patients. Program development of HPUPP involved input from administrators, staff and adult patients on an orthopaedic service in an academic tertiary care facility, located in a small urban centre in Canada. Prospective evaluation was conducted. Consensus exercises with clinical staff and administrators (Delphi and Nominal group) were used to, evaluate current practices, select a heel protective device, and develop key aspects of the HPUPP. HPUPP involved an individualised, bedside, staff education program, a team approach to improve patient mobility and use of a heel protective device. A 2-inch foam wedge covered in washable vinyl was placed at the foot of all beds on the orthopedic service. After the program was implemented, the incidence of heel pressure ulcers was 0%, which was a significant reduction compared with pre-implementation levels [13·8% (95% confidence interval 8–18%)]. Key components of the program success were initial and ongoing support from administration and surgeons, incorporation of feedback from clinical staff and patients, and keeping the program simple. Heel PU can be prevented in most orthopaedic patients using a universal heel PU prevention program.

Key words: heel pressure ulcers • prevention program • heel device • RNAO best practice guidelines • RNAO toolkit

Key Points

- pressure ulcers can significantly increase a patient's length of stay in the hospital, mortality and costs, reduce quality of life, increase the risk of a below-the-knee amputation in diabetics and limit rehabilitation
- heel pressure ulcers are different than pressure ulcers on other parts of the body
- the shape of the heel makes it more difficult to download pressure unless the heel is lifted directly off the bed
- prevention strategies for the heel are different than prevention strategies for other parts of the body and need to include a method to completely offload pressure by lifting the heel off the bed

Pressure ulcers are an ongoing and serious health concern. Pressure ulcers can significantly increase a patient's length of stay in the hospital (1,2), mortality (3), and costs (2,4), reduce quality of life (5), increase the risk of a below-the-knee amputation in diabetics (6) and limit rehabilitation. Heel pressure ulcers (HPUs) are different than pressure ulcers on other parts of the body. The shape of the heel makes it more difficult to download pressure unless the heel is lifted directly off the bed. The calcaneus bone has a pointed shape with little subcutaneous fat and this as well makes it vulnerable to pressure (7). It has been found previously that heel perfusion is highest with complete pressure relief (7), and this finding is supported by a recent research study (8). Therefore, prevention strategies for the heel are different than prevention strategies for other parts of the body and need to include a method to completely offload pressure by lifting the heel off the bed. Heels have been identified as a common site for pressure ulcers, and generally either the most common or the second most common site in studies in Europe, the USA and Canada (9–15). Some

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studies have found that the prevalence of HPU is increasing over the past, whereas the number occurring in other body locations is the same or decreasing (13,16). Individuals undergoing lower extremity orthopedic surgery are at particularly high risk of developing HPU (10,17–19) as are the elderly (20–23).

Much work on developing pressure ulcer prevention programs has been carried out, with the development of best practice guidelines (BPGs) or clinical practice guidelines (CPGs) by organisations, such as the Registered Nurse Association of Ontario (RNAO) (24), the US Agency for Health Care Policy & Research (AHCPR) (25) and the Canadian Association of Wound Care (26).

RNAO developed a toolkit for implementing BPG because of its concern that BPG would not be fully used by health care clinicians if they were not effectively introduced, supported and implemented (27). In the toolkit, which can be used to implement any BPG, six essential components of successful BPG implementation are proposed: BPG identification, stakeholder involvement, environmental readiness, use of effective implementation strategies, evaluation of BPG implementation and identification of required resources.

Research studies and quality improvement projects on the prevention of pressure ulcers have focused on implementation of part or all of the BPG, such as the AHCPR guidelines and the Guidelines for Prevention and Management of Pressure Ulcers from the Wound Ostomy and Continence Nurses Society (28–32). Some of these prevention programs have been successful (12,17,33–35), whereas others have not been successful (11,36). Barriers to implementation included a lack of visible senior nursing leadership and time required to learn new skills and implement the guideline, as well as difficulties with the computer (37).

Although the ability of BPG implementation to reduce the prevalence or incidence of pressure ulcers has been documented in several studies, the effectiveness of prevention programs designed specifically for heel ulcers has been examined in only a few studies (38).

In a recent meta-analysis, the authors concluded that there was limited research that has evaluated whether heel boots or similar devices reduce the risk of HPU development (39). Two clinical trials were located in this systematic literature search and review and both found no significant difference in HPU incidence (40,41). In a recent product evaluation report, greater patient satisfaction was found with a fibre filled boot than with an air-filled foot waffle (42). After the meta-analysis was completed, a randomised controlled trial (RCT) involving intensive care unit (ICU) patients showed a statistically significant reduction in the number of HPU for patients using a heel device compared with control subjects who did not use heel protection. The device tested in this RCT was a foam body support covered in fabric that suspended the heel off the bed, with a second piece of foam that was used to prevent foot drop (43).

