Research article

Implementing a patient education intervention about Methicillin-resistant *Staphylococcus aureus* prevention and effect on knowledge and behavior in veterans with spinal cord injuries and disorders: A pilot randomized controlled trial

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Objectives: To assess the feasibility and effect of a nurse-administered patient educational intervention about Methicillin-resistant *Staphylococcus aureus* (MRSA) prevention on knowledge and behavior of Veterans with spinal cord injuries and disorders (SCI/D).

Design: Blinded, block-randomized controlled pilot trial.

Setting: Two Department of Veterans Affairs (VA) SCI Centers.

Participants: Veterans were recruited March–September 2010 through referral by a healthcare provider from inpatient, outpatient, and residential care settings.

Intervention: Thirty participants were randomized to the nurse-administered intervention and 31 to the usual care group. The intervention included a brochure and tools to assist nurses in conducting the education.

Outcome measures: Pre- and post-intervention measurement of knowledge and behaviors related to MRSA and prevention strategies and feasibility measures related to implementation.

Results: Participants were primarily male (95.1%), white (63.9%), with tetraplegia (63.9%) and mean age and duration of injury of 64.3 and 20.5 years, respectively. The intervention groups mean knowledge score significantly increased between pre- and post-test (mean change score = 1.70, 95% confidence interval, CI 0.25–3.15) while the usual care groups score did not significantly change (mean change score = 1.45, 95% CI –0.08–2.98). However, the mean knowledge change between intervention and usual care groups was not

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significantly different ($P = 0.81$). Overall behavior scores did not significantly differ between treatment groups; however, the intervention group was more likely to report intentions to clean hands (90.0% vs. 64.5%, $P = 0.03$) and asking providers about MRSA status (46.7% vs. 16.1%, $P = 0.01$). Nurse educators reported that the quality of the intervention was high and could be implemented in clinical care.

Conclusions: A targeted educational strategy is feasible to implement in SCI/D clinical practices and may improve some participants' knowledge about MRSA and increase intentions to improve hand hygiene and engagement with providers about their MRSA status.

Keywords: Methicillin-resistant staphylococcus aureus, Patient education, Spinal cord injury

Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a frequent cause of community- and hospital-acquired infection in the USA and in the VA. MRSA is responsible for over 100 000 US hospitalizations per year¹ and increases the risk of in-hospital death, length of stay, and hospital charges two-fold compared to non-MRSA-infected patients.^{2,3}

Individuals with spinal cord injuries and disorders (SCI/D) are at increased risk for MRSA colonization and infection due to frequent contact with body fluids. Most individuals with SCI/D have a neurogenic bladder and empty the bladder using a catheter. Further, frequent development of chronic wounds such as pressure ulcers, and antibiotic use due to frequent infections such as urinary tract infections and pneumonia increases the risk of MRSA among these patients.⁴ Controlling the spread of MRSA among SCI/D patients within the hospital environment also is complicated by the use of common areas for rehabilitation and exercise, shared exercise equipment, and challenges with hand hygiene among individuals with impaired hand function secondary to tetraplegia. In January 2007, VHA Directive 2007-002 "Methicillin-Resistant Staphylococcus Aureus (MRSA) Initiative" was released, which described infection control strategies to prevent the spread of MRSA.⁵ Along with the directive, educational materials for MRSA testing, treatment, and prevention were developed by VA MRSA Program Office and made available on their prevention website.⁵ Because of the unique aspects of risk and infection control in the SCI/D population, the VA MRSA Program Office and the VA Office of Spinal Cord Injury/Disorders Services also released specific guidelines for VA SCI centers, "Guidelines for Implementation of MRSA Prevention Initiative in the Spinal Cord Injury Centers" (24 July 2008) to support the ongoing implementation of the VHA Directive for the MRSA Prevention Initiative.⁶

Existing VA educational materials for patients and providers describe and define MRSA, who is susceptible to it, how one can get it, and how to prevent its spread.

However, these materials did not address issues related to individuals with SCI/D and needed to be supplemented with SCI/D specific information in order to address the needs of this population.

