

## A structured educational model to improve pressure ulcer prevention knowledge in veterans with spinal cord dysfunction

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**Abstract—Objective.** This paper describes an educational model for increasing and retaining the knowledge of pressure ulcer prevention and management in veterans with spinal cord injury (SCI) or multiple sclerosis (MS) who have had surgical repair of a pressure ulcer. It also describes the correlates of pressure ulcer knowledge at admission and discharge. **Methods.** Before pressure ulcer surgery, 41 male veterans with SCI or MS were randomized to either an intervention group or a control group. A pressure ulcer prevention knowledge test was administered before surgery and at discharge from the hospital, as well as at 3, 6, 12, and 24 months after discharge for the intervention group and at the end of participation for the control group. Other measures obtained at admission included health locus of control and health beliefs. Near the end of their hospital stay, participants of the intervention group received 4 hours of structured, individualized education on the prevention of pressure ulcers while participants of the control group received standard education. **Results.** Results indicated that participants in the intervention group gained more knowledge during hospitalization than did those in the control group. Lower admission knowledge scores were

related to the “chance” dimension of locus of control, nonbelief that an ulcer would interfere “a lot” in one’s life, and nonbelief that daily skin checks make “a lot” of difference in whether one gets an ulcer. Lower discharge knowledge scores were related to older age, older age at onset, a greater number of previous pressure ulcer surgeries, and nonbelief that daily skin checks make “a lot” of difference in whether one gets an ulcer. Both groups retained most of their discharge knowledge up to 24 months postdischarge or to discontinuation because of recurrence. **Conclusions.** Enhanced, individualized education about pressure ulcer prevention and management was effective in improving pressure ulcer knowledge during hospitalization for surgical repair of a pressure ulcer. The effect of the intervention on recurrence of pressure ulcers will be addressed in future reports.

**Key words:** *patient education, pressure ulcers, prevention, spinal cord injury.*

### INTRODUCTION

Pressure ulcers are a severe and costly complication of spinal cord injury (SCI). They interfere with every aspect of life for veterans with SCI and are a deterrent to rehabilitation and to the resumption of active, productive lives. Pressure ulcer prevalence rates range from 8 percent 1-year post-SCI to 33 percent for community-resident persons with SCI [1–4]. Current prevention programs, specifically hospital-based educational interventions, have had limited success in reducing the prevalence of

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this potentially life-threatening complication of SCI. Although many pressure ulcer educational programs are described in the literature [5–8], in general, these educational programs were developed for an in-patient population and rarely were evaluated for their effectiveness in increasing pressure ulcer knowledge or retention of that knowledge following community reintegration.

### Patient Education

Educational programs are mechanisms for transferring essential information to patients and caregivers. The primary focus of educational programs that deal with pressure ulcers is to translate this information into effective strategies for prevention and treatment [9]. Effective educational programs and materials should—

- Be relevant to the target audience (e.g., patient characteristics, learner's knowledge and skills, education level, language, lifestyle).
- Motivate the person to take responsibility for maintaining healthy behaviors.
- Be interactive.
- Encourage patient, family, and/or personal care attendant participation.
- Be evaluated for positive outcomes or changes in behaviors [7,10–15].

Furthermore, educational programs succeed if—

- They are individualized to the patient's lifestyle.
- They are systematic and consistent.
- The recommended regimen is easy to follow.
- Positive reinforcement is provided.
- Support systems are enhanced.
- A patient care agreement that delineates the patient's responsibilities is developed.
- There is responsibility for follow-through and problem solving [8,13–17].

Additionally, the patient's motivation to comply may depend on beliefs about his or her susceptibility to the problem or about the severity of the problem [16,18].

### Patient Education, Spinal Cord Injury, and Pressure Ulcers

Contemporary approaches to pressure ulcer management emphasize prevention through education [5,7–8,11,14–15,17]. Most educational programs on pressure ulcer prevention targeted to persons with SCI are designed for an in-patient population during initial rehabilitation. Rarely is

a mechanism available to evaluate adequately what information has been retained, what behaviors are practiced, and what value the prevention strategies are perceived in the individual's daily life. Frequently, didactic education is one component of a more comprehensive pressure ulcer prevention program [19] and, in some cases, has been found to increase knowledge test scores [8,20–21]. Traditionally, patient education programs emphasize a combination of specific behaviors which, when performed regularly, are intended to reduce the risk, occurrence, and/or recurrence of skin breakdown [6]. However, generally, a lack of objective data exists demonstrating that the educational programs resulted in strict adherence to a skin-care regimen that has the potential to reduce the occurrence or recurrence of pressure ulcers. Conversely, there is no published evidence that failure to practice these techniques regularly is associated with the occurrence or recurrence of pressure ulcers [22].

Dai and Catanzaro pioneered the use of the Health Beliefs Model to describe factors that predict adherence to skin care regimens [18]. Their results suggested that skin care education might more effectively increase compliance if it emphasizes information on severity, specific knowledge and techniques, and evidence of efficient skin care. Basta recommended that patient educators (1) assess learning style on admission, (2) time the delivery of the pressure ulcer prevention education to coincide with times when the information and skills would be most immediately applicable and relevant, and (3) prioritize prevention measures when educating the patient [5].