In our previous research, performed in the same acute care facility, the incidence of HPU occurring on patients undergoing an acute orthopedic procedure was 13·3%, 95% confidence interval (CI) 8–18% (44). In a further study, we followed acute orthopedic subjects post-operatively as they were admitted and discharged across health care settings (45). From this research we determined that 17% of subjects developed a HPU and that all new HPU occurred while they were in acute care (45). Therefore, intervention that prevents the occurrence of HPU in the orthopedic population should be focused in the acute care setting. There is no current research that describes the implementation of BPG to prevent HPU in acute orthopedic patients.

The purpose of this project was to develop, implement and evaluate a HPU prevention program. There were three steps involved in this study:

1. Development of the HPU prevention program
    i. To identify key stakeholders in the hospital and obtain their support for the implementation of a HPU prevention program.
    ii. To involve clinical staff in the review current knowledge and practices and propose a simple universal HPU prevention program.
    iii. To select a HPU prevention device by identifying important selection criteria, using these criteria to select three devices for trial, and selecting the device for universal

Key Points

- RNAO developed a toolkit for implementing BPG because of its concern that BPG would not be fully used by health care clinicians if they were not effectively introduced, supported and implemented
- in the toolkit, which can be used to implement any BPG, six essential components of successful BPG implementation are proposed: BPG identification, stakeholder involvement, environmental readiness, use of effective implementation strategies, evaluation of BPG implementation and identification of required resources
- although the ability of BPG implementation to reduce the prevalence or incidence of pressure ulcers has been documented in several studies, the effectiveness of prevention programs designed specifically for heel ulcers has been examined in only a few studies
- the purpose of this project was to develop, implement and evaluate a HPU prevention program

Key Points

- this project was undertaken in six phases or parts: stakeholder involvement, development of HPU prevention program, identification of the best HPU prevention device, product evaluation, HPU prevention program implementation and post-incidence study
- the RNAO Toolkit on implementation of Best Practice Guidelines was used as a framework for this implementation process
- as recommended in the toolkit, key stakeholders were identified, analysed and engaged

use based on patient and patient feedback.

2. Implementation of the HPU prevention program
   Over a 1-month period, a HPU champion provided education about HPU and supported clinical staff to improve patient mobility and use a heel protection device.
3. Evaluation of the HPU prevention program
   The incidence of new heel ulcers that develop in this patient population while on the orthopaedic service was determined

METHODS

Prior to beginning the study, approval for the project was obtained from the research ethics board at the local university and the hospital review board.

Setting

The research took place in an academic tertiary care facility, London Health Sciences Centre, University Hospital (UH). It is located in a small urban centre in southwestern Ontario, Canada. The health centre has approximately 850 beds. At UH, there are 36 inpatient acute orthopaedic surgery beds, and 15 other orthopaedic surgery patients are often off service on other units. The hospital performs 1300 elective hip and knee replacements and cares for 200 patients with fractured hips per year. The prevention program was conducted in the emergency department (ED), the orthopaedic unit and the post-anaesthetic care unit (PACU) because the majority of the orthopaedic patients were cared for in those places.

Study design

This project was undertaken in six phases or parts – stakeholder involvement, development of HPU prevention program, identification of the best HPU prevention device, product evaluation, HPU prevention program implementation and post-incidence study. This study was performed in partial fulfilment of a PhD thesis, therefore a single and consistent person (termed HPU champion) lead the development and implementation of the project. Therefore, time spent by this advanced practice nurse spent on the project was resourced through a nursing doctoral research fellowship.

PREPARATION AND DEVELOPMENT OF THE HPU PREVENTION PROGRAM

The RNAO Toolkit on implementation of BPGs was used as a framework for this implementation process. As recommended in the toolkit, key stakeholders were identified, analysed and engaged (27).

Part 1: Stakeholder involvement

Stakeholders included three key groups: (i) hospital administrators in surgery, medicine, the ED and the professional practice leaders (PPLs) for nursing, physical therapy and occupational therapy; (ii) orthopaedic surgeons and surgical residents and (iii) clinical staff providing direct care to orthopaedic patients including nurse practitioners, occupational therapists (OTs), physical therapists (PTs), registered nurses (RNs) and registered practical nurses (RPN). Twelve administrators, all the orthopaedic surgeons and their residents ($n = 15$), and forty orthopaedic clinical staff participated in the information sessions. It took a total of 18 months to complete this very important consultative process with key stakeholders prior to implementing the HPU prevention program.

