Reducing Hospital-Acquired Pressure Ulcers with a Silicone-Based Dermal Nourishing Emollient-Associated Skincare Regimen

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INTRODUCTION

According to the Agency for Healthcare Research and Quality (AHRQ), the number of hospital patients who develop pressure ulcers (PrUs) has risen by 63% over the last 10 years. PrUs represent a serious problem for patients within the acute care setting and are a significant care management challenge for clinicians. Effective October 1, 2008, the Centers for Medicare and Medicaid Services will no longer reimburse hospitals at the higher diagnosis-related group rate for Stages III and IV PrUs that are not documented on admission.

The AHRQ found that the average stay for patients admitted to hospitals for the treatment of PrUs was 13 days, with an average cost of $37,800 per hospital stay. An average acute care hospital will spend between $400,000 and $700,000 per year to treat PrUs. Research also shows that the actual costs on a timeline from creation of the ulcer to complete healing can reach as high as $90,000. Nearly 9 of every 10 hospital stays involving PrUs were covered by government health programs—66% by Medicare and 23% by state Medicaid programs. Liability is another indirect cost of PrUs. The average malpractice award in 1995 was $500,000. This figure does not include the costs of management time or legal fees incurred by the practitioners or the facility.

Maintaining skin integrity is a critical factor for reducing the risk of PrUs. Many commercial products exist to improve skin integrity and protect against factors that produce PrUs. In the study reported in this article, the authors incorporated one skin care program (Remedy; Medline Industries, Inc, Mundelein, Illinois), which is silicone based and uses dermal nourishing emollients. For the purposes of this article, this skin program is referred to as the silicone-based dermal nourishing emollient (SBDNE) program or regimen. The SBDNE regimen contains a proprietary blend of antioxidants, amino acids, vitamins (A, B₇, 

ABSTRACT

OBJECTIVE: To determine the effect of a silicone-based dermal nourishing emollient (SBDNE) regimen on the reduction of pressure ulcers (PrUs) and costs in a hospital medical unit.

RATIONALE: PrUs represent a serious problem for patients within the acute care setting and are a significant care management challenge for clinicians. Effective October 1, 2008, the Centers for Medicare and Medicaid Services will no longer reimburse hospitals at the higher diagnosis-related group rate for Stages III and IV PrUs that are not documented on admission. In addition, formation of PrUs in the hospital also puts the institution at financial risk of lawsuits.

RESEARCH DESIGN AND METHODS: The wound healing center at Porter Adventist Hospital, Denver, Colorado, documented the hospital-acquired incidence rate of PrU patients in the hospital from May 2006 to December 2007. A retrospective, quasi-experimental design was used to examine the changes in PrU incidence rates and the economic effect of introducing a SBDNE regimen into an existing PrU prevention protocol.

RESULTS: The replacement of a mixture of ad hoc skin care products, none of which contained silicone-based emollients, with an SBDNE skin care regimen into an existing prevention program significantly reduced the proportion of hospital-acquired PrUs to 0% after 8 months. Estimated cost savings per patient admitted to the medical unit attributed to SBDNE averaged $6677.11 per patient.

MAIN CONCLUSIONS: The use of an SBDNE skin care regimen was important in bringing about a significant reduction in the number of patients with PrUs and respective treatment costs in a medical unit experiencing high incidence rates of PrUs.
B₆, C, and D₃) and methylsulfonylmethane (MSM). Each of these ingredients has been well researched for its role in basic cellular maintenance and protection.

HOSPITAL CHALLENGE
In September 2006, the Porter Adventist Hospital, Denver, Colorado, instituted a new management team to provide improved care to patients and to target the reduction of PrU rates as an objective. Staff members completed a refresher training course to improve their focus on patient care. As a consequence of these steps, PrU development rates began to decline to a more acceptable rate, nearer to the national average. Clinicians considered the rates to be amenable to further reduction by a change in their skin care program because every other activity, including education, pressure redistribution, nutrition, and timely removal of urine and feces, had been optimized, based on nursing activity charts and feedback.