While previous studies identified the importance of education about MRSA,⁷⁻¹⁰ only a handful have explored knowledge and attitudes about MRSA in patient populations.¹⁰⁻¹⁶ Literature from the general population suggests that patients typically have little or no knowledge of MRSA, nor where to get information about it.^{11,15,17} The knowledge that patients do have about MRSA may come from biased or ill-informed sources such as the popular media.^{12,18} Focus groups conducted with patients with SCI/D and providers identified significant gaps in general MRSA knowledge among both patients and providers.¹⁹ In addition, providers identified barriers to educating patients with SCI/D such as needing materials that addressed SCI/D specific risk factors and wanting a more interactive modality for educating patients. Based on these focus groups, we used best practices²⁰ to develop materials for educating patients with SCI/D about MRSA.¹⁹

Therefore, the objective of this pilot study was to assess the feasibility of implementing a targeted patient education intervention in a clinical setting and to determine its effect on knowledge and behavior in Veterans with SCI/D. We hypothesized that (1) knowledge acquisition in the intervention group would be higher than that in the control/usual care group receiving general VA MRSA education materials, and that (2) participants in the intervention group would have increased self-reported hand hygiene behavior than those in the usual care group.

Methods

Trial design and participants

This pilot study was a blinded, block-randomized controlled trial. Veterans with SCI/D from two VA Midwest SCI centers participated, including inpatients, outpatients, and long-term care patients. Eligibility criteria for Veteran participants included: 18 years of age or older, cognitively intact, and available for telephone

or in-person follow-up. Exclusionary criteria included: having significant active mental health co-morbidities (e.g. schizophrenia and other active psychoses, dementia), moderate-to-severe traumatic brain injury, or a terminal diagnosis. A total of 69 participants with SCI were enrolled in this pilot feasibility study. The institutional review boards at the two study sites approved this study.

Intervention and randomization

Trained research assistants (RAs) approached potential subjects who were admitted or had clinic appointments scheduled, with their physicians consent, to explain the study. Informed consent was obtained from all willing participants. Prior to randomization, the RA administered a brief questionnaire to assess baseline characteristics of the participants. Participants were randomly assigned to a group using block randomization (block sizes 2, 4, and 6). Randomization was stratified by site to ensure even distribution of the intervention within sites and across sites. Pre-sealed numbered envelopes included the appropriate educational materials for either the intervention or control group. The study RAs were blinded to the patient's randomization assignment until they opened the envelope of educational materials for each consented subject.

Participants randomized to the usual care group received a brochure from the RA on MRSA that was already in use at that facility. If control group patients had additional questions, they were referred to their primary care provider. Patients randomized to the intervention group received a one-on-one educational intervention from a nurse on the SCI unit trained to provide the education.

The intervention was developed by the research team through collaboration with an expert panel of SCI medicine/nursing, infectious disease, nursing, and education experts, as well as additional feedback obtained via focus groups with SCI/D providers and SCI patients.¹⁹ The results of the collaboration and focus groups identified gaps in timing of patient education, the content of the education, and educational resources.¹⁹ In addition, we used best practices for developing patient education materials including addressing appropriate literacy levels and engaging patients through use of plain language,^{21,22} visual cues or pictures,^{22,23} and recall and repetition through using return demonstration of skill or "teach back".^{22,24} Thus, the intervention for this study was designed to address best practices identified in the literature and previous identified gaps in this patient population;¹⁹ both in written materials and in the method by which the education was delivered.

The intervention group received a brochure that described specific information for Veterans with SCI/D about: (1) what is MRSA, (2) what puts someone with SCI/D at risk, (3) what puts others at risk, (4) what can you do to prevent spreading MRSA, and (5) important things to remember when cleaning your hands. An educational flip chart was used to facilitate interactive discussion between the nurse educator and patient, and included similar information from the brochure and encouraged patients to ask questions. A patient return demonstration of skill component followed the education, where the educator asked the patient to identify the five main components of the education described above. If the patient was unable to describe the main points in a coherent manner, the nurse educator would review the information for that component, allowing the patient a chance to repeat it in their own words. The nurse educator also asked the patient to demonstrate the proper way to wash their hands, or if they were unable to wash their hands themselves due to impaired hand function, to recite the steps to proper hand washing. After the conclusion of the educational session, intervention participants received a copy of the brochure.

