Research article

The application of implementation science for pressure ulcer prevention best practices in an inpatient spinal cord injury rehabilitation program

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Objectives: To implement pressure ulcer (PU) prevention best practices in spinal cord injury (SCI) rehabilitation using implementation science frameworks.
Design: Quality improvement.
Setting: SCI Rehabilitation Center.
Participants: Inpatients admitted January 2012 to July 2013.
Interventions: Implementation of two PU best practices were targeted: (1) completing a comprehensive PU risk assessment and individualized interprofessional PU prevention plan (PUPP); and (2) providing patient education for PU prevention; as part of the pan-Canadian SCI Knowledge Mobilization Network. At our center, the SCI Pressure Ulcer Scale replaced the Braden risk assessment scale and an interprofessional PUPP form was implemented. Comprehensive educational programing existed, so efforts focused on improving documentation. Implementation science frameworks provided structure for a systematic approach to best practice implementation (BPI): (1) site implementation team, (2) implementation drivers, (3) stages of implementation, and (4) improvement cycles. Strategies were developed to address key implementation drivers (staff competency, organizational supports, and leadership) through the four stages of implementation: exploration, installation, initial implementation, and full implementation. Improvement cycles were used to address BPI challenges.
Outcome Measures: Implementation processes (e.g. staff training) and BPI outcomes (completion rates).
Results: Following BPI, risk assessment completion rates improved from 29 to 82%. The PUPP completion rate was 89%. PU education was documented for 45% of patients (vs. 21% pre-implementation).
Conclusion: Implementation science provided a framework and effective tools for successful pressure ulcer BPI in SCI rehabilitation. Ongoing improvement cycles will target timeliness of tool completion and documentation of patient education.

Keywords: Spinal cord injuries, Pressure ulcer, Risk assessment, Best practice, Implementation

Introduction

Pressure ulcers (PUs) are a devastating secondary complication after spinal cord injury (SCI). Fifteen percent of persons with traumatic SCI sustain a PU in the first year following injury, with risk increasing every year thereafter.[1] Eighty-five percent of people with SCI develop a PU at least once in their life,[2,3] and 7–8% of deaths in persons with SCI are attributable to PUs.[4] PUs account for up to one-fourth of the total care costs for persons with SCI, yet appropriate prevention

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strategies may cost less than one-tenth of this estimate.[4] To support incorporation of existing evidence for PU prevention and treatment into clinical practice, PU best practice (BP) guidelines have been developed.[5–7]

However, despite enormous investments in clinical research and BP guideline development, the translation of evidence into clinical practice remains a significant challenge,[8] with as little as 14% of research being effectively translated into routine clinical practice.[9] Even when it occurs, the pace can be frustratingly slow, with a lag time up to 17 years.[10,11] Prior studies from the rehabilitation context and SCI specifically suggest that simply publishing evidence or practice guidelines does little to impact practice.[12–14] Instead, concurrent and directed efforts are required to support uptake, and even then results are mixed.[12,13,15]

Implementation science is an emerging field which provides frameworks to support successful implementation and sustainability of evidence-based practices, resulting in an increased likelihood of sustained practice changes.[16] The National Implementation Research Network (NIRN; University of North Carolina at Chapel Hill) developed frameworks and practical tools to systematically address barriers and identify facilitators for successful best practice implementation (BPI).[17]

The SCI rehabilitation program at the University Health Network – Toronto Rehabilitation Institute is a member of the SCI Knowledge Mobilization Network (SCI KMN). The SCI KMN is a pan-Canadian collaboration focused on reducing secondary complications and improving outcomes after SCI through BPI, with an initial focus on PU prevention. The SCI KMN consists of six rehabilitation centers (L'Institut de Réadaptation en Déficience Physique de Québec (Québec City, Québec), Institut de Réadaptation Gingras-Lindsay-de-Montréal (Montréal, Québec), Glenrose Rehabilitation Hospital (Edmonton, Alberta), Foothills Medical Centre (Calgary, Alberta), Parkwood Hospital – St Joseph's Health Care (London, Ontario), and the University Health Network – Toronto Rehabilitation Institute (Toronto, Ontario)) funded through a partnership of the Rick Hansen Institute, Ontario Neurotrauma Foundation and Alberta Paraplegic Foundation. The SCI KMN is tackling the issue of BPI utilizing principles of implementation science. The SCI KMN partnered with NIRN to promote the adoption and utilization of BPs and increase expertise and capacity in BPI.