In January 2007, the wound, ostomy, and continence nurses began to look more specifically for causes of PrU breakdown in the medical unit to try to further reduce PrU occurrence rates. PrU incidence data were collected with a focus on the recognition of patient risk factors for skin breakdown. It was discovered during a January 2007 evaluation that all of the patients in the medical unit with nosocomial skin breakdown were incontinent. All had been treated by a mixture of skin care products and brands, with no particular thought paid to any synergy, effectiveness, or lack thereof, among these diverse products.

While making a choice in implementing a consistent skin care program to bring down PrU incidence rates below the national average, the SBDNE skin care product line was chosen by the wound care team because they felt it reflected the latest technology. Also, the range was formulated to enhance the skin improvement effects in a synergistic fashion and included products that would protect intact skin, as well as treat raw, denuded skin. A protocol for appropriate use of the products was drafted and in-serviced to the medical unit staff. At the time of the skin care product change, no other additional measures were taken to reduce PrUs beyond those already in practice.

Experimental Approach
This study aimed to estimate the economic impact of switching from ad hoc skin care products to a product regimen including SBDNE to prevent hospital-acquired PrUs. Through reduction of PrUs in a medical unit, the hospital will save on treatment costs and the potential financial implications of lawsuits.

METHODS
In 2006, Porter Adventist Hospital Wound Healing Center began collecting PrU incidence and prevalence data. Data collection forms and instruction were provided by Kinetic Concepts, Inc (KCI), San Antonio, Texas. The forms included patient demographics, primary diagnosis for admittance, incontinence status, risk assessment scores (Braden Scale for Predicting Pressure Sore Risk), prevention interventions used, and documentation of PrUs (on admission and nosocomial). Data were collected on a quarterly basis, allowing for the quantification of incidence and prevalence rates for each quarter. Additional information on hospital policy and staffing changes in the medical unit was attained from the clinical manager at the wound healing center.

The hospital gave approval for the nursing staff to review patient information and summarize the data for analysis. It was determined impractical to contact patients from the past for consent to use their data for analysis. The hospital is confident that the results are useful for the benefit of healthcare decisions to the community and that patient information has not been compromised.

A graphical time-series analysis was used to show the changes in incidence rates from first data collection in May 2006 through December 2007. The incidence rate is the number of new cases of pressure ulceration per unit of person-time at risk. A chi-square analysis was used to determine statistical differences in patient risk for PrUs and the proportion of PrUs acquired between the periods before implementation of the SBDNE regimen and after implementation.

The Braden Scale for Predicting Pressure Sore Risk scores were obtained from the hospital for all patients in the quarterly reports including the pre-SBDNE and post-SBDNE patients. The Braden Scale for predicting PrU risk is validated across multiple healthcare settings, including hospitalized patients. Clinicians at Porter Adventist Hospital used the tool to assess 6 risk areas (subscales) for developing PrUs: sensory perception, skin moisture, activity, mobility, nutrition, and friction/shear. Each subscale within the Braden Scale contains a numerical range of scores, with 1 being the lowest score possible. The friction/shear subscale ranges from 1 to 3; the other subscales range from 1 to 4. All risk areas are then added, and the total overall risk, ranging from 6 to 23, is determined. In the medical unit, scores of 16 and less are used to indicate high risk, whereas scores greater than 16 indicate moderate to no risk. For purposes of this evaluation, the cutoff point for patients at risk of pressure ulceration is 18 or less. The authors also stratified the risk according to a broad outline of protocols by risk level and measured statistical differences between the 2 periods.

The risk for acquiring PrUs in the hospital increases with age. Approximately 70% of all PrUs occur in persons older than 70 years. An independent t test for equality of means compared the pre-SBDNE and post-SBDNE periods for differences in
patient age. Incontinence is a risk factor for hospitalized patients, especially those older than 65 years.\textsuperscript{23} The focus of this investigation is directly related to the use of SBDNE on incontinent patients in the medical unit. A chi-square analysis is used to determine statistical differences in the proportion of incontinent patients before implementation of the SBDNE regimen and after implementation.