A post-test survey was administered to study participants by an RA in-person or via phone within 7–10 working days after the education session. At completion of the post-test interview, patients received a \$10 gift certificate as an honorarium for their study participation.

Outcomes

The primary outcomes included knowledge about MRSA and self-reported hand hygiene behavior. These outcomes were assessed via the RA administered survey at the time of consent (pre-test) and after receipt of intervention or usual care (post-test). Secondary outcomes included patient attitudes regarding MRSA and a brief evaluation of the intervention elements for those individuals randomized to the intervention group. The survey questions were developed based on the content and recommendations in the educational materials and adapted from survey content from the literature.^{16,18,25,26} Both of the pre- and post-test surveys were piloted with five patients with SCI/D to assess patient understanding of the questions and revised accordingly. Demographic characteristics and health information including age, race/ethnicity, gender, living arrangements, level of injury, time since injury, completeness of injury, health conditions in the last 12 months, and MRSA colonization or infection status were collected during the pre-test.

Evaluation of implementation

A brief evaluation of the implementation of the intervention was conducted among those patients who received the intervention as well as among the nurses who delivered the education and assessed return demonstration of skill. The goal of this evaluation was to determine feasibility of conducting this intervention on a larger-scale. Patients were asked about the clarity of the education and their perceptions of the materials. Nurse questions addressed the quality and implementation of the intervention.

Statistical methods

The intervention and usual care groups were compared by demographic and medical characteristics using odds ratios (ORs) and 95% confidence intervals (CIs) and Fisher's exact test. Responses to the knowledge questions were true, false, and "I don't know". Correct answers were given a value of 1 and incorrect/"don't know" answers were assigned a value of zero. A knowledge score for both the pre-test and the post-test was calculated based on 21 knowledge questions by summing the pre- and post-test knowledge scores for each subject.

Items on self-reported hand hygiene behavior were assessed using a 5-point scale of "Always, Often, Sometimes, Rarely, Never," indicating the frequency of that behavior. Participants also were provided the response option of "I don't know/Unsure." A self-reported behavior scale was calculated where "always" received a value of 4 and "never" or "I don't know" received a value of 0; participant responses were summed. The maximum score possible was 36.

Change scores were computed by subtracting knowledge and behavior pre-test scores from the post-test scores; the *t*-test was used to test the main hypotheses and compare whether changes in scores differed between the intervention and control groups. In addition, analysis of variance (ANOVA) was used to assess changes in score by treatment group, controlling for site for both knowledge and behavior and outcomes. In addition, the McNemar's test and paired *t*-test were used to compare pre- and post-test scores for knowledge and behavior responses. Fisher's exact test and *t*-test were used for comparing basic demographics between the intervention and control groups.

The post-test included additional items to assess participant self-report regarding if hand hygiene behavior had changed since the educational intervention, if they intended to change behavior, and if they had spoken with providers about their MRSA status. Responses were compared by treatment group using Fisher's exact test, ORs and 95% CIs. All tests of statistical

significance were conducted using two-sided tests. All analyses were conducted using SAS software version 9.2 (SAS Institute Inc, Cary, NC, USA).

Results

Demographics and baseline characteristics

Seventy-two patients were approached for this study, 69 consented to participate; eight patients were lost to follow-up. Due to the necessary involvement of the nurse in providing the intervention, more patients were lost in the intervention group than the control group. Reasons for loss in the intervention group ($n = 7$) included; the nurse not being available to conduct the intervention for five patients, one patient became too sick to participate, and one patient was discharged before receiving the intervention. Only one patient was lost to follow-up in the control group and this was due to them being discharged before the intervention was administered by the nurse. Thus, 61 patients completed both the pre-test and post-test and were included in the analysis (Fig. 1). The sample was primarily male, white, with tetraplegia, with at least some college and on average was injured for 20.51 years (Table 1). Previous diagnosis of MRSA colonization or infection was reported by 42.6% of participants. Treatment groups were similar across demographic and baseline characteristics. Study site differences in patient characteristics included one site having a higher proportion of non-African-American patients, and having a higher proportion of patients who lived alone.