Several consistent points were stressed in meetings with the key stakeholders:

- A review of previous research conducted in other countries showed that a relatively high incidence of HPU in this patient population is common and not just a problem in our region.
- Our previous research showed a relatively high incidence of HPU (13%) in this patient population and all of new HPU developed while patients were in acute care.
- The prevention of HPU would start when the patients entered the acute care hospital and stop when they were discharged from acute care.
- The solutions would be positive changes in practice; minimal focus would be on negative practices and no blaming or finger pointing would be tolerated.
- Interventions would be based on the RNAO BPGs.
- The HPU champion was willing to work collaboratively on this project as part of fulfilling requirements for a PhD.

Although background information and rationale for doing the project was consistent, the communication strategies and information were tailored for each of these groups. A formal presentation was delivered by the HPU champion to the orthopaedic surgeons, fellows and residents. In this presentation, the extent of HPU in the acute orthopaedic population was provided, the RNAO BPG's and the research support was reviewed, and the proposed intervention was outlined. The presentation was followed by an opportunity for open discussion, and their feedback was incorporated into the project. From this meeting, all orthopaedic surgeons recognised the negative impact that pressure ulcer had on their patient outcomes and they offered their support for the project. Individual meetings were booked with directors, managers and PPLs. Because these administrative personnel were not involved in direct patient care, they received more information regarding resource use, patient safety and patient outcomes. Concerns expressed by administrators related to the cost to implement the intervention program and the potential cost of the device. One director had had a personal experience with a family member breaking a hip and developing two HPU in hospital. This individual understood the impact of the HPU on the patient. Both the presentation to orthopaedic surgeons and the meetings with hospital administrators were conducted prior to approaching clinical staff. In this way, support from necessary key stakeholders was obtained very early on in the project implementation.

At staff meetings and lunch in-services, the HPU prevention project was outlined and the clinical staff members were provided with specific details regarding how this initiative would change their clinical practice. It was emphasised that interventions needed to be simple and easily integrated with all patients. The clinical staff was very supportive of a simple intervention approach and easy-to-use device. They were also pleased that the device did not compromise or negatively affect the orthopedic condition/surgery. It was important to the front line clinical staff that this initiative was supported fully by hospital administrators involved in their supervision and by the orthopedic surgeons.

A key aspect to this consultative process was that at all levels of discussion; feedback on the proposed intervention was requested and used to shape how the process proceeded. For example, initially the project was to focus only on patients with fractured hips, but the clinical staff indicated that heel ulcers were a problem with all patients undergoing lower extremity surgery. The study was then changed to include a HPU prevention program that would be provided to all patients on the orthopaedic service who underwent lower extremity orthopaedic surgery. This included not only those individuals who required surgical repair of a recent hip fracture but also those undergoing elective hip and knee joint replacement surgery.

Part 2: Design of a specific HPU prevention program

All clinical staff members were invited to participate in a focus group or written survey that reviewed current knowledge and practices regarding HPU prevention. A letter of information was provided and consent was assumed if the staff participated in the process. Twenty-seven staff members including a surgeon ($n = 1$), RNs ($n = 15$), RPNs ($n = 4$), PTs ($n = 4$) and OTs ($n = 3$) volunteered to participate in this process. The HPU champion met with the clinical staff that volunteered and asked for their responses to the following four questions:

1. What factors contribute to HPU development in the orthopaedic population?
2. What current practices are used for HPU prevention in the area in which you work?
3. What are possible interventions that the health care team could implement that would help prevent HPU?
4. What are the current barriers and challenges to the implementation of a HPU prevention program?

From these meetings, a list of responses was generated from each participant and then a Dephi process was used to build consensus and help prioritise responses (46). A collated list of responses from all 27 participants was generated and circulated by e-mail, and participants were asked to rank the responses to each of the questions. From this consensus process, the top five responses to each of the four questions were identified (see Table 1). It took one iteration performed by e-mail to reach

Key Points

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- a formal presentation was delivered by the HPU champion to the orthopaedic surgeons, fellows and residents
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- the clinical staff was very supportive of a simple intervention approach and easy-to use device
- the study was to include an HPU prevention program that would be provided to all patients on the orthopaedic service who underwent lower extremity orthopaedic surgery