This paper describes an educational model for increasing knowledge about pressure ulcers with the ultimate goal of preventing recurrence. It focuses on knowledge gained and retained in veterans with SCI who have had surgical repair of a pressure ulcer. It also describes the correlates of pressure ulcer knowledge. In a subsequent paper, the investigators will address the effect of the intervention (enhanced education and structured follow-up) on preventing recurrent pressure ulcers. The hypothesis is that persons receiving an individualized educational intervention with structured follow-up would gain and retain more pressure ulcer knowledge during hospitalization than persons receiving standard care do now.

## METHOD

### Sample

The sample consisted of 39 men with SCI and 2 men with multiple sclerosis (MS) who were admitted to the Houston Veterans Affairs Medical Center (VAMC) for

surgery to repair a Stage III or IV pelvic pressure ulcer (sacrum/coccyx, ischium, or trochanter). Veterans were included regardless of level and completeness of SCI, age, ethnicity, educational level, or functional independence. Veterans were excluded if they were cognitively impaired to the extent that they were unable to understand either the consent form or the educational material. In addition, two individuals refused to participate and one

withdrew shortly after enrollment. Two individuals were admitted for pressure ulcer surgery but did not have the surgery primarily because of anticipated noncompliance with postsurgery restrictions.

The participants had a wide range of age, age at onset of SCI or MS, and time since onset of SCI or MS (**Table 1**). The sample had an equal number of Caucasian and

**Table 1.**  
Characteristics of sample.

Variable	Overall (n = 41)	Intervention Group (n = 20)	Control Group (n = 21)	Variable	Overall (n = 41)	Intervention Group (n = 20)
	Mean	SD	Range		Mean	SD
Age (yr)	53	11	28 to 78	55	11	40 to 78
Age at onset of SCI or MS (yr)	36	12	19 to 69	35	12	1 to 69
Time since onset of SCI or MS (yr)	17	10	1 to 44	20	11	1 to 44
	Number	Percent	Number	Percent	Number	Percent
<b>Race</b>						
Caucasian	20	49	11	55	9	43
African American	20	49	9	45	11	52
Hispanic American	1	2	0	0	1	5
<b>Educational Status</b>						
Less than high school graduate	3	7	2	10	1	5
High school graduate or GED	15	37	6	30	9	43
Some college	16	39	10	50	6	29
Bachelor's degree	7	17	2	10	5	24
Graduate school	0	0	0	0	0	0
<b>Level of Impairment</b>						
Cervical	16	39	7	35	9	43
Thoracic/lumbar	24	59	12	60	12	57
Unspecified (MS)	1	2	1	5	0	0
<b>ASIA Impairment Score</b>						
A	28	68	13	65	15	71
B	10	24	5	25	5	24
C	0	0	0	0	0	0
D	1	2	0	0	1	5
N/A (MS)	2	5	2	10	0	0
<b>No. of Previous Flap Surgeries</b>						
0	18	44	10	50	8	38
1	9	22	4	20	5	24
2 or more	13	32	6	30	7	33
Missing data	1	2	0	0	1	5

ASIA = American Spinal Injury Association

MS = multiple sclerosis

GED = general equivalency diploma

SCI = spinal cord injury

SD = standard deviation

N/A = not applicable

African-American participants. Most were married or divorced. All but three participants had high school diplomas or their general equivalency diplomas (GEDs), 39 percent had some college, and 17 percent had a bachelor's degree. Most of the participants were not employed just before admission. The most frequent cause of injury was a motor vehicle crash. Etiologies categorized as "Other" included the two participants with MS, a boating accident, a crush injury, a parachute jump, a stab wound, and complications of surgery. Most of the injuries were in the cervical or thoracic areas. All but two of the persons with SCI had American Spinal Injury Association (ASIA) impairment scores indicating that they were motor-complete injuries.

More than half of the participants had had from one to five previous flap surgeries, with their last surgeries occurring from under 1 year to 14 years before the current admission. The pressure ulcers that were surgically repaired were in several locations in the pelvic area—sacrum/coccyx ( $n = 7$ ), ischium ( $n = 21$ ), or trochanter ( $n = 13$ ). There was a wide range of length of the current hospital stay, extending to over 1 year. No significant differences were found between the intervention and control groups on the variables displayed in **Table 1**.

## Procedure

Potential participants were interviewed soon after their admission to the VAMC. At which time, an investigator described the study. Persons who were interested in participating and met all study criteria signed a consent form and were given a copy. They were randomized to one of two groups by selecting a numbered paper from a container. Persons randomized to the intervention group received the enhanced educational intervention and structured follow-up. Persons who were randomized to the control group received standard education and no structured follow-up.