An estimate of the cost to treat a patient in the medical unit, with skin care products, before and after the use of SBDNE was completed. The estimate includes costs of nursing time and products used per patient over an average length of stay. The average length of stay for a hospital admission at Porter Adventist Hospital is 7.5 days.

Costs of PrU treatment can vary dramatically, depending on the severity of the wound and complications. Average costs of treatment for PrUs in an acute care setting, published by the AHRQ, were used to estimate the economic consequences.

**RESULTS**

**Time-Series, Incidence Rates**

The PrU incidence rate reached a high of 31\% for the quarter ending September 2006, from the point data began to be gathered in a rigorous manner using the designated form. PrU quarterly incidence rates dropped an average of 10\% after new management implemented staffing changes in October 2006. Results indicated that the change to a silicone-based dermal emollient regimen for skin care further reduced the incidence rate below the KCI national database average of 7\% for hospital-acquired PrUs (Figure 1). In December 2007, the hospital medical unit experienced a 0\% incidence rate for PrUs.

**Statistics**

A chi-square analysis was used to determine statistical differences between the proportion of hospital-acquired PrUs and the proportion of patients who were incontinent before and after...
the SBDNE regimen was implemented. Figure 2 shows proportional differences in hospital-acquired PrUs from pre-SBDNE to post-SBDNE implementation. A significant difference in the likelihood that a patient will get a PrU exists between the pre-SBDNE and post-SBDNE program ($\chi^2 = 7.09$, $P = .008$). In Figure 3, patients had the same predictive risk profile for pressure ulceration in both periods as determined by a cutoff Braden score of 18 and stratified prevention protocols by risk level ($\chi^2 = 1.64$, $P = .801$). The prevalence of incontinent patients in the medical unit was statistically the same for each period ($\chi^2 = 1.17$, $P = .279$). There were 22 (47.8%) and 24 (37.5%) patients incontinent in the pre-SBDNE and post-SBDNE groups, respectively.

There were no significant differences in age of patients admitted to the medical unit during the evaluation period (Table 1). The average ages were 68.65 and 67.81 years for the pre-SBDNE and post-SBDNE patients, respectively.

### Cost of Skin Care Treatments
Skin was inspected regularly and throughout the investigative period. This included an entire body scan at least twice a day. Total body skin care was given to patients in the medical unit, especially on high-risk areas for PrUs. All incontinent patients were treated according to practice guidelines for incontinent care. Skin care products were used as indicated by their manufacturer.

In Table 2, a cost analysis estimates the cost of skin care treatment before and after implementing the SBDNE products. Taking into consideration nursing time, cost of products per application, number of applications per day, and average length of stay, the authors derived an estimate for average cost of skin care treatment per admission. The average cost of treatment per admission using generic products is $32.51 per admission. It costs approximately $33.26 per admission using SDNE products. The difference was $0.75 per admission.

### Table 1.
**AGE AS A FACTOR FOR PRESSURE ULCER OCCURRENCE**

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-SBDNE</td>
<td>46</td>
<td>68.65</td>
<td>18.109</td>
<td>2.105</td>
</tr>
<tr>
<td>Post-SBDNE</td>
<td>64</td>
<td>67.81</td>
<td>17.541</td>
<td>2.532</td>
</tr>
</tbody>
</table>

*Test for equality of means (2-tailed significance, $P = .801$).