Table 1 Summary of Delphi consensus process

Question	% Consensus	Highest response	Second response	Third response	Fourth response	Fifth response
What contributes to HPU development in the orthopedic population?	72% Consensus for the top five responses	Multiple patient comorbidities	Immobility	Longer wait time for surgery	HOB elevated & puts more pressure on heels and coccyx	Fragile skin
What are the current practices to help prevent HPU?	78% Consensus for the top five responses	Positioning	Devices: pillows, sheets, custom made by OT	Use of special beds	Early mobilization	Good skin care products
What are possible interventions that could be implemented to prevent HPU?	70% Consensus for the top five responses	Daily routine with consistent mobilization	Frequent heel inspection	Heel device	Team approach to mobilization. Special beds for everyone	Education of all staff about prevention & risk assessment
What are the current barriers and challenges to implementing a HPU program?	74% Consensus for the top five responses	Staff overwhelmed with current workload	Lack of leadership or a champion	Cost of prevention	Device maintenance and availability	Time if extra time is needed

HOB, head of bed; HPU, Heel pressure ulcers; HOB, OT, occupational therapist.

our goal of at least 67% consensus amongst responders. Despite several reminders, we had only a 52% response rate from the 27 participants to these e-mail based iterations.

1. Factors contributing to HPU development in the orthopedic population. The following five themes arose:

- Patient factors including advanced age, fragile skin, comorbidities [peripheral vascular disease (PVD), diabetes, hypoxia, dementia, delirium] and pain management (either not well managed or overly sedated).
- Positioning and mobilisation, for example immobility post-operatively; head of bed elevated so there is pressure on the heels; operative leg not easily moved post-operatively; exercise for knee replacement patents requires them to drag their heel up and down the bed; and patients lying on fracture board until cervical spine is cleared.
- Hospital materials and resources, for example current hospital mattresses are too soft; reduced access to pressure relief mattresses; ED stretchers do not have pressure reduction foam on them; and lack of access to pressure relief surfaces.
- Staff factors such as over use of Foley catheters and not getting patients out of bed to toilet; differing expectations of staff regarding mobilisation, for example some staff thought that this was the responsibility of the PT; risk assessment not being performed; and lack of knowledge on how to prevent HPU.
- System factors such as wait time in ER and reluctance of administrative staff to listen to complaints about heel ulcers.

2. Current practices that reduce the risk of heel ulcers

Interventions that they are currently doing to prevent HPU included the use of pillows and folded flannels, use of special surfaces, early mobilisation, good skin care products, automatic referrals to PT and OT for certain patients, frequent skin assessment, positioning, following the pathway for hip and knee replacements, educating patients on how to lift their heels and using a multidisciplinary approach.

The hospital had already implemented certain aspects of best practice, such as pressure reduction foam replacement mattresses on all beds, the Braden Scale risk assessment, skin care protocols and access to interdisciplinary team members by referral. Each surgeon also had a preventative program for deep vein thrombosis, which is a common complication that can develop in this patient population. All of these current practices were not changed. The HPU prevention program dealt only with specific interventions based on the RNAO BPG on prevention of pressure ulcers.

A final examination of current practices involved a visit by the HPU champion to the operating room (OR) to observe positioning of patients undergoing hip and knee surgeries. From this observation, she determined that the position in which patients were placed during surgery did not result in sustained pressures on the heel and therefore no changes in practice were recommended in the OR. Rather, this HPU prevention program would focus on strategies for patients in the ED and once they were in the post-operative recovering period.

3. Additional practices that could help prevent HPUs

Staff identified 29 potential interventions that they could add to current practices that could help prevent HPU. Examples included a daily routine of mobilisation, use of a heel protective device, involve the ED and PACU, manage pain, use simple approaches that achieve multiple goals, provide pressure relief for every patient, consult the dietician for all patients with fractured hips, check albumin levels on every patient, have better mattresses for stretchers, use visual cues like pictures to help staff, teach patients and families how to prevent HPU, and have all patients wear socks to help with friction.

4. Barriers and challenges to implementation of a HPU prevention program

Examples of the 14 barriers that were identified were lack of knowledge of options available for prevention, getting the ED to see HPU prevention as a priority, availability and maintenance of devices, having extra time if it is needed, process of implementation is overwhelming, gaining support from administration, improving limited dietary support, blaming approach

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Key Points

- offloading the heel was based on previous research that suggested that this was the only way to prevent pressure induced skin damage in the heel region
- they selected three heel protective devices that best met the criteria above: a hospital pillow, the Repose™boot and a wedge

and the cost of prevention if extra resources were needed.

A working group of made up of seven key opinion leaders: the coordinator, clinical educator, two RNs, one RPN, one OT and one PT (total $n = 7$) from ED, PACU and the orthopaedic unit was formed. They were tasked with taking the consensus document and developing clinically based interventions that would prevent HPU. Recommended changes combined responses from the Delphi process with RNAO BPGs on risk assessment and prevention of pressure ulcer (24).