All participants completed the Demographic and Health Information Questionnaire, the Pressure Ulcer Knowledge Test, the Health Beliefs Questionnaire, and the Multidimensional Health Locus of Control Scale upon entry into the study. The Pressure Ulcer Knowledge Test was administered again to all participants just before discharge from the hospital. The intervention group also completed the Pressure Ulcer Knowledge Test at 3, 6, and 12 months postdischarge. Participants from both groups completed the Pressure Ulcer Knowledge Test at 24 months or when they discontinued because of pressure ulcer recurrence.

## Educational Intervention

Veterans in the intervention group received up to 4 hours of individualized, structured education on the prevention and management of pressure ulcers near the end of their hospital stay. In general, this education was presented in four 1-hour sessions. Each session consisted of specific information followed by discussion. Topics included pressure ulcer etiology, prevention strategies (e.g., weight shifts, skin inspection), nutrition, and pressure-reducing support surfaces for the bed and wheelchair. The content of the educational model is presented in **Figure 1**. One of the sessions included family members, significant others, or attendants, either in person or by telephone. The investigator also provided printed materials that the veteran could take home, including monographs on skin care, prevention, and treatment of pressure ulcers. All these materials were developed specifically for persons at risk for pressure ulcers [23–26].

## Structured Follow-up

The intervention group participants were contacted by telephone monthly after discharge until 2 years after discharge or the recurrence of a pressure ulcer in the pelvic area, whichever came first. During the telephone contacts, participants responded to questions about the status of their skin and pressure ulcer prevention behaviors. They were reminded of any behaviors that they should have been doing but were not (e.g., eating a balanced diet). The control group was contacted periodically only to determine skin status; no information was sought or given regarding preventive practices during these contacts until the final contact at 24 months postdischarge or when discontinued because of a recurrence of a pressure ulcer.

## Measures

### *Demographic and Health Information Questionnaire*

Through interviews, we obtained the age, race, marital status, and level of education of the participants. SCI and MS descriptors such as level and completeness of SCI, age at onset of SCI or MS, time since onset (duration), and history of pressure ulcers and pressure ulcer surgery were obtained from the medical record. Information regarding other health conditions was documented.

### *Pressure Ulcer Knowledge Test*

This measure is an investigator-constructed 14-item questionnaire that assesses knowledge about pressure

<b>Hour 1:</b>	<ul style="list-style-type: none"> <li>• Establish rapport with patient.</li> <li>• Review pressure ulcer history and current problem for which surgery is required.</li> <li>• Review pressure ulcer etiology, including pressure, shear, friction, and moisture.</li> <li>• Review layers of the skin and pressure ulcer pathology (in layman's terms).</li> <li>• Review prevention strategies, identifying which ones have been done in the past, which ones have not been done and why, and which ones may be done in the future: <ul style="list-style-type: none"> <li>▸ Nutrition.</li> <li>▸ Cleanliness.</li> <li>▸ Weight shifts/turns.</li> <li>▸ Skin inspection.</li> <li>▸ Use of wheelchair cushions and special mattresses.</li> <li>▸ Safety regarding tight clothing or shoes.</li> </ul> </li> </ul>
<b>Hour 2:</b>	<ul style="list-style-type: none"> <li>• Introduce the manual <i>A Personal Guide to Healthy Skin</i>.</li> <li>• Review areas of insufficient pressure ulcer knowledge or misinformation.</li> </ul>
<b>Hour 3:</b>	<ul style="list-style-type: none"> <li>• Train a family member, significant other, or attendant either by telephone or in person, emphasizing specific areas of concern.</li> <li>• Introduce the Agency for Healthcare Policy and Research (AHCPR) (now called the Agency for Healthcare Research and Quality [AHRQ]) clinical practice guideline titled <i>Preventing Pressure Ulcers—Patient Guide</i> (consumer version).</li> </ul>
<b>Hour 4:</b>	<ul style="list-style-type: none"> <li>• Introduce the AHCPR clinical practice guideline <i>Treating Pressure Sores—Consumer Guide</i>.</li> <li>• Review all written material including VA SCI manual "Yes You Can."</li> <li>• Test patient's pressure ulcer knowledge and review relevant prevention strategies.</li> <li>• Answer questions from patient or family, significant other, or attendant.</li> </ul>

**Figure 1.**  
Content of educational model.

ulcer etiology, stages of tissue deterioration, skin inspection, weight shifts and turns, nutrition, pressure-reducing devices for the wheelchair and bed, and prevention and management strategies. The items on this questionnaire reflect the most frequently presented topics on skin integrity covered during initial rehabilitation following an SCI [5–7,9,19,23]. These included (1) items critical to pressure ulcer prevention and/or

(2) behaviors not practiced regularly. Scores can range from 0 to 60 points, and the percentage of possible points is calculated.

#### *Multidimensional Health Locus of Control Scale*

Locus of control is a person's way of viewing life's experiences. It is one's beliefs about an association between one's actions and outcomes. The Locus of Control

Scale is an 18-item questionnaire that classifies a person as either internally or externally controlled [27]. Internally controlled individuals believe that their individual actions influence outcomes. Externally controlled individuals believe that external forces determine outcomes. A third category in the scale is “chance” in which the person believes that events occur randomly and are totally separate from individual actions and that outcomes are dominated by authoritative figures.