### Table 2.
**COST ANALYSIS FOR SKIN CARE REGIMEN**

#### Pre-SBDNE Implementation

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Average Cost/Application, $</th>
<th>No. Applications/Day</th>
<th>Average Cost/Day, $</th>
<th>Average Cost/Admission, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleansing foam</td>
<td>0.19</td>
<td>2</td>
<td>0.38</td>
<td>2.85</td>
</tr>
<tr>
<td>Skin conditioner</td>
<td>0.05</td>
<td>2</td>
<td>0.10</td>
<td>0.75</td>
</tr>
<tr>
<td>Protective barrier cream</td>
<td>0.21</td>
<td>2</td>
<td>0.42</td>
<td>3.15</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td>6.75</td>
<td></td>
</tr>
<tr>
<td>Nursing Cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>7</td>
<td>2</td>
<td>3.44</td>
<td>25.76</td>
</tr>
<tr>
<td>Pre-SBDNE grand total</td>
<td></td>
<td></td>
<td></td>
<td>32.51</td>
</tr>
</tbody>
</table>

#### Post-SBDNE Implementation

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Average Cost/Application, $</th>
<th>No. Applications/Day</th>
<th>Average Cost/Day, $</th>
<th>Average Cost/Admission, $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remedy 4-in-1 skin cleansing lotion</td>
<td>0.24</td>
<td>2</td>
<td>0.48</td>
<td>3.60</td>
</tr>
<tr>
<td>Remedy skin repair cream</td>
<td>0.08</td>
<td>2</td>
<td>0.16</td>
<td>1.20</td>
</tr>
<tr>
<td>Remedy NutraShield skin protectant</td>
<td>0.1</td>
<td>2</td>
<td>0.2</td>
<td>1.50</td>
</tr>
<tr>
<td>Remedy Calazime protectant paste</td>
<td>0.08</td>
<td>2</td>
<td>0.16</td>
<td>1.20</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing cost†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>7</td>
<td>2</td>
<td>3.44</td>
<td>25.76</td>
</tr>
<tr>
<td>Post-SBDNE grand total</td>
<td></td>
<td></td>
<td></td>
<td>33.26</td>
</tr>
<tr>
<td>Difference</td>
<td></td>
<td></td>
<td></td>
<td>0.75/admission</td>
</tr>
</tbody>
</table>

*Average hourly rate = $14.72 including benefits discounted to year 2007.
Average Cost Savings

Table 3 illustrates the estimated cost of PrU treatment by quarter from May 2006 to December 2007. Costs were reduced first by improvements in training, nursing practices, and nurse/supervisor interactions (October 2006 to March 2007) that were initiated by a change in management during September 2006. Secondly, a drop in the number of patients with hospital-acquired PrUs was observed during the SBDNE period (April 2007 to December 2007), producing a further cost savings for the hospital. The average cost savings produced by switching to the SBDNE regimen was estimated at $6,677.11 per patient admitted to the medical unit. Savings were directly related to the development of PrUs.

In addition to reduced costs from treating PrUs, the hospital has reduced the possible financial implication of lawsuits. Settlement costs for a hospital-acquired PrU can be as high as $2 million.23

DISCUSSION

There are many factors associated with PrU formation in at-risk hospital patients. This article demonstrates the importance of skin care and especially the use of synergistic products with a formulation that has been developed in the context of promoting basic cellular maintenance and protection of damaged skin.

Clinical research for SBDNE demonstrates the ability to ameliorate skin conditions, such as in lymphedema-affected skin, ichthyotic skin, and skin affected by poor lower limb circulation.10–12 The specialized nutrients, for example, modulate biochemical abnormalities associated with pruritus.10 The mechanism by which the SBDNE products prevent PrU formation is yet to be definitively confirmed, but it is believed that the capacity of the product range to keep skin moist and hydrated may have a major contributory effect.13 Free radical damage has been implicated in PrU creation.14–18 It is possible that the antioxidant nature of potent antioxidative ingredients (such as hydroxytyrosol) prevents reactive molecular species damage to the skin, which in turn leads to a decrease in PrU conditions and rates.

The authors believe that the Porter Adventist Hospital is moving in the right direction to reduce the incidence of hospital-acquired PrUs. Because of the CMS policy that took effect on October 1, 2008, it is imperative that all hospitals use best practices and evidence-based products to avoid skin breakdown.