An overarching principle that arose from the Delphi process was that the program should be implemented on all patients on all three units (ED, PACU and Orthopaedic) and run from admission until patients were mobile. Moreover, everyone thought the program should be simple.

The following interventions were selected for implementation:

1. Use a heel device to be chosen during a product evaluation process, on every patient. The device will be cleaned by patient care assistants and be stored in each patient's room where pillows are stored.
2. Mobilise all orthopaedic patients. The goal is to mobilise all patients unless contraindicated (e.g. non weight bearing status). Mobilisation involves all members of every heath care discipline (not just the PTs). Getting patients out of bed and on their feet is helpful for many things including preventing HPU.

Part 3: Identification of the best HPU prevention device

A three-step process was undertaken in order to select an appropriate HPU prevention device. The first step involved orthopaedic clinicians who identified key criteria to be considered when selecting a heel protection device. Then a small group of wound care specialists applied these criteria to select three devices from a long list of commercially available products. These devices were they trialed on the orthopaedic service and a final single device was selected based on feedback gathered from both patients and clinicians using the device.

To determine key criteria for selection of a heel device, a group of 12 experienced clinicians (RN, OT, PT and coordinator) from various areas of the orthopaedic service (orthopaedic unit, ED and PACU) were invited to a 1·5-hour meeting. A nominal group process (47) was used to come to 100% agreement that the top criteria for heel boot selection in order of priority are:

1. cleanable, reusable and approved by infection control,
2. ease of use,
3. price,
4. effectiveness without side effects,
5. comfortable to patient,
6. BPG supports the device,
7. Available to purchase or make.

A group of five wound care experts reviewed all devices available on the market. They were asked to use a 3-point Likert scale to rank the HPU devices based on how well they met the key criteria. The higher the score, the more likely it was that the device met the criteria. It was determined that if the device did not meet infection control criteria completely or did not float the heel off the bed, it would not be considered. The infection control concern was prompted by the increasing concern about hospital-acquired infections and multi-resistant organisms. Offloading the heel was based on previous research that suggested that this was the only way to prevent pressure-induced skin damage in the heel region. They selected three heel protective devices that best met the criteria above: a hospital pillow, the Repose™ boot and a wedge. The wedge we had selected was no longer available so the HPU champion and two orthopaedic OT's custom designed a wedge.

Part 4: Product evaluation

Prior to initiation of the product evaluation, all clinical staff and orthopaedic surgeons were sent electronic messages about the product evaluation. Orthopaedic surgeons were given an opportunity to raise any concerns about orthopaedic patients being randomly selected to use a heel protection device during the trial. Three of nine orthopaedic surgeons responded to e-mails stating that they had no concerns about testing the devices on any of their patients and that they were supportive of this project. An additional step taken just prior to the trial of these three products was that the HPU champion met with staff daily on the

orthopaedic unit for 1 week to remind them about the upcoming trial. She also met with the patient care assistants to review all the processes for cleaning and storing the devices under trial.

Evaluation of the selected heel protection devices occurred over a 14-day period in January 2008. All consecutive patients with orthopaedic condition or surgery below the waist (lower extremity) that were admitted to the orthopaedic service over a 2-week period were recruited to participate in the trial. A letter of information about the study was provided to clinical staff and patients on the orthopaedic service. Written consent was obtained from those who completed an evaluation form about the device they used. Patients could refuse to use a device. Because the use of a heel offloading device is considered best practice, all patients on the orthopaedic service were offered a heel protection device. However which one of the three devices being tested the patient received was determined randomly using a table of random numbers. A total of 72 subjects participated with each person testing only one device. Of these 72 subjects, 27 tested the Repose boot, 23 the wedge and 22 the pillow.

A photo of the device used on a particular patient was placed above his or her bed to ensure that patients received the correct devices that they had been assigned. These photos also showed the correct use of the device. Daily visits by the HPU champion were carried out to reinforce the correct use of each device, solve problems and obtain feedback.

Separate evaluation forms were developed for patients and clinical staff and the HPU champion recorded any oral feedback that was volunteered by either patients or clinicians. Both written and verbal feedback that was gathered was based on the key criteria identified during the consensus process. Any side effects related to the device were recorded; this included the development of a HPU or any other complication. At the end of the evaluation, the device with the most favuorable feedback and the fewest complaints were selected for use as the HPU prevention device to be used in the prevention program.

Device failures, where the device was removed from the patients because of clinical concerns, occurred with four subjects when a pillow was used to protect the heel. All four of these subjects had undergone knee replacement surgery. They had relatively short legs and the pillow bunched up behind the knee, thereby interfering with the newly replaced joint. The wedge had a device failure on a subject with a fractured hip because it was not high enough to keep the subject's hip aligned in traction. No device failures were reported by subjects using the Repose boot™. All patients who reported a device failure were provided with an alternate heel protection device, and no further evaluation was recorded. All three devices were liked and disliked by some subjects and staff.