Impact of treatment group on participant knowledge

Results of pre- and post-test knowledge questions and scores are shown by treatment group in Table 2. Overall, the mean change in knowledge score between groups was not significant (1.70 vs. 1.45, $P = 0.81$). A significant difference in the pre-/post-test knowledge change score was observed for Site A score (mean = 3.3, 95% CI 1.68–4.92) compared to Site B (mean = 0.21, 95% CI –0.97–1.39) ($P = 0.002$). An ANOVA, controlling for site, showed no difference in knowledge change score by treatment group ($P = 0.60$). In individual knowledge questions, increases in knowledge were seen from the pre-test to post-test in some, but not all, items. While mean knowledge score improved in both groups, it was only significant in the intervention group.

Impact of treatment group on hand hygiene behaviors

Table 3 shows the percent of subjects who improved their behaviors from the pre-test to the post-test by

Figure 1 CONSORT diagram of recruitment.

treatment group. Reports of individual hand hygiene practices varied across different activities at baseline. For example, at baseline, subjects frequently reported “always” using hand hygiene both before (59.0%) or after bowel care or bladder care (73.8%). Less frequently endorsed activities at baseline included before using shared therapy/gym equipment (29.5%), after sneezing (29.5%), and after coughing (29.5%). Overall, hand hygiene behavior scores did not differ between groups (2.50 vs. 2.40, $P = 0.83$).

Additional questions related to changes in behavior were asked at the post-test only. When asked “Have you changed your hand washing behavior since your discussion with the RA or nurse?” 60.0% of the intervention group responded “yes” compared to 29.0% of the control group ($P = 0.02$); with most (94.4%) reporting that they cleaned their hands more frequently or asked their caregivers to clean their hands. In addition, the intervention group was 10 times more likely compared to the control group to report that they intended to clean their hands more often. Intervention group subjects were also four times more likely to report having

asked their provider about their MRSA status (46.7% vs. 16.1%, $P = 0.03$).

Evaluation of implementation

An evaluation of implementation of the intervention was completed with all five nurses who conducted the intervention. Overall all of the nurses reported that the quality of the intervention was high or very high, that the intervention provided the right amount of information, was appealing, had an appropriate reading level, was effective at increasing knowledge about MRSA and hand hygiene, and assisted them in educating patients about MRSA and hand hygiene. The average time nurses spent providing the education was 25 minutes. Nurses reported that the intervention could be completed as part of regular clinical practice (at the time of testing and/or at discharge); however, one study site expressed challenges with dedicated time to work on the study and thus implement the intervention.

Intervention group participants ($n = 30$) reported that the brochure was interesting (86.2%) and the discussion was very clear (80.0%), very informative (76.7%), and