Here, we describe the methodology of BPI for PU risk assessment and prevention in Toronto Rehab's inpatient SCI rehabilitation program; utilizing the principles of implementation science. Results include measures of implementation process (staff training, uptake, and ongoing monitoring) and implementation outcomes (completion rates of implemented BP). Patient outcomes (PU incidence) will be reported in future publications following full BPI at all participating SCI KMN sites.

Methods

The SCI KMN provided formalized processes and structure for collaboration, communication, and support between sites, and was directly involved in selecting and defining the BPs to be implemented. Selected BPs were implemented at all sites. This paper addresses and describes BPI at the Toronto Rehab site. PU implementation activities were reviewed by the Toronto Rehab institutional Research Ethics Board and deemed quality improvement; therefore, exemption status was granted. The structure and demographics of the SCI rehabilitation program at Toronto Rehab are described in Table 1.

NIRN's four active implementation frameworks provided structure for a systematic approach to BPI: (1) site implementation team, (2) implementation drivers, (3) stages of implementation, and (4) improvement cycles (Fig. 1).

Site implementation team

A site implementation team (SIT) was formed at Toronto Rehab to support effective, efficient, and sustainable implementation. The SIT included staff who could address the drivers of implementation (i.e. content experts, educators, and organizational leaders), and was comprised of a physiatrist, advanced practice leader (interprofessional leadership role focusing on BPI in SCI rehabilitation), registered nurse specialized in wound care, advanced practice nurse educator, and knowledge mobilization specialist (a dedicated role funded by the SCI KMN that coordinated implementation activities, and provided logistical support and additional leadership for BPI at each site). Additional support was provided by other clinicians, a patient educator, and data support personnel.

Implementation drivers

Implementation drivers are facilitators for successful implementation (Fig. 1).[18] Drivers include eight key

Table 1 Structure and patient demographics at Toronto Rehab's inpatient spinal cord rehabilitation program

Spinal cord rehabilitation program structure	60-bed program consisting of 3 inpatient units
Number of cases in 2012–2013	287
Traumatic/non-traumatic SCI	33%/67%
Mean age	53.8 years