### *Health Beliefs Questionnaire*

Dai and Catanzaro described four factors that constitute health beliefs regarding skin care [18]:

1. Perceived susceptibility to pressure ulcers.
2. Perceived severity of pressure ulcers.
3. Perceived efficacy of behaviors for preventing pressure ulcers.
4. Perceived barriers to skin care.

In this study, participants were asked the following questions:

- How serious do you believe pressure ulcers are?
- How likely are you to get them in the future?
- How much would pressure ulcers interfere with your daily lives?
- Are they difficult to treat?
- Are they preventable?
- How important are specific preventive behaviors (e.g. weight shifts, skin checks).

Response options are presented in **Table 2**.

### **Data Analysis**

Descriptive statistics were obtained for all study variables for the entire sample and for each group separately, including means, standard deviations (SDs), and ranges for continuous variables and number and percent for categorical variables. To determine whether differences existed between the two groups on continuous variables, we performed t-tests. For differences on categorical variables, we performed Chi-square tests. For the Chi-square tests, some categories were combined to avoid very small cell sizes.

Continuous correlates of pressure ulcer knowledge at admission and discharge were identified with Spearman rho correlational analysis for the entire sample and for each group separately. Categorical correlates of knowledge were identified with t-tests and analyses of variance. To avoid very small cell sizes, when possible, we either

combined or omitted categories. With two exceptions, all t-tests were based on the assumption of equal variances (i.e., pooled) as indicated by Levene’s test for equality of variances. The exceptions were the relationships between admission knowledge and (1) belief in the extent to which pressure ulcers interfere with activities and (2) belief in the value of daily skin checks.

We performed separate multiple regression analyses to determine the best set of predictors for knowledge of pressure ulcer at admission and discharge. All variables that had a significant bivariate relationship with either admission or discharge knowledge for the entire sample or for either group were entered as potential predictors. We entered group membership (intervention or control) last to determine the effect of group after controlling for other relevant variables. In the analysis predicting discharge knowledge, the admission knowledge score was entered first as a covariate.

## **RESULTS**

### **Descriptive Findings and Group Differences**

#### *Pressure Ulcer Knowledge Test*

At admission, the participants scored, on average, only slightly more than half (54 percent) of possible points regarding their knowledge of pressure ulcer prevention and treatment (**Table 2**). At discharge, percentage points increased to 15 overall. Eighty-four percent of the intervention group and eighty percent of the control group improved their scores between admission and discharge. We obtained wide ranges of scores at both time points. We found no significant differences between the two groups at admission ( $t_{39} = -0.12, p < 0.91$ ), but at discharge, we found a significant difference ( $t_{37} = 2.26, p < 0.03$ ).

#### *Multidimensional Health Locus of Control Scale*

At admission, all three health locus of control subscales had wide ranges of scores (**Table 2**). The lowest average score was on the “Chance” subscale. We found no significant differences between the two groups on any of the subscales.

#### *Health Beliefs Questionnaire*

The responses to the Health Beliefs Questionnaire at the time of admission are displayed in **Table 2**. Most participants believed that a pressure ulcer is very serious,