Table 1 Demographics and baseline characteristics by treatment group and overall

Characteristics	Intervention (n = 30)	Control (n = 31)	Overall (n = 61)	Fisher's exact P value
Sex				
Male	29 (96.7%)	29 (93.6%)	58 (95.1%)	Reference
Female	1 (3.3%)	2 (6.5%)	3 (4.9%)	1.00
Age (mean, Std, min–max)	65.45 (12.81, 23–84)	63.63 (9.28, 48–86)	64.53 (11.10, 23–86)	t-Test P-value = 0.53
Race/ethnicity				
White	17 (56.7%)	22 (71.0%)	39 (63.9%)	Reference
Hispanic (White or Black)	1 (3.3%)	0 (0.0%)	1 (1.6%)	NE
Black	11 (36.7%)	8 (25.8%)	19 (31.2%)	0.42
American Indian/Alaska Native	1 (3.3%)	1 (3.2%)	2 (3.3%)	11.00
Level of injury				
Quadriplegia/tetraplegia	22 (73.3%)	17 (54.8%)	39 (63.9%)	Reference
Paraplegia	8 (26.6%)	14 (45.2%)	22 (36.1%)	0.18
Duration of injury (in years)	18.87 (18.60, 15.5) 0–78	22.10 (18.20, 23) 0–75	20.51 (18.32, 18) 0–78	t-test P-value = 0.50
Completeness of injury				
Incomplete	20 (66.7%)	21 (67.7%)	41 (67.2%)	Reference
Complete	10 (33.3%)	10 (32.3%)	20 (32.8%)	1.00
Education				
Some college	13 (43.3%)	15 (48.4%)	28 (45.9%)	Reference
<Some HS	3 (10.0%)	2 (6.5%)	5 (8.2%)	0.66
HS Grad	7 (23.3%)	7 (22.6%)	14 (23.0%)	1.00
College grad	7 (23.3%)	7 (22.6%)	14 (23.0%)	1.00
Living arrangements				
Family/friend/spouse	13 (43.3%)	13 (42.0%)	26 (42.6%)	Reference
Live alone	5 (16.7%)	10 (32.3%)	15 (24.6%)	0.35
Live in assisted living	1 (3.3%)	1 (3.2%)	2 (3.3%)	1.00
Live in nursing home	10 (33.3%)	6 (19.4%)	16 (26.3%)	0.53
Formal (hired/paid) caregiver	1 (3.3%)	1 (3.2%)	2 (3.3%)	1.00
Hand washing & personal care				
How difficult is it for you to wash your own hands?				
Only with caregiver assistance	10 (33.3%)	3 (9.7%)	13 (21.3%)	Reference
Not at all difficult	14 (46.7%)	21 (67.7%)	35 (57.4%)	0.05
Not very difficult	2 (6.7%)	1 (3.2%)	3 (4.9%)	1.00
Somewhat difficult	3 (10.0%)	3 (9.7%)	6 (9.8%)	0.32
Very difficult	1 (3.3%)	3 (9.7%)	4 (6.6%)	0.10
How difficult is it for you to change the dressings for a wound?				
Only with caregiver assistance	19 (63.3%)	15 (48.4%)	34 (55.7%)	Reference
Not at all difficult	6 (20.0%)	3 (9.7%)	9 (14.8%)	0.71
Not very difficult	2 (6.7%)	3 (9.7%)	5 (8.2%)	0.65
Somewhat difficult	3 (10.0%)	2 (6.5%)	5 (8.2%)	1.00
Very difficult		4 (12.9%)	4 (6.6%)	NE
Does not apply	0 (0.0%)	4 (12.9%)	4 (6.6%)	NE
History of MRSA				
Have you ever had MRSA?				
Yes	16 (53.3%)	10 (32.3%)	26 (42.6%)	Reference
No	11 (36.7%)	16 (51.6%)	27 (44.3%)	0.17
Don't remember	3 (10.0%)	5 (16.1%)	8 (13.1%)	0.42

NE, not estimable.

very believable (96.7%). About 30% of the intervention group thought the discussion was scary; however, 80% reported that it was reassuring.

Discussion

This pilot feasibility study describes the evaluation of implementing an education intervention to improve SCI/D patient knowledge and behaviors about MRSA prevention. An evaluation of this targeted educational strategy demonstrated there was limited improvement in patient knowledge about MRSA and MRSA prevention, hand hygiene practices, and engagement with providers about their MRSA status. There were significant

increases in knowledge acquisition between the pre- and post-test test, but these changes did not significantly differ between the treatment groups. The lack of a significant difference in knowledge change between the two treatment groups may be the result of a ceiling effect. That is, the intervention group began with a higher knowledge score at the pre-test than the control group. Thus, it may have been more difficult to increase further knowledge acquisition in the intervention group compared to the control group. This was a pilot study using implementation methods (i.e. using the nurses on the unit to administer the intervention versus research study staff) and therefore, the null results for

Table 2 Knowledge by treatment group pre-test to post-test (% answered correct)