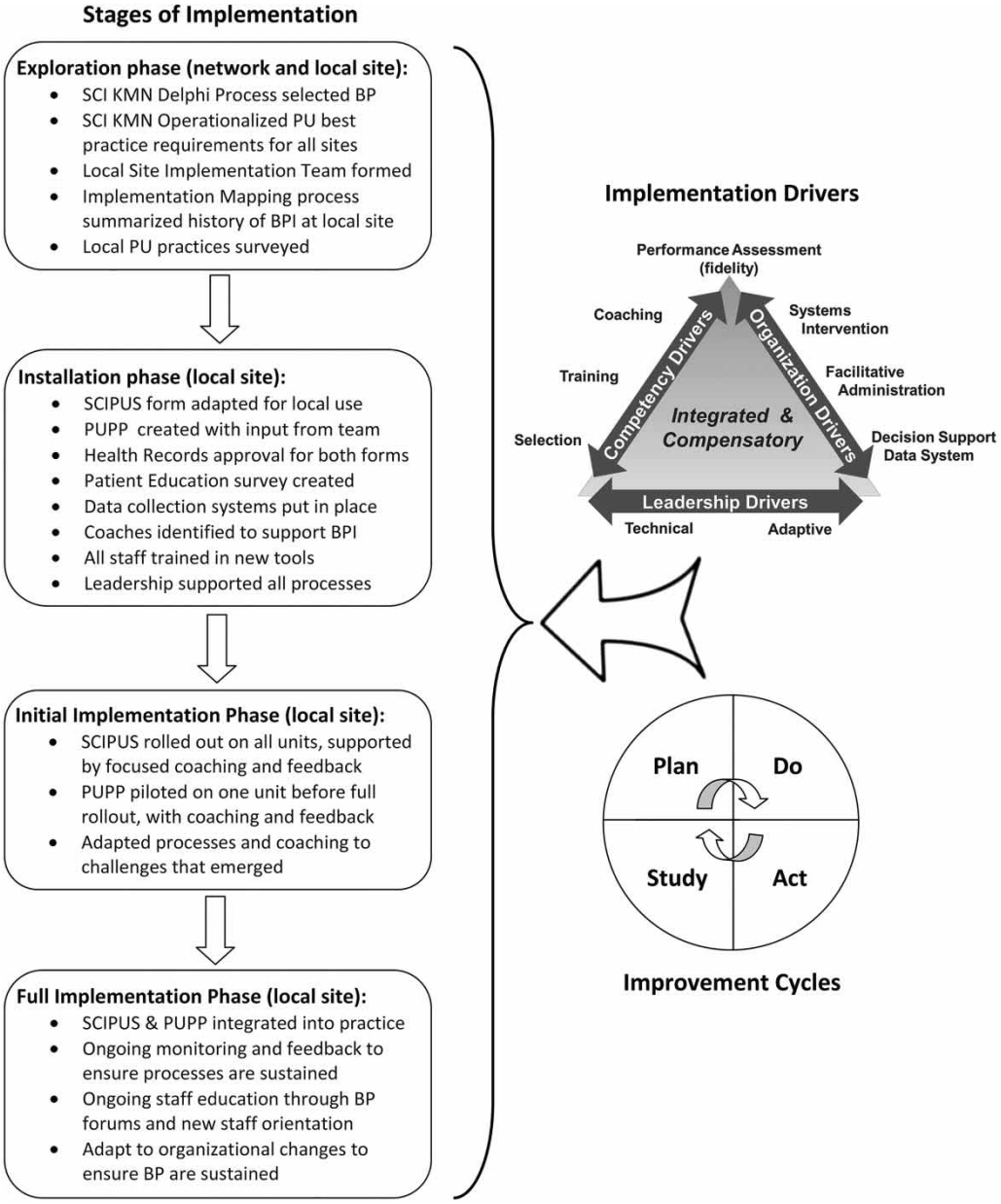

Figure 1 The main steps taken by the site implementation team (SIT) to implement the pressure ulcer (PU) best practices (BPs). NIRN frameworks of stages of implementation, implementation drivers, and improvement cycles were used, with the support of NIRN consultants, to facilitate best practice implementation (BPI). The broader SCI knowledge mobilization network (SCI KMN) was involved in defining the BP in the exploration phase. The remaining implementation was done by the local SIT. SCIPUS is the SCI pressure ulcer scale for PU risk assessment; PUPP is the PU Prevention Plan. NIRN Implementation Drivers image© National Implementation Research Network 2013, Creative Commons license CC BY-NC-ND[18].

components, divided into three categories: (i) *staff competency*: recruitment and selection, training, and coaching; (ii) *organizational supports*: decision support data systems, facilitative administration, and systems intervention; and (iii) *leadership*: technical (logistic support to remove barriers to implementation) and adaptive (address challenges of competing priorities, consensus building). In consultation with NIRN consultants and the SCI KMN, the SIT developed an action plan to address implementation drivers in a comprehensive and systematic fashion.

Stages of implementation

Stages of implementation include *exploration* (determining what to implement), *installation* (how to implement), *initial implementation* (trialing and adapting implementation), and *full implementation* (ensuring

practice is routine and sustained – generally requiring 2–4 years).[17]

Exploration stage

Three PU practice guidelines[5–7] were used to create a list of candidate BPs for implementation. A modified Delphi process[19,20] was used to build consensus and select BPs for implementation at all SCI KMN sites. Delphi participants included funders, hospital leadership, clinicians, and persons with SCI, with equal representation across SCI KMN sites. At the conclusion, the following BPs were selected:

1. Complete a comprehensive PU risk assessment using a structured tool and an accompanying individualized, interprofessional PU risk assessment and prevention plan.
2. Provide structured and individualized PU prevention education to patients.

An operationalization team, comprised of SCI KMN leadership and knowledge mobilization specialists from each site, broke down the selected BPs into specific, clinically relevant practices, with sufficient details to facilitate standardization across sites.

Two NIRN consultants facilitated an implementation mapping process that examined BPI history at Toronto Rehab, and summarized the strengths and challenges from previous efforts. Thirty-five staff, including hospital leadership and clinicians, participated in the process. Strengths included an integrated interprofessional approach to practice and enthusiasm for learning and improving based on research and BP recommendations. An identified challenge was the abundance of changes and concurrent initiatives originating from multiple levels of the organization. This highlighted the need to integrate new practices into existing ones and, when possible, replace existing processes rather than adding more. It was recognized that prior successful implementation efforts were characterized by staff buy-in, ongoing coaching, close monitoring of outcomes, and strong leadership support including allocation of required resources.