**Table 2.**  
Pressure ulcer knowledge, health locus of control, health beliefs and practices, and life events.

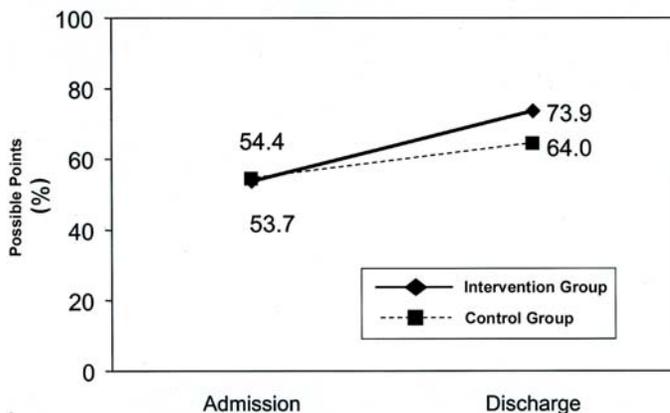
Variable	Overall (n = 41)			InterventionGroup (n = 20)			ControlGroup (n = 21)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Admission Pressure Ulcer Knowledge (% of possible points)	54.47	15.68	12 to 83	54.16	19.18	12 to 83	54.76	11.93	28 to 77
Discharge Pressure Ulcer Knowledge (% of possible points; n = 39, 19, and 20, respectively)	68.80	14.35	37 to 95	73.86	12.35	40 to 95	64.00	14.74	37 to 93
Admission health locus of control									
Internal health locus of control	28.66	3.86	17 to 36	28.55	4.30	17 to 36	28.76	3.51	22 to 34
Powerful others health locus of control	25.20	6.52	9 to 36	25.15	7.14	9 to 36	25.24	6.04	11 to 35
Chance health locus of control	18.00	7.12	6 to 32	17.45	7.03	6 to 30	18.52	7.33	10 to 32
Admission Health Beliefs									
How serious do you believe a pressure ulcer would be for you if you were to get one in the future?									
Not serious		2	5		1	5		1	5
Fairly serious		6	15		2	10		4	19
Very serious		30	73		15	75		15	71
Life threatening		3	7		2	10		1	5
How likely do you believe you are to get pressure ulcers?									
Very likely		5	12		4	20		1	5
Somewhat likely		23	56		12	60		11	52
Not very likely		13	32		4	20		9	43
How much do you believe pressure ulcers would interfere with your daily activities?									
None		1	2		1	5		0	0
Some		12	29		6	30		6	29
A lot		28	38		13	65		15	71
How difficult do you believe pressure ulcers are to treat?									
Easy to treat		8	20		4	20		4	19
Difficult to treat		33	81		16	80		17	81
Not treatable		0	0		0	0		0	0
To what degree do you believe that you can prevent your getting pressure ulcers?									
Completely		7	17		2	10		5	24
Somewhat		33	81		17	85		16	76
Not at all		1	2		1	5		0	0
Admission Health Beliefs									
To what degree do you believe that the following practices make a difference in your chances of getting pressure ulcers?									
Daily skin checks									
None		1	2		0	0		1	5
Some		4	10		3	15		1	5
A lot		36	88		17	85		19	91
Weight shifts									
None		0	0		0	0		0	0
Some		3	7		2	10		1	5
A lot		38	93		18	90		20	95
Limit sitting time									
None		1	2		0	0		1	5
Some		16	39		7	35		9	43
A lot		24	59		13	65		11	52
Using a wheelchair cushion									
None		0	0		0	0		0	0
Some		1	2		0	0		1	5
A lot		40	97		20	100		20	95

Note: Some percentages do not sum to 100% because of rounding. One participant from each group failed to complete the knowledge test at discharge.

that they are somewhat likely to get one, that an ulcer would interfere a lot in their daily activities, that ulcers are difficult to treat, and that ulcers are somewhat preventable. In general, the participants believed that doing daily skin checks and weight shifts and using a wheelchair cushion would make a lot of difference in their chances of getting a pressure ulcer. However, less than 60 percent believed that limiting sitting time would make a lot of difference in their chances of getting an ulcer. Most of the remainder thought it would make only some difference. There were no significant differences between the two groups on any of the questions, even when categories were collapsed to avoid small cell sizes.

### Effect of Enhanced Education on Knowledge During Hospitalization

Presented in **Figure 2** are the scores at admission and discharge for the group who received the enhanced pressure ulcer prevention and treatment education compared with the group who received only standard education during their hospital stay. The two groups had similar scores at admission. A repeated measure analysis of variance indicated that there was a main effect of time (admission versus discharge,  $F = 37.23$ ,  $p < 0.0001$ ), no main effect of group (intervention group versus control group,  $F = 1.22$ ,  $p < 0.28$ ), and an interaction effect (time by group,  $F = 4.72$ ,  $p < 0.04$ ). Thus, both groups gained some knowledge during their hospitalization, but the enhanced education group gained more (20 versus 10 percentage points gained).



**Figure 2.** Effect of enhanced education on knowledge during hospitalization.

### Correlates of Pressure Ulcer Knowledge at Admission and Discharge

#### Continuous Variables

Presented in **Table 3** are the Spearman correlation coefficients between pressure ulcer knowledge at admission and discharge and other continuous study variables for both admission and discharge.

**Admission.** For the entire sample, the only continuous variable significantly related to knowledge at admission was the “chance” subscale on the locus of control scale (**Table 3**). Participants who believed that chance was largely responsible for their health tended to have lower knowledge scores than did persons less likely to attribute their health status to chance. For the control group, age at onset and time since onset (of SCI or MS) were significantly related to admission knowledge. Persons who were older or had a more recent onset had lower admission knowledge scores.

**Discharge.** Pressure ulcer knowledge at discharge was moderately correlated with pressure ulcer knowledge at admission (**Table 3**). At discharge, age and age at onset were related to knowledge for the entire sample. Only age at onset was significantly related to knowledge for the control group. Older persons and persons who were older at onset had lower knowledge scores at discharge than those who were younger or younger at onset.

#### Categorical Variables

The relationships between pressure ulcer knowledge at admission and discharge and the categorical study variables are presented in **Table 4**.

**Admission.** Admission knowledge was related to the extent to which the participant believed a pressure ulcer would interfere with daily activities (**Table 4**). Participants who believed an ulcer would interfere “a lot” had more knowledge than those who believed an ulcer would interfere either “none” or “some.” This was true overall and for each group. Interestingly, persons with all levels of education had approximately the same knowledge scores, except that the three persons who had less than a high school education had lower scores at admission. However, because of the small cell size, the difference was not significant.