Question text	Intervention (n = 30)			Control (n = 31)		
	Pre-test	Post-test	P value	Pre-test	Post-test	P value
MRSA is a bacterium	20 (66.7%)	24 (80.0%)	0.21	21 (67.7%)	26 (83.9%)	0.06
MRSA is resistant to antibiotics	17 (56.7%)	23 (76.7%)	0.06	13 (41.9%)	16 (51.6%)	0.37
MRSA infections can easily be treated	17 (56.7%)	15 (50.0%)	0.53	6 (19.4%)	9 (29.0%)	0.37
If I got MRSA, I could give it to someone else	23 (76.7%)	26 (86.7%)	0.26	23 (74.2%)	22 (71.0%)	0.65
Washing my hands regularly can help prevent the spread of MRSA	25 (83.3%)	29 (96.7%)	0.10	27 (87.1%)	29 (93.6%)	0.16
I would know if I had MRSA	26 (86.7%)	20 (66.7%)	0.01	17 (54.8%)	21 (67.7%)	0.21
Family members who live with someone with MRSA are not at risk of getting MRSA	24 (80.0%)	26 (86.7%)	0.41	21 (67.7%)	23 (74.2%)	0.41
I can only get MRSA if I touch an open wound of someone with MRSA	26 (86.7%)	20 (66.7%)	0.29	14 (45.2%)	19 (61.3%)	0.17
Please indicate (true or false) whether the following increase someone's risk of having or getting MRSA						
Frequent antibiotic use	7 (23.3%)	12 (40.0%)	0.17	9 (29.0%)	12 (38.7%)	0.37
Lack of vitamin C	7 (23.3%)	10 (33.3%)	0.32	7 (22.6%)	10 (32.3%)	0.32
Contact with other people who might have MRSA	23 (76.7%)	26 (86.7%)	0.26	23 (74.2%)	22 (71.0%)	0.65
Having diabetes	10 (33.3%)	10 (33.3%)	0.76	9 (29.0%)	13 (42.0%)	0.02
Frequent skin issues such as wounds or pressure ulcers	20 (66.7%)	28 (93.3%)	0.005	20 (64.5%)	22 (71.0%)	0.53
Getting any vaccine	17 (56.7%)	14 (46.7%)	0.32	14 (45.2%)	16 (51.6%)	0.62
Use of devices such as a urinary catheter	18 (60.0%)	18 (60.0%)	1.00	11 (35.5%)	16 (51.6%)	0.10
Having a spinal cord injury	16 (53.3%)	23 (76.7%)	0.02	12 (38.7%)	15 (48.4%)	0.37
Living in a long-term care facility/nursing home	22 (73.3%)	27 (90.0%)	0.03	21 (67.7%)	23 (74.2%)	0.53
Being hospitalized	23 (76.7%)	27 (90.0%)	0.10	24 (77.4%)	22 (71.0%)	0.48
Soap and water is the only way to clean my hands	27 (87.1%)	28 (90.32%)	0.65	27 (87.1%)	28 (90.3%)	0.56
When washing my hands, I should rub them together for at least 15–20 seconds	25 (83.3%)	29 (96.7%)	0.05	28 (90.3%)	28 (90.3%)	1.00
If my hands are visibly dirty, I should use alcohol hand sanitizer to clean them	15 (50.0%)	13 (43.3%)	0.56	14 (45.2%)	11 (35.5%)	0.37
Mean Knowledge Score (out of possible 21) (Std, min–max)	Intervention Pre-test	Pre-test	P value	Control Pre-test	Post-test	P value
	13.20 (3.80, 2–20)	14.90 (3.55, 3–20)	0.02	11.65 (5.38, 1–19)	13.10 (5.01, 3–19)	0.06
Mean change score (95% CI)	1.70 (0.25–3.15)		1.45 (–0.08–2.98)			

knowledge and behavior scores may reflect differences in implementation. In our evaluation of the implementation of the intervention, the nurses at one site expressed difficulty with scheduling the administration of the intervention with participants.