To understand the current state, local PU prevalence was investigated through a center-wide audit. All available inpatients were examined by trained evaluators in a single day. Concurrent chart audits captured PU prevalence, documentation of staging, and Braden scale completion rates at admission. Existing patient PU education programs were also reviewed.

Installation stage

Organizational supports

The SCI Pressure Ulcer Scale (SCIPUS),[21] a SCI-specific risk assessment based on risk factors associated with PU development post-SCI, was implemented for PU risk assessment and replaced the Braden,[22] a general PU risk assessment scale. The operationalization team agreed that the SCIPUS should be initiated within 24 hours, and completed within 72 hours of admission. Since SCIPUS completion requires laboratory test results (e.g. albumin), processes ensuring timely completion and accurate documentation were required. Operationalization of the practice included reformatting of the scoring form and clarifying definitions of the SCIPUS elements. Institutional policy required the approval of the SCIPUS form by Health Records and the approval of the SCIPUS as an accepted risk assessment tool (organizational PU Prevention and Treatment Policy).

The interprofessional PU Risk Assessment and Prevention Plan (PUPP) best practice was operationally defined by the SCI KMN as follows: complete an assessment and plan within 10 days of admission for patients scoring high or very high risk, review within 4–5 weeks of admission, and include all relevant professions: doctors, nurses, physical therapists, occupational therapists, dieticians, social workers, and psychologists. The SIT collaborated with clinicians to ensure the PUPP form aligned with clinical practice, institutional policy, and Canadian SCI rehabilitation accreditation requirements. The form documented information regarding current PUs, mattress type, seating, dietary considerations, turning schedule, educational opportunities, and relevant comorbidities. Prior to implementation, individualized prevention plans were infrequently documented; therefore, the PUPP form incorporated checkboxes to increase ease of use. The PUPP form also required Health Records approval.

To promote usage and increase accountability, SCIPUS scores and PUPP completion were incorporated into the Patient Management Report, a tool that captures important patient information for weekly team rounds discussions. The format for rounds was also changed to incorporate a weekly skin discussion. To improve PU communication to clinicians, PU staging, SCIPUS score, and PUPP status were also incorporated into the nursing station electronic whiteboards, large monitors which provide staff with an overview of patient characteristics.

Since comprehensive educational programing was already in place at Toronto Rehab (formal educational tools and individualized education by interprofessional team during patient care), the focus was to improve the documentation of education. This was facilitated by incorporating a checklist of PU educational opportunities into the PUPP. In collaboration with the SCI

KMN, a brief questionnaire regarding PU education was provided to patients 2 weeks before discharge to assess the effectiveness of inpatient education.

Decision support systems were put in place to collect data related to SCIPUS and PUPP completion, PU staging, and patient education documentation from patient charts following discharge. Data collection began 4 months prior to SCIPUS implementation and will continue into full implementation.

Staff competence

Training and coaching is central to developing and maintaining staff competency.[17] To address this need, two nurse champions were trained for each inpatient unit ($n = 6$), five of whom were also trained and certified as Wound Resource Nurses. Multiple training sessions were conducted for nurses in conjunction with the champions. Sessions covered definitions of the SCIPUS risk items and practical process logistics such as timeframe to complete, location in chart, and how to communicate outstanding laboratory values needed to complete the risk assessment. Nurses were also provided clinical cases to practice completing the SCIPUS. Sessions were videotaped and made available for those unable to attend, as well as new staff during orientation, thus ensuring sustainability. Knowledge gaps were identified through the administration of tests post-training, which were addressed by the SIT and champions. PUPP training was conducted through profession-specific education sessions prior to implementation. SIT members also attended team rounds as coaches to support PUPP discussion and form completion.

Additional training included PU educational lectures and nursing-specific sessions addressing PU staging, skin checks, documentation, and wound care products. Feedback on PU prevalence and documentation audits was provided to staff through emails, BP lectures, and profession-specific sessions. The patient and family educator also conducted training on adult education principles, learning styles, cultural competency, teach-back method, and documentation of education.

Leadership

Technical and adaptive leadership support was integrated into the project. The SIT included three members of the Program Leadership Team, and the SCI KMN initiative was incorporated into the Program Operating Plan. The SIT liaised with program leadership for endorsement and ongoing feedback, and to communicate implementation efforts to senior hospital administration. Unit managers supported implementation efforts by requiring training attendance, providing backfilling in some cases, and ensuring completion of new forms and adherence to new processes.