**Table 3.**

Spearman correlations between pressure ulcer knowledge at admission and discharge and other continuous study variables.

Variable	Admission Knowledge			Discharge Knowledge		
	Overall	Intervention Group	Control Group	Overall	Intervention Group	Control Group
Discharge Pressure Ulcer Knowledge (% of possible points)	0.47*	0.40	0.62*	—	—	—
Age (yr)	-0.13	-0.24	-0.01	-0.34†	-0.44	-0.38
Age at Onset of SCI or MS (yr)	-0.15	0.09	-0.49†	-0.49*	-0.36	-0.72*
Time Since Onset of SCI or MS (yr)	0.14	-0.16	0.57*	0.27	0.07	0.37
Internal Health Locus of Control	-0.03	-0.04	0.01	0.30	0.24	0.43
Powerful Others Health Locus of Control	-0.27	-0.23	-0.25	-0.00	-0.22	0.03
Chance Health Locus of Control	-0.37†	-0.36	-0.34	-0.25	-0.07	-0.37

\* $p < 0.01$  (two-tailed)† $p < 0.05$  (two-tailed)

MS = multiple sclerosis

SCI = spinal cord injury

**Discharge.** Knowledge of pressure ulcers was related to the number of previous flap surgeries for the entire sample and for the control group (Table 4). Persons who had had more than one previous flap surgery had better scores than persons with one or no previous flap surgeries. Belief in the effectiveness of doing daily skin checks was related to knowledge at discharge for the entire sample. Individuals who believed in the preventive effect of daily skin checks had higher knowledge scores at discharge.

### Multiple Regression Analyses: Predictors of Admission and Discharge Knowledge

#### Admission Knowledge

The variables that we entered into a regression model to determine the best set of predictors included age, age at onset, time since onset, chance health locus of control, number of previous pressure ulcer surgeries (dummy coded a 0 and 0 for none, 1 and 0 for one, and 1 and 1 for more than one), beliefs about pressure ulcers interfering in daily activities, and beliefs about the effectiveness of daily skin checks (Table 5). Participants' beliefs regarding the extent to which pressure ulcers would interfere in daily activities entered first and accounted for 26 percent of the variance. Belief in the extent to which doing daily skin checks would make a difference in the chances of

getting a pressure ulcer entered next and accounted for an additional 15 percent of the variance ( $R^2$  change). To test the equality of knowledge between the intervention and control groups, we entered a dummy code for the group (1 = intervention; 2 = control). The group did *not* account for additional variance in knowledge, indicating that the groups were equal in knowledge at admission even after controlling for relevant health beliefs.

#### Discharge Knowledge

We performed a similar regression analysis to determine the best set of predictors for pressure ulcer knowledge at discharge (Table 5). The admission knowledge score was entered first as a covariate. It accounted for 20 percent of the variance in discharge knowledge. Age at onset accounted for an additional 15 percent of the variance. Number of previous flap surgeries and belief in the extent to which daily skin checks would make a difference did not account for a significant amount of unique variance. Finally, the group was entered to determine whether group differences remained after controlling for the other relevant variables. The group accounted for an additional 12 percent of the variance, indicating that after controlling for admission knowledge and age at onset, the group receiving enhanced education had more pressure ulcer knowledge at discharge than did those receiving only standard education.

Table 4.

Relationships of admission and discharge pressure ulcer knowledge and categorical study variables.