In this study, it was apparent that new hospital management had an early impact on PrU incidence rates by focusing nursing time into prevention. Nurses were more cognizant of PrU statistics and the need to investigate and improve upon outcomes. They did not change their protocol but gave more attention to risk assessment and factors placing the patients at risk. In a short time, nursing interventions became standard practice and remained constant throughout the study period. There were no efforts to improve skin care before SBDNE use. This evaluation suggests that SBDNE skin care products lead to cost savings when added to an existing program of PrU prevention.

Limitations and Assumptions

Average costs for hospital stay related to PrUs, determined by the AHRQ, were used as a basis for estimating the cost to treat PrUs. The assumption was that each patient acquiring PrUs had the same severity of ulcer and length of stay in the hospital. The authors acknowledge that there is a high variation in

### Table 3.

<table>
<thead>
<tr>
<th>ESTIMATED COST SAVINGS FROM SBDNE SKIN CARE REGIMEN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-SBDNE Implementation</strong></td>
</tr>
<tr>
<td><strong>May 2006</strong></td>
</tr>
<tr>
<td>No. patients</td>
</tr>
<tr>
<td>No. with pressure ulcers</td>
</tr>
<tr>
<td>No. incontinent patients</td>
</tr>
<tr>
<td>Estimated cost of skin care treatment (assuming 65% of patients receive skin care treatment), $</td>
</tr>
<tr>
<td>Estimated hospital cost for pressure ulcer treatment, $ ($&lt;37,800)</td>
</tr>
<tr>
<td>Total costs after skin care treatment costs subtracted, $</td>
</tr>
<tr>
<td>Total cost savings, $</td>
</tr>
<tr>
<td>Average cost of pressure ulcer treatment per admitted patient in the medical unit, $</td>
</tr>
<tr>
<td>Average cost savings per admitted patient in the medical unit, $</td>
</tr>
</tbody>
</table>
treatment costs from wound severity, complications, and patient comorbidities and compliance. In addition, some patients are discharged early from the hospital (before the ulcer is healed) to other healthcare venues in response to insurance reimbursement and other factors. This could reduce the financial implications on the hospital.

The authors note that there are multiple factors that can predispose a patient to PrUs. The clinical staff at the hospital assured the authors that, after management changes, there were consistent nursing interventions and efforts to address the risk factors. Further analysis and chart review could assist in verifying this assumption.

**Implications/Significance of the Evaluation**

Clinical observation of outcomes is an important factor when considering the use of healthcare products and services. In this evaluation, the clinical nurse manager was confident that the use of SBDNE products in the medical unit was the major factor for PrU reduction after changes in management at the hospital had produced some early, positive results. The results appear to validate the manager’s clinical intuition. A significant reduction in incidence rates was evident after SBDNE-based skin care regimen implementation. The replacement of SBDNE skin care products and a formal regimen/practice from a mixture of ad hoc skin care products and brands into an existing PrU prevention program at Porter Adventist Hospital helped to reduce the incidence rate to 0% from a high of 12% at the time of change.

From the hospital’s perspective, the cost savings of switching to SBDNE skin care products and brands from a mixture of ad hoc skin care products to an existing PrU prevention program helped to reduce the incidence rate to 0% from a high of 12% at the time of change. The change came with sequential and methodical use of SBDNE products as directed by product indication and protocol established at the hospital. It seems that the introduction of a comprehensive program, including the introduction of the new skin care regimen, played a role in reducing PrU levels at a significant rate.

**CONCLUSION**

The implementation of a silicone-based dermal emollient regimen was important in bringing about a significant reduction in the number of patients with PrUs. At Porter Adventist Hospital, the cost savings attributed to SBDNE was estimated at $6677.11 per patient in the medical unit. The authors conclude that there is a statistically significant difference in the proportion of hospital-acquired PrUs between pre-SBDNE and post-SBDNE implementation given the same comprehensive prevention program (P = .008).

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21. CMS Roundtable Discussion on Pressure Ulcer Prevention; February 2, 2008; Chicago, IL.