In general, all the devices were easy to clean. Six RNs stated that all three devices were helpful in preventing HPU and that they would be happy using any one of them. Two patients were admitted with existing bilateral heel ulcers; one patient was randomly selected to use the pillow and the other to use the wedge. Both patients had an improvement in the heel ulcers and neither patient had deterioration. None of the 72 patients developed a HPU during the 14-day product trial. A common complaint about all three devices was that it did not stay in place. Staff reported that as patients recovered and were more mobile, the device was less likely to stay in place.

Eighteen patients and staff gave specific positive feedback regarding the pillow. Some of the comments included: 'My heels feel better already'; 'My heels feel better with the pillow'; 'I had the pillow when I first came back from surgery and it was excellent. Now I am moving about and don't need it'. Negative comments were received from 15 staff and patients regarding the pillow. Four main themes arose: the pillow was not seen as a device, it was not always put in place; it did not stay in place and had to be repositioned; there was no standard size so some pillows were too thin and some too thick; and it caused pain in the Achilles tendon.

The Repose boot™ had 19 positive comments. Some of the comments included: 'Comfortable and kept leg in proper alignment'; 'The boots keep my hips in alignment'; 'My heels were sore, and now that I have the boots, they are not'; and 'My heels feel better'. The Repose ™ boot received 19 complaints. Ten people indicated that it hurt the calf. The second most common complaint was that it did not stay in place.

Key Points

- evaluation of the selected heel protection devices occurred over a 14-day period in January 2008
- a total of 72 subjects participated with each person testing only one device. Of these 72 subjects, 27 tested the Repose boot, 23 the wedge and 22 the pillow
- none of the 72 patients developed a HPU during the 14-day product trial

Key Points

- the wedge had 28 positive comments and was the selected heel device
- during the 1-month implementation of the heel ulcer prevention program, no heel ulcers developed on any patient on the orthopedic service

The wedge had 28 positive comments. Several patients captured their approval in the following comments: 'Wish I had this 2 years ago when my heel burned and hurt'; 'I think this wedge helps; can we keep it?'; 'The wedge was comfortable, and I did not develop ulcers'. Staff and patients liked the wedge as it was easy to use and comfortable. The wedge received 13 negative comments. The most common theme was that it did not stay in place, and there were two comments that it was not high enough for heavy legs.

HPU PREVENTION PROGRAM IMPLEMENTATION

The HPU prevention program that was shaped by an extensive pre-implementation consultation process was then implemented over a 1-month period. In addition to using the selected heel device (the wedge), a mobilisation program was instituted that promoted early and frequent mobilisation of all patients by all team members. The wedge and mobilisation interventions were implemented universally with all patients on the orthopaedic service who underwent lower extremity surgery (below the waist).

Prior to the implementation phase of this HPU prevention program, the HPU champion sent out e-mails to remind all staff of the commencement of the HPU prevention program. In addition, she visited all three units daily for 2 weeks prior to the actual start date and conducted direct education about the program. The percentage of staff receiving direct education prior to the implementation was 60% for the orthopaedic unit, 67% for the PACU and 50% for the ED. This education was either one-on-one or with a few staff at the bedside.

During the implementation period, the HPU champion visited all three units and saw patients daily for 1 month, at which time further education took place, therefore increasing the proportion of staff who received education. Initially, the HPU champion spent 4 hours a day on the units, but as the project progressed, this time was reduced to 1·5 hours. Finally, the HPU champion made a point of praising the staff for any effort to implement the prevention strategies and everyone involved was motivated with improved outcomes. During the 1-month implementation of the heel ulcer prevention program, no heel ulcers developed on any patient on the orthopedic service.

EVALUATION OF PROGRAM

One month after the implementation began; the incidence of HPU was re-evaluated. Patients who were admitted to LHSC UH for fractures or surgery below the waist were approached consecutively from May 2008 to June 2008. The methods used were identical to a prior study by the research team when the pre-implementation was completed (44). Briefly, this involved direct examination of the heels of patients on admission and prior to discharge from the orthopaedic service.

When using an alpha level of 0·05 and beta of 0·20, the sample size to detect a change in incidence rate from 13·3% to 2% after implementation of our program would require us to follow 38 patients (48).

The incidence estimates were expressed as percentages with 95% confidence intervals (CI) (49).