Contrary to the summary behavior score, the intervention group was more likely to express having changed their handwashing behavior since recruitment into the study and more likely to report intending to clean their hands. The differences between the results

Table 3 Behavior improvement pre-test to post-test by treatment group showing the percentage of respondents who had one or more improved behaviors

Question	Intervention (N = 30)	Control (N = 31)	Overall (N = 61)	P value
Before I do bowel care or bladder care	7 (23.3%)	9 (29.0%)	16 (26.2%)	0.77
After I do bowel care or bladder care	5 (16.7%)	7 (22.6%)	12 (19.7%)	0.75
Before eating	8 (26.7%)	10 (32.3%)	18 (29.5%)	0.78
Before using shared therapy/gym equipment	10 (33.3%)	12 (38.7%)	22 (36.1%)	0.79
After using shared therapy/gym equipment	5 (16.7%)	7 (22.6%)	12 (19.7%)	0.75
After sneezing	13 (43.3%)	13 (41.9%)	26 (42.6%)	1.00
After coughing	12 (40.0%)	10 (32.3%)	22 (36.1%)	0.60
After blowing my nose	12 (40.0%)	10 (32.3%)	22 (36.1%)	0.60
Mean number of improved hand hygiene behaviors (Std, min–max)	Intervention	Control		P value
	2.50 (2.23, 0–7)	2.40 (1.94, 0–7)		0.83

Table 4 Self-reported change in behaviors at post-test administration by intervention vs. control group

Question text	Intervention (n = 30)	Control (n = 31)	Overall (n = 61)	OR (95%CI), Fisher exact P value
Have you changed your handwashing behavior since your discussion with the RA or nurse?				
No	12 (40.0%)	22 (71.0%)	34 (55.7%)	Reference
Yes	18 (60.0%)	9 (29.0%)	27 (44.3%)	3.67 (1.26–10.64), 0.02
If yes, how has it changed?				
I ask others (caregivers) to clean their hands	2 (11.1%)	0 (0.0%)	2 (7.1%)	
I clean my hands less frequently	1 (5.6%)	0 (0.0%)	1 (3.6%)	
I clean my hands more frequently	15 (83.3%)	9 (100.0%)	24 (89.3%)	
Do you intend to clean your hands more often?				
No	1 (3.3%)	8 (25.8%)	9 (14.7%)	Reference
Yes	27 (90.0%)	20 (64.5%)	47 (77.1%)	10.80 (1.25–93.44), 0.02
Unsure	2 (6.7%)	3 (9.7%)	5 (8.2%)	5.33 (0.34–82.83), 0.51
Have you asked your provider about your MRSA status?				
No	16 (53.3%)	25 (80.7%)	41 (67.2%)	Reference
Yes	14 (46.7%)	5 (16.1%)	19 (31.2%)	4.38 (1.32–14.5), 0.03
Unsure	0 (0.0%)	1 (3.2%)	1 (1.6%)	0.96 (0.89–1.04), 1.00
Do you intend to ask your provider about your MRSA status?				
No	4 (25%)	5 (19.2%)	9 (21.4%)	Reference
Yes	11 (68.8%)	21 (80.8%)	32 (76.2%)	0.65 (0.15–2.95), 0.70
Unsure	1 (6.2%)	0 (0.0%)	1 (2.4%)	NE

of these questions and the summary behavior score may reflect measurement issues. These data suggest that the targeted education strategy may be effective in improving self-reported hand hygiene behavior (Table 4).

Despite the results of the main hypotheses, we found that just engaging patients in a conversation about MRSA can improve their knowledge based on changes from the pre-test to post-test evaluation. Patients were also more likely to have asked their provider about their MRSA status in the intervention group compared to the control group. In addition, we identified that implementing this intervention during routine clinical care is feasible based on feedback from the nursing staff who administered the intervention. We chose to include clinical nursing staff, rather than hired research staff to conduct the intervention, so that we could understand the implementation issues in using this educational strategy. This intervention was acceptable for implementation.