Initial implementation stage

The first BP implemented was a systematic and comprehensive PU risk assessment, including the replacement of the Braden with the SCIPUS. Nursing champions provided coaching and SCIPUS completion was closely monitored by the SIT. Successes, challenges, and gaps were communicated to staff regularly. Individualized feedback was provided to nurses to highlight process details and emphasize timely SCIPUS completion. During initial implementation, it became apparent that admission blood work was not uniform across inpatient units. Through discussions with physicians, blood work was standardized to ensure the availability of parameters required for risk assessment completion. Additional communication mechanisms (e.g. nursing diary) were required to ensure timely completion of the SCIPUS. Nurses were provided a two-page, locally developed survey 4 months after SCIPUS implementation to evaluate confidence (scale: 1–5), retest SCIPUS completion proficiency, and obtain feedback regarding challenges.

The PUPP form was piloted for 2 weeks on one unit and then edited based on clinician feedback. The revised form and processes were then implemented on all units. Coaching and feedback were provided to staff individually and at interprofessional team rounds to ensure completion of both the initial PUPP and 1-month review. Following implementation of the PUPP, the clinical team requested notification (via email) of patient attendance at structured education sessions, so that individualized follow-up education could occur.

Full implementation stage

During the full implementation stage, new tools and processes become an established part of regular practice. However, ongoing monitoring is required to maintain staff competency and ensure that implemented activities remain part of routine practice. At Toronto Rehab, staff education is being sustained through BP forums and new staff orientation. Monitoring of PU occurrence, and SCIPUS and PUPP completion has been integrated into the Patient Management Report and electronic whiteboards. Processes were adapted to accommodate local organizational changes such as a hospital merger, internal restructuring, and other new practices being concurrently implemented.

Improvement cycles

Improvement cycles, e.g. the Plan-Do-Study-Act Cycle,[23] (Fig. 1) ensure continued review and refinement of implemented practices. At each stage of implementation, the SIT responded to challenges that arose due to new BPI processes and changes to the local environment and structure. Improvement cycles must continue through full implementation to ensure that implemented practices remain integrated into routine practice in a changing environment.

Results

Exploration phase

The inpatient skin audit revealed a prevalence rate of 14% for PUs stage 2 or greater; however, documentation of PUs in the charts was poor (39%), making it difficult to confirm which PUs were present on admission. Braden completion rates were 29%, and anecdotal feedback from clinical staff was that the Braden was felt to be not SCI-specific and therefore of limited utility. Audit results were used to engage staff and build support for replacing the Braden with the SCIPUS. Comprehensive educational programing was already in place for PU prevention at Toronto Rehab.

Initial implementation – staff competency

Prior to rollout, 41 registered nurses completed in-person SCIPUS training. The remainder viewed the video recording (total staffing: 46 full- and part-time, plus casual registered nurses). Participants were tested post-training, and 91% felt confident that they understood and could complete the SCIPUS appropriately (percent of nurses who agreed or strongly agreed to statement on 5-point scale). A 4-month re-evaluation survey of 29 nurses indicated continued staff confidence regarding SCIPUS scoring (97%), where to find required information (90%), and how to get their questions answered (i.e. from coaches – 93%). Based on staff feedback, ongoing challenges in getting timely laboratory values were addressed, additional scoring clarifications were added to the SCIPUS form and weekly "helpful hints" were posted on the unit to address questions about SCIPUS scoring and timing of completion. Staff training for the PUPP included 7 nursing training sessions (37 nurses), and individual in-services for physicians, physiotherapists, occupational therapists, social workers, and recreational therapists (40 clinicians).

Implementation results

Pre- and post-implementation completion rates for PU risk assessment are illustrated in Fig. 2. The cumulative completion rate for the SCIPUS shows considerable improvement compared to the Braden pre-implementation (82 vs. 29%). Since initial implementation, there has been a trend towards improved completion rates with the exception of a drop in the second quarter (70%). Completion rates have approached 90% in Q4 and Q5. Ensuring SCIPUS completion in the targeted timeframe remains a challenge, with 67% completed on time.