RESULTS

An important lesson learned during preparation and development of the heel ulcer prevention program was the need to obtain support from hospital administration and orthopaedic surgeons prior early in the process. This support was facilitated by having a prior incidence study of the target population that provided an accurate assessment of the number of patients who develop HPU while on their service. Support from supervisors and surgeons were key to involvement by clinical staff.

The clinical staff was involved in shaping the nature of the HPU program. Through this consensus process, it was decided that the prevention program should be applied universally to all patients undergoing lower extremity surgery. Based on the current practices already in place, this program focused in three areas: (i) education of staff, (ii) a team approach to early and frequent patient mobilisation and (iii) use of a heel protection device.

The heel protection device that was selected was the wedge. The wedge was designed by the primary author and two OTs (see Figure 1 for a photograph). A third party company (Remington Medical) then made the prototypes for the study and now sells this product in Canada. Neither the OTs nor the

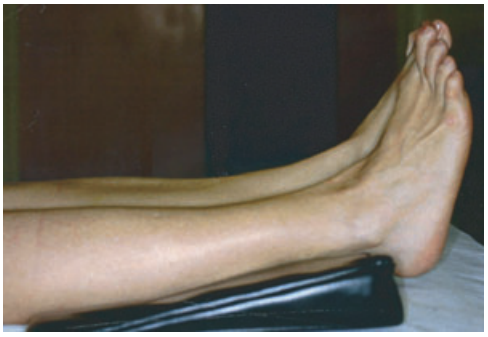

Figure 1. Photograph of the wedge heel protective device.

authors receive any compensation for this. Three prototypes were tested on capable acute orthopaedic patients until a final model was designed that met their needs. The wedge is 20 inches wide, so that it fits across a bed or stretcher. It is 2 inches thick at the thickest end so that it lifts the heel off the bed slightly without hyper-extending the joints (knee or hip). The wedge is 12 inches long so that it does not extend to the area behind the knee. Prior prototypes were 4 inches and 2·5 inches thick, and patients complained when the heel lift was too high it caused pain in the knee and hip joints. Finally, the wedge was covered in medical-grade vinyl so that it could be cleaned with the same cleaning products used for the mattresses and pillows.

Issues that arose during implementation of the HPU prevention program were:

- Despite reminders about the project and the selected prevention strategies, some clinical staff did not follow the interventions. By the end of 1 month, interventions were followed 90% of the time.
- A problem occurred regarding the availability of the wedges in all three units where orthopaedic patients transferred through post-operatively. A new process was worked out so that all wedges were stored in a common location on the orthopedic unit. Porters would restock ED and PACU with wedges when they were on the orthopaedic unit transferring patients.
- Five patients initially did not want to use a heel protective device. Some expressed a concern that they had been told by their orthopaedic surgeon not to lift the foot off the bed. When this occurred, the HPU champion spoke with the patients and explained that the orthopaedic surgeons were supportive of this device. In addition, they were educated regarding the high occurrence of HPU after lower extremity surgery and the need to prevent them. In all but one case the patients then agreed to use the wedge.
- One patient developed blisters all over her legs during the implementation period. The orthopaedic surgeon reviewed the patient and determined they were fracture blisters and not a side effect of the wedge. No other problems occurred such as deep vein thrombosis.

EVALUATION OF HPU PREVENTION PROGRAM

Forty subjects were enrolled consecutively over a 4-week period; four patients refused to participate in the study. The incidence of HPU after the implementation of the prevention program was 0%. This was statistically significant from the pre-intervention incidence of 13·3%, as it fell below the lower limit of the 95% CI that was 8–18%. The average age of the study population was 64 years with a standard deviation of 15 years. Fifty-eight percent were female; 50% had hip replacements; 30% had knee replacements, 10% had fractured hips and 10% had undergone surgeries below the waist.

DISCUSSION

This study has described steps involved in the development and implementation of a heel ulcer prevention program for people undergoing lower extremity orthopaedic procedures in an acute care hospital. Implementation of this prevention program was guided by RNAO toolkit for BPG implementation. Re-assessment of HPU incidence showed that no patient developed a HPU after the prevention program was implemented.

A key factor in the success of this program was meeting with senior administration and physicians at the outset of the project to obtain their support. Having the support of these key stakeholders up-front made subsequent meetings with the clinical staff much more effective because we were able to allay concerns that arose regarding surgeons and administrators support. Using

Key Points

- this study has described steps involved in the development and implementation of a heel ulcer prevention program for people undergoing lower extremity orthopaedic procedures in an acute care hospital
- a key factor in the success of this program was meeting with senior administration and physicians at the outset of the project to obtain their support

Key Points

- our results strongly suggest the program was successful because no HPUs were identified during or within 1 month of implementing the prevention program
- it is possible that the reduction in the number of people who acquired heel ulcers after the prevention program was implemented was influenced by the younger, healthier sample population included post-intervention

e-mail and personal reminders was helpful to keep administrators and clinical staff engaged and supportive throughout the project. In a Canadian study on pressure ulcers and implementation of evidenced-based nursing practice, a lack of visible senior nursing leadership was found to be a barrier to the implementation of BPG on PU (37). In a US study of a program to prevent HPU, incidence of HPU stayed essentially the same after the program implementation. The authors attributed their lack of success to a lack of organisational approval and the fact that management failed to convey messages to staff about the importance of the project and their support for it (50).