Variable	Admission Knowledge						Discharge Knowledge					
	Overall		Intervention Group		Control Group		Overall		Intervention Group		Control Group	
	Possible Points (%)	$t_{df}/F_{df}$	Possible Points (%)	$t_{df}/F_{df}$	Possible Points (%)	$t_{df}/F_{df}$						
Race*												
Caucasian	55	0.30 <sub>38</sub>	52	0.56 <sub>18</sub>	59	1.62 <sub>19</sub>	69	0.34 <sub>39</sub>	73	0.52 <sub>17</sub>	65	0.22 <sub>18</sub>
Other	54		57		51		69		76		63	
Educational Status												
Less than high school graduate	39		31		57		64		69		55	
High school graduate or GED	55	1.00 <sub>3,37</sub>	51	1.68 <sub>3,16</sub>	59	0.54 <sub>3,17</sub>	67	0.37 <sub>3,35</sub>	71	0.39 <sub>3,15</sub>	65	0.12 <sub>3,16</sub>
Some college	56		58		51		72		76		65	
Bachelor's degree	56		68		52		67		82		64	
Level of Impairment†												
Cervical	58	0.89 <sub>38</sub>	59	0.42 <sub>17</sub>	58	0.94 <sub>18</sub>	68	0.44 <sub>36</sub>	73	0.94 <sub>16</sub>	64	0.04 <sub>18</sub>
Thoracic/Lumbar	54		55		53		70		77		64	
ASIA Impairment Scale‡												
A	54	0.75 <sub>37</sub>	57	0.02 <sub>16</sub>	53	1.29 <sub>19</sub>	69	0.25 <sub>35</sub>	73	1.69 <sub>15</sub>	65	0.62 <sub>18</sub>
B	58		56		60		70		82		61	
Number of Previous Flap Surgeries												
0	52		52		51		66		74		55	
1	51	1.70 <sub>2,37</sub>	51	0.41 <sub>2,17</sub>	50	1.87 <sub>2,17</sub>	62	3.79 <sub>2,35</sub> §	64	1.26 <sub>2,16</sub>	60	5.58 <sub>2,16</sub> §
2 or more	61		60		61		77		78		76	
Health Beliefs—Seriousness												
Not serious or fairly serious	49	1.07 <sub>39</sub>	47	0.73 <sub>18</sub>	51	0.87 <sub>19</sub>	66	0.56 <sub>37</sub>	65	1.39 <sub>17</sub>	67	0.52 <sub>18</sub>
Very serious or life threatening	58		55		56		69		76		63	
Health Beliefs—Likeliness												
Somewhat or very likely	56	1.10 <sub>39</sub>	57	1.56 <sub>18</sub>	55	0.04 <sub>19</sub>	71	1.75 <sub>37</sub>	76	1.79 <sub>17</sub>	65	0.47 <sub>18</sub>
Not very likely	51		41		55		63		65		62	
Health Beliefs—Interference												
None or some	43	3.73 <sub>39</sub> ¶	42	2.22 <sub>18</sub> §	43	3.45 <sub>19</sub> ¶	63	1.75 <sub>37</sub>	68	0.97 <sub>5,5</sub>	58	1.32 <sub>18</sub>
A lot	60		61		59		71		76		67	
Health Beliefs—Ease of Treating												
Easy to treat	46	1.78 <sub>39</sub>	39	1.86 <sub>18</sub>	53	0.41 <sub>19</sub>	69	0.08 <sub>37</sub>	78	0.73 <sub>17</sub>	60	0.53 <sub>18</sub>
Difficult to treat	57		58		55		69		73		65	
Health Beliefs—Ability to Prevent												
Completely	55	0.11 <sub>38</sub>	47	0.86 <sub>17</sub>	58	0.76 <sub>19</sub>	70	0.19 <sub>36</sub>	72	0.63 <sub>16</sub>	70	1.05 <sub>18</sub>
Somewhat or not at all	56		58		54		69		76		62	
Health Beliefs—Daily Skin Checks												
None or some	37	1.78 <sub>4,3</sub>	36	1.95 <sub>18</sub>	40	1.97 <sub>19</sub>	56	2.25 <sub>37</sub> §	62	1.90 <sub>17</sub>	47	1.86 <sub>18</sub>
A lot	57		57		56		71		76		66	
Health Beliefs—Weight Shifts												
Some	44	1.22 <sub>39</sub>	35	0.90 <sub>1,1</sub>	62	0.58 <sub>19</sub>	66	0.40 <sub>37</sub>	60	1.78 <sub>17</sub>	77	0.88 <sub>18</sub>
A lot	55		56		54		69		75		63	
Health Beliefs—Limit Sitting Time												
None or some	50	1.53 <sub>39</sub>	46	1.45 <sub>18</sub>	53	0.64 <sub>19</sub>	64	1.85 <sub>37</sub>	67	1.86 <sub>17</sub>	62	0.65 <sub>18</sub>
A lot	58		59		56		72		78		66	

$t_{df}/F_{df}$ : t-tests were performed for all variables except education and number of previous pressure ulcer surgeries for which one-way analyses of variance were performed.

\*African-American and Hispanic-American categories were combined.

†One person whose level of impairment was unspecified was omitted.

‡Persons with impairment scores of D (n = 1) or with MS (n = 2) were omitted.

§  $p < 0.01$  (two-tailed)

¶  $p < 0.05$  (two-tailed)

**Table 5.**

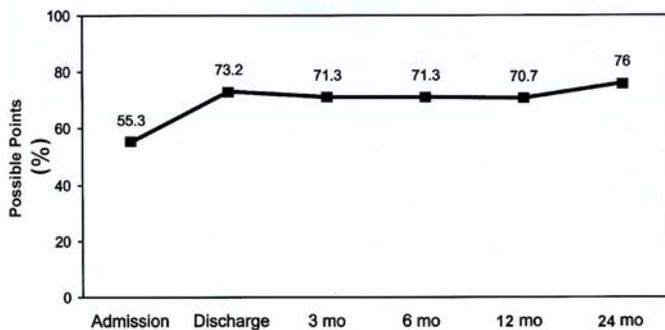
Multiple regression models: Predictors of admission and discharge pressure ulcer knowledge; n = 40.