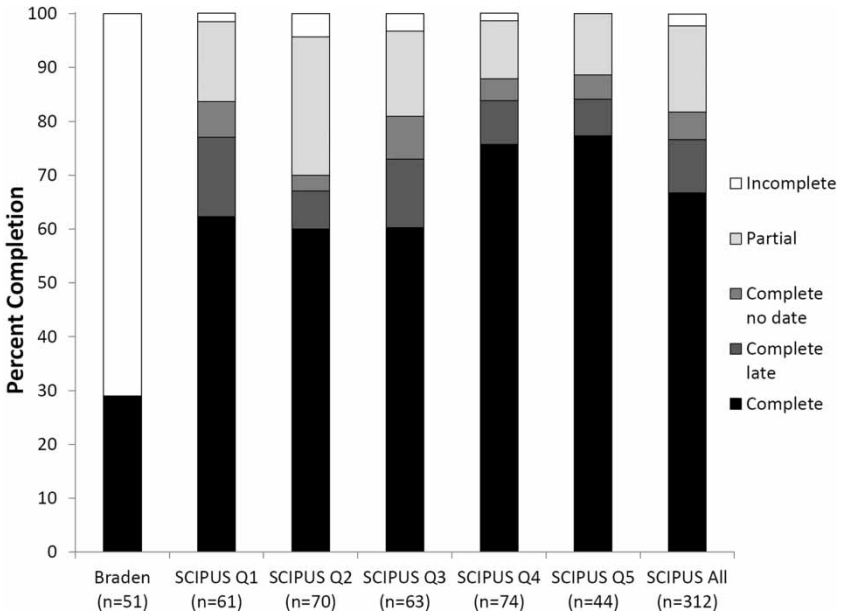

Figure 2 Risk assessment scale completion rates. Braden was used pre-implementation and completion rates were collected during the inpatient skin audit, October 2011. SCIPUS post-implementation results shown per quarter (3-month period), starting in April 2012.

Table 2 PUPP completion results for first 5 months after implementation in May 2013

	n	%
Admissions within first 5 months of PUPP implementation	130	
Patients at low or moderate SCIPUS PU risk	18	14%
Patients who stayed <10 days	4	3%
Admission PUPP		
Patients requiring PUPP (high or very high PU risk)	108	83%
PUPP completed	96	89%
PUPP completed within 10 days	72	67%
1-month review (for those with completed PUPP)	96	
Patients discharged before PUPP review	9	9%
Completed PUPP requiring review	87	91%
Completed PUPP reviewed	65	75%
Completed PUPP reviewed within 35 days	36	41%

Completion rates at admission, and 1-month review shown.

Table 3 Patient education results

	n	%
Evidence patient education provided (pre-implementation cohort: $n = 68$)	14	21%
Evidence patient education provided (post-implementation cohort: $n = 314$)	141	45%
Patient education discharge survey – number of surveys completed	71	
I received information and learned skills about skin care that are right for me	39	55%
I understood the information about skin care that was provided to me	36	51%
The way I received information and learned skills met my needs	38	54%
I will use the skills and information about skin care in my daily life	42	59%

Discharge survey results indicate the number of patients who answered agree or strongly agree to the question. Pre-implementation cohort collected January to March 2012; post-implementation collected April 2012 to July 2013.

The PUPP was a new tool; therefore, there is no pre-implementation data. Initial completion rates were good (89%) but challenges remain ensuring both completion within 10 days of admission (67%) and 1-month review (75%) (Table 2). The documentation of patient education (45%, Table 3) doubled from pre-implementation (21%), but remains low. The post-implementation discharge survey assessed the perceived efficacy and value of PU education, with responses ranging from 51% who understood the information they received to 59% who will use the information in their daily life.

Discussion

The implementation of BP guidelines and recommendations into clinical practice is challenging,[8] and concurrent and directed efforts are required to support uptake.[12–15,24] To support the adoption of BP recommendations into SCI rehabilitation centers, tools must be (1) developed to facilitate implementation of these practices and (2) be evaluated in that context.

Several frameworks to support BPI were explored by the SCI KMN (e.g. NIRN implementation science[17]; Consolidated Framework for Implementation Research[25]; Promoting Action on Research Implementation in Health Services[26]; Knowledge to Action[27]; and LEAN[28]). There is little evidence comparing the relative success of different approaches to BPI. NIRN was selected because their practical tools and resources, based on universal implementation practices, could guide local implementation efforts.[17] In addition, the NIRN implementation frameworks can complement other quality improvement processes by providing guidance, structure, and tools for a more detailed and comprehensive approach to operationalizing quality improvement plans. There is emerging evidence that a systematic, comprehensive approach is more likely to lead to sustained practice change.[16]

The NIRN implementation frameworks supported the pressure ulcer BPI efforts at Toronto Rehab. An appreciation for the stages of implementation helped ensure appropriate preparation in the exploration and installation phases.[17] Consideration of implementation drivers and development of action plans helped ensure environmental readiness and address barriers that might otherwise impede uptake of the new practice. Successful BPI was also facilitated by the provision of time and dedicated staff to prepare appropriately for implementation. Ongoing monitoring and data collection during initial implementation allowed challenges and gaps in implementation to be identified quickly. In order to ensure that new practices were well received and compatible with staff workflow, it was necessary to adapt processes, provide ongoing support, and keep staff informed throughout implementation.

The systematic attention to implementation drivers (organizational supports, staff competency, and leadership) led to the successful uptake of targeted PU best practices. Prior to BPI, the completion rate for PU risk assessment was 29%. Utilizing the SCIPUS, completion rates improved to 84% in the initial quarter post-implementation; a period characterized by focused coaching and monitoring. SCIPUS completion rates initially dropped in the second quarter. However, with ongoing monitoring and feedback, the SCIPUS has become integrated into standard practice and completion rates have approached 90% in Q4 and Q5. Pre-implementation, there was no structured process to support the development of individualized PUPPs. In the first 5 months post-implementation, PUPPs were completed for 89% of indicated patients.

Completion of forms in targeted timeframes continues to be a challenge both for the SCIPUS and PUPP, despite coaching and monitoring. These practices require coordination and input from more than one clinician to complete (e.g. second nurse to input completed blood work into the SCIPUS, interprofessional team to complete the PUPP). Continued adaptation of the practices is needed to reduce barriers to timely completion. The SCI KMN defined and operationalized timeframes for SCIPUS and PUPP completion based on clinical experience. Timeframes might need to be adjusted to acknowledge the day-to-day realities of the inpatient rehabilitation environment. This example highlights the value and importance of ongoing improvement cycles.

Despite significant staff training, the documentation of PU education remains low (45%); although rates have doubled compared to pre-implementation. Prior to implementation, patient education was recorded in clinician progress notes and through attendance at patient and family education sessions. Post-implementation, education was also captured on the PUPP and patient discharge survey. The documentation of patient education (particularly informal point-of-care teaching) continues to be a challenge; therefore, the extent of actual patient education is underestimated. The extent of practice change related to documentation of patient education was underestimated. Among the clinical team, the need for explicit documentation of education was not always recognized and since much of rehabilitation includes patient education, there are concerns that documentation of all patient education exchanges would be laborious.

Given that PU patient education practices were already in place prior to implementation, the patient education BP did not receive as much implementation science focus compared to the introduction of two new practices (SCIPUS and PUPP). As a result, no monitoring of education documentation occurred during initial implementation. Neglecting the drivers for coaching and data monitoring may have reduced the effectiveness of PU education BPI. The rates of satisfaction with PU education identified in the discharge survey suggest that there is considerable room for improvement related to patient education, and this is a target for future improvement cycles. This experience supports the importance of completing implementation frameworks, even when the practice change is perceived to be less.

Conclusions

Implementation science provided a framework for the successful implementation of BPs addressing PU prevention following SCI. This was evident in a sustained increase in completion rates for structured risk assessment (SCIPUS), as well as the PU prevention plan. Implementation frameworks were not employed as rigorously for the patient PU education BPI, reflected in lower documentation rates and patient satisfaction. This is a target for future improvement cycles. Patient outcomes such as PU incidence are still being collected, and will be reported in future publications. The expertise in implementation frameworks developed for the PU best practices lays the groundwork for other BPI in the future, within the SCI KMN and in the wider SCI rehabilitation community.

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Disclaimer statements

Contributors All authors provided significant contributions to this work. CYS: conceiving and designing the study, collecting, analyzing and interpreting the data, and writing and revising the manuscript. HMF: conceiving and designing the study, obtaining funding approval, collecting and interpreting the data, and writing and revising the manuscript. LTM: conceiving and designing the study, collecting and interpreting the data, and revising the manuscript. JJD: collecting, analyzing and interpreting the data, and revising the manuscript. DJL: conceiving and designing the study, collecting the data. JB: conceiving and designing the study, interpreting the data and revising the manuscript. ASB: conceiving and designing the study, obtaining funding and ethics approval, interpreting the data, and writing and revising the manuscript. SCI KMN: conceiving and designing the study, obtaining funding approval.

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Conflicts of interest None.

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