The implications of this pilot intervention are that it provides data for a larger implementation randomized trial to improve patient education about MRSA and prevention strategies and is a useful tool to be used by clinicians in educating their patients. The CDC, VA, and many other healthcare organizations emphasize that education is the cornerstone in preventing the spread of MRSA. However, the education patients have received about MRSA has been limited, which is evident in the poor levels of knowledge reported in previous studies and this study.^{13,14,16,26} Specifically, the CDC recommends that clinicians should educate patients, those who care for them, and if possible,

household members, on strategies to reduce further spread of infection in the household and other close contacts.² Previous work has demonstrated that there are significant gaps in the education of patients with SCI/D about MRSA and prevention strategies¹⁹ and we focused on addressing these gaps.

The importance of educating patients as part of a MRSA prevention program is two-fold. Having an informed understanding of a disease has been shown to enhance clinical outcomes in various illnesses. For example, patients who have negative perceptions about their illness often have increased future disability and slower recovery independent of the initial medical severity.²⁷ A review of the literature²⁸ and several studies have shown that contact isolation can have a negative psychological impact on patients, including decreased patient satisfaction with care,^{29,30} more anxiety or depression,^{31–34} increased anger about their infection and being worried about passing their infection on to family.²⁵ Increasing the knowledge level in patients and their families may help to reduce these fears and negative perceptions about being placed in isolation.²⁸ In this study, those who received the nurse-administered intervention found the information reassuring.

Second, studies have shown that household transmission can occur due to person-to-person contact as well as from inanimate objects in the home that have been contaminated such as dish towels, kitchen or bathroom faucets.^{35,36} Educating MRSA-positive patients about these potential risks for transmission and the importance of hand hygiene may have an impact on

development of infection and subsequent transmission to family members. A patient's knowledge of MRSA and the reasons for these preventive behaviors could be important predictors of compliance to recommended infection control practices.¹⁶

In an earlier phase of this study, focus groups were conducted with SCI/D patients and providers about patient educational needs related to MRSA.¹⁹ Three major themes emerged from these focus groups including patients' limited knowledge about MRSA, the importance of hand hygiene, and the need for better modes of educating patients.¹⁹ This intervention was developed to address these education gaps.

This intervention involved "active" education in the form of one-on-one educational counseling delivered by a nurse, versus provision of a written brochure to a patient. Many fact sheets and other patient materials are in the public domain; however, it is unclear how often patients actually receive this information and if they comprehend it. In addition, the limited hand function of some persons with SCI/D to manipulate a brochure warrant provider discussion with the patient, rather than handing them a brochure to read. Research has suggested that more comprehensive interventions including combined educational strategies (e.g. one-on-one counseling supplemented by written educational materials) have shown greater effectiveness than interventions focused solely on single modalities (e.g. written materials only).³⁷

Study limitations

This was a pilot implementation study to assess feasibility as well as to determine whether patient knowledge and behavior could be impacted with the interactive educational intervention. Although small differences were observed between pre- and post-test scores between sites and by treatment groups for some questions, the sample size and the time between baseline and the post-test may have been too short to assess sustained changes in patient knowledge and behavior. In addition, these patients were subject to more exposure to MRSA education in the VA system due to the ongoing MRSA initiative and therefore potentially decreasing the opportunity to see large differences between the intervention and usual care groups. A larger trial over a longer time period would be necessary to detect more differences over time. However, a number of questions about changes in behavior showed significant differences between the intervention and control group in terms of improved hand hygiene, intention to improve hand hygiene, and engaging with providers about the patient's MRSA status.

Conclusions

This study provides feasibility information supporting a more targeted teaching style versus solely providing a brochure to patients. We found that the study improved patient knowledge about MRSA and preventive practices between both the intervention and control groups. Although knowledge scores did not significantly differ between the two groups, intervention group subjects were more likely to report improved hand hygiene practices, intention to improve hand hygiene, and engagement with providers about their MRSA status. Over a longer period of time, these changes have the potential to improve MRSA colonization rates and transmission in Veterans with SCI/D. This study was a collaborative effort between SCI QUERI, SCI/D Services, and the VA MRSA Prevention Initiative Program and provides important pilot data that support an educational toolkit for SCI/D providers in providing MRSA information to patients and their caregivers.

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