Performance Improvement

Preventing Pressure Ulcers in Connecticut Hospitals by Using the Plan-Do-Study-Act Model of Quality Improvement

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The prevalence of pressure ulcers among high-risk hospitalized patients has been noted to be as high as 38%,[1] with the cumulative prevalence among patients aged 55 years and older as high as 30%.[2] Hospital-acquired pressure ulcers have been associated with a greater risk of death within one year of hospitalization.[3] They can not only result in death and other adverse outcomes for patients but can also increase physician and hospital liability.[4,5] The development of pressure ulcers in hospitalized patients results from a breakdown in the institutional system of care delivery because the prevention of pressure ulcers requires the cooperation and skill of the entire medical team.[6]

A large percentage of pressure ulcers can be prevented through systematic risk factor identification, skin assessments, use of effective support surfaces, and education of patients and staff. Implementation of a pressure ulcer prevention program is effective in decreasing the incidence of pressure ulcers in hospitals.[7,8] Moreover, in 1992, the Agency for Health Care Policy and Research (AHCPR; now the Agency for Healthcare Research and Quality [AHRQ]), developed comprehensive guidelines for the prediction and prevention of pressure ulcers.[9] These guidelines were intended to assist clinicians in providing high-quality care to patients at risk of developing pressure ulcers. However, few studies have been published that demonstrate the implementation of the AHRQ prevention guidelines in their entirety,

Article-at-a-Glance

Background: Seventeen hospitals and the Peer Review Organization of Connecticut (Qualidigm) attempted to increase early identification of high-risk patients and utilization of pressure ulcer preventive measures.

Methods: A multihospital retrospective cohort study with medical record abstraction was used to obtain a total of 1,955 (baseline) and 891 (follow-up) patients aged 65 years and older discharged after treatment for pneumonia, cerebrovascular disease, or congestive heart failure with a length of stay ≥ five days. During a nine-month period, the hospitals conducted four plan-do-study-act improvement cycles and shared their results in conference calls and group meetings.

Results: Statistically significant increases were noted from baseline (1/1/96–12/31/96) to follow-up (10/1/97–3/31/98) in identification of high-risk patients, repositioning of bed-bound or chair-bound patients, nutritional consults in malnourished patients, and staging of acquired Stage II pressure ulcers. Daily skin assessments occurred at a high rate in both periods. There were no statistically significant changes in other processes of care, pressure ulcer incidence, or mortality.

Discussion: Performance of four pressure ulcer prevention processes of care increased concurrently with a multifaceted improvement intervention.

which is most likely due to the complex and interdisciplinary nature of pressure ulcer prevention.

Several studies have reported the implementation of components of recommendations from the AHRQ guidelines in the hospital setting. Gunningberg et al., investigating the incidence of pressure ulcers in 1997 and 1999 among patients with hip fractures, attributed significant reductions in incidence (55% in 1997 to 29% in 1999) to performance of systematic risk assessment on admission, accurate staging of pressure ulcers, use of pressure-reducing mattresses, and continuing education of staff.[10] Another study, involving implementation of a comprehensive prevention program, consisting of a risk assessment tool, uniform skin care, pressure-reducing support surfaces, repositioning schedules, standardized nutritional assessment and support, and staff education, found significant reductions in pressure ulcer incidence during a five-month period.[11] Similar results have been noted elsewhere.[12,13] Although these studies support the benefit of a comprehensive approach, no study could be found that has implemented all recommendations of the AHRQ prevention guidelines. Moreover, the sustainability of pressure ulcer reductions has not been studied for long periods.

In response, in 1997 the Centers for Medicare & Medicaid Services (CMS) charged that Peer Review Organizations (PROs), now known as Quality Improvement Organizations (QIOs), measure and improve the quality of care provided to Medicare patients.[14]

Qualidigm, the Connecticut Quality Improvement Organization, initiated a multihospital quality improvement (QI) collaboration to increase the identification of high-risk patients and to promote the use of preventive measures among Medicare patients hospitalized in Connecticut.

Methods

Collaborator Roles

In April 1997 Qualidigm sent invitation letters to the QI and nursing directors at the 32 Connecticut acute care hospitals. Hospitals were to conduct rapid improvement cycles using the plan-do-study-act (PDSA) methodology[15] and to share their results in monthly conference calls and meetings. Although 20 hospitals initially committed to participate in the project, 3 were unable to submit an adequate number of medical records for abstraction or to conduct PDSA cycles within the agreed-on time frames. The 17 hospitals that ultimately participated in the project with Qualidigm represented the diversity within the state of Connecticut, ranging from 200 to 800 beds and located in urban (n = 9) and rural (n = 8) settings.

PDSA

The PDSA framework[15] is an effective method for sustaining continuous change in an organization. The key is to develop rapid cycles of change to sustain momentum in changing behaviors, procedures, and policies as quickly as possible. PDSA can be done on a small scale (for example, patient care unit) or on a hospitalwide scale.

Plan. The first step in a PDSA cycle is plan, the purpose of which is to identify the problem to be changed and to design an appropriate intervention. For example, in pressure ulcer prevention, the problem may be that patients are not being assessed for pressure ulcer risk within two days or that support surfaces are not placed on beds of high-