Dependent Variable	Predictor Variables	Multiple $R^2$	Change in $R^2$	B	p Value	Adjusted $R^2$
Admission Pressure Ulcer Knowledge	Belief in extent to which pressure ulcers would interfere in daily activities	0.26	0.26	0.489	0.01	0.24
	Belief in extent to which doing daily skin checks would make a difference in chances of getting pressure ulcers	0.41	0.15	0.382	0.01	0.38
Discharge Pressure Ulcer Knowledge	Admission pressure ulcer knowledge	0.20	0.20	0.383	0.01	0.18
	Age at onset	0.35	0.15	-0.352	0.01	0.32
	Intervention or control group	0.47	0.12	-0.350	0.01	0.43

### Retention of Pressure Ulcer Knowledge Over Time

#### Intervention Group

Ten of the participants who received the enhanced education and follow-up provided knowledge data at admission; discharge; and 3, 6, 12, and 24 months postdischarge. In **Figure 3**, the mean scores are displayed for each time point for those 10 persons. It can be seen that knowledge retention during the 2 years after discharge was excellent. Five persons who received enhanced education provided knowledge data at admission, discharge, and when discontinued because of a pressure ulcer. They were discontinued an average of 11.2 months (SD = 5.8, range = 4 to 17) postdischarge. In **Figure 4** (bold line), the scores are displayed for those three points in time. These five participants also had retained much of the knowledge they had gained during admission.

**Figure 3.**

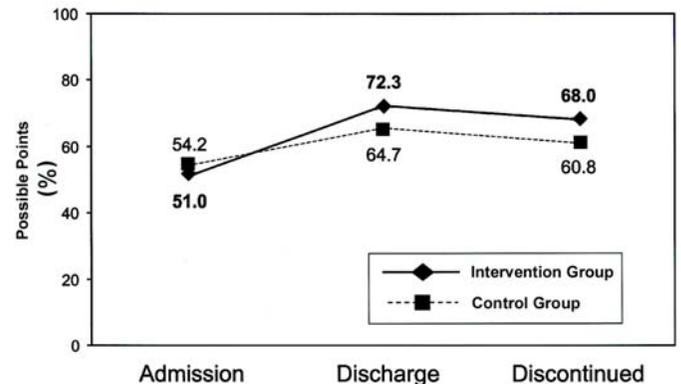
Pressure ulcer knowledge at admission; discharge; and 3, 6, 12, and 24 months postdischarge—enhanced education group.

#### Control Group

Twelve participants who received standard education provided knowledge data at admission, discharge, and discontinuation because of a pressure ulcer. They were discontinued an average of 7.3 months (SD = 6.1, range = 2 to 25) postdischarge. As can be seen in **Figure 4** (dashed line), the control group participants also retained much of their knowledge between discharge and the point of being discontinued. However, the *level* of knowledge remained substantially below that of the intervention group.

### DISCUSSION

The primary purpose of hospital or institutional-based educational programs is to produce knowledgeable

**Figure 4.**

Pressure ulcer knowledge at admission, discharge, and discontinuation—enhanced education versus standard education.

consumers [17]. Few studies have explored the effect of education on pressure ulcer knowledge. In this study with veterans with SCI and MS who were hospitalized for surgical repair of a pressure ulcer, participants who received individualized, enhanced education about pressure ulcer prevention and management gained more knowledge during admission than those who received standard education (20 versus 10 percentage points gained). Eighty-two percent of all participants increased their scores, and thirteen percent decreased their scores on the knowledge test during their hospitalization for pressure ulcer surgery. The enhanced education program consisted of individualized instruction, printed materials, and discussion and included family members or other caregivers.

In this study, the Health Beliefs Model was used to describe participants' individual beliefs about skin care and their actions taken to prevent pressure ulcers. Most participants believed pressure ulcers are very serious, they are somewhat likely to get them, pressure ulcers interfere with daily routines, they are difficult to treat, and they are somewhat preventable. In a recent study of 118 men with SCI, Garber and colleagues reported similar findings [28]:

- Over 50 percent believed pressure ulcers are very serious.
- 47 percent believed they were not very likely to get one.
- 64 percent believed it was not difficult to follow good skin practices.
- 51 percent believed pressure ulcers could be completely prevented.

In both studies, the most frequently cited behavior for preventing pressure ulcers was performing weight shifts. Daily skin checks, frequent weight shifts, and use of an appropriate wheelchair cushion were considered important in preventing pressure ulcers.

The primary limitation of this study was the small sample size. Forty-three veterans agreed to participate. Of those, two never had surgery. A second limitation was that the Pressure Ulcer Knowledge Test was not a standardized instrument. Rather, it was developed for patients experiencing their initial in-patient rehabilitation following SCI. It was intended to identify knowledge gaps and promote the preventive behaviors associated with skin integrity. A third limitation was occasional missing data.

This study evidently should be replicated with some modification in the research design. A multisite, randomized, controlled study is recommended. A larger study

will validate the findings of the pilot. If the larger study supports the findings, a pressure ulcer education model could be implemented for veterans with SCI.

## CONCLUSION

This study supported the hypothesis that an enhanced pressure ulcer prevention educational program is effective in helping persons with SCI gain and retain knowledge about this frequent, but often preventable, complication. The effect of the intervention on recurrence of pressure ulcers will be addressed in a subsequent paper.

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