In this study, the Delphi process (46) was used so that all staff would have input, and no one person could influence the group to make decisions because the voting was carried out privately. The nominal group process (47) was used to determine key criteria for choosing a heel protection device. This consensus method was very efficient and prevented any one person from overpowering the group process. The selection process used in this study for determining which devices should be tested was transparent and objective. This systematic process also served to address any issues related to commercial interests and limited biases and conflicts of interest. The involvement of clinical staff and patients in the decisions about which heel protective device to adopt for use in the heel ulcer prevention program also served to promote adoption of the program and compliance with the use of the heel device. All of these methodologies are unique to this project and have not been used previously in other pressure ulcer prevention programs.

We elected to apply this prevention program universally to all orthopaedic patients who had undergone surgery to the lower extremity. This is in contrast to prevention programs that have a risk assessment tool like the Braden scale to identify high-risk individuals for whom the prevention program is applied. We did not elect to use a risk assessment tool in this prevention program because all orthopaedic patients are likely to be high risk, and adoption and use of risk assessment tools by staff at this facility has been historically been low. This universal approach allowed the program to be simple and efforts of clinical staff could be focused on implementing the prevention strategies rather than performing assessments.

A simple foam wedge with vinyl coating was selected and used as the heel protection device in this study. The effectiveness of this device as a heel protection device has not been tested previously. We organised for the specific dimensions of the wedge to be made by a local company for a cost of $48·35 cdn per wedge. However, given the simple design it could be easily produced by other sources. We elected to use only one size of the wedge. The ease of adoption of a program that has a one size fits all approach to the heel protection device were obvious. We recognize that other sizes may have better suited certain leg and body shapes. For example, people with larger and heavier legs may have benefited from a thicker wedge. We decided to lay a folded sheet underneath the wedge in these cases to lift the heels off the bed. This simple approach was appropriate for all but 1 of 23 patients who tested the wedge and was in traction.

Previous work in this health care setting showed a heel ulcer incidence of 13·3% (95%CI 8–18%) (44). To obtain this estimate of the proportion of patients undergoing leg surgery who develop HPU while on this orthopedic service, we directly examined both heels of 150 consecutive patients. In this study, we repeated the same methodology using 40 consecutive patients to evaluate the effectiveness of the HPU prevention program. Our results strongly suggest the program was successful because no HPUs were identified during or within 1 month of implementing the prevention program. This reduction in HPU incidence post-implementation is significant because it is well below the lower 95% confidence limit around the estimate of HPU incidence pre-intervention. However, the sample population in the present report was younger (63 versus 77 years), included more people with hip fractures (33% versus 10%), and contained a lower proportion of females (58% versus 69%) compared with the population used to estimate HPU incidence prior to intervention. Therefore, it is possible that the reduction in the number of people who acquired heel ulcers after the prevention program was implemented was influenced by the younger, healthier sample population included post-intervention. However, the higher proportion of female hip fracture patients in the post-implementation

sample would offset this. Collectively, we believe these slight differences in pre- and post-implementation samples would even out and it is likely that these populations had a similar risk of heel ulcer development.

The sample population used to estimate the HPU incidence post-implementation was fairly small ($n = 40$) compared with other studies published in this field. However, we used a sample size calculation by Baumgarten (48) to determine that a sample size of 38 or greater would give us 80% power to detect a significant difference in incidence between the pretest value of 13·3 and a post-implementation value of 2%.

The implementation and evaluation periods were fairly short in duration (each lasting 1 month). However, given that HPU were totally eliminated after a 1-month intervention suggested the intervention period was long enough to produce the desired response. Our evaluation period performed within 1 month of program implementation allows us to comment on the short-term effect of this program. It would be of interest to repeat the incidence of HPU in a few months time to see whether the heel ulcer prevention program has had lasting effects.

CONCLUSION

HPUs are a common and serious health concern, but they can be prevented in most patients with a universal HPU prevention program that incorporated patient and staff input.

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Key Points

- it would be of interest to repeat the incidence of HPU in a few months time to see whether the heel ulcer prevention program has had lasting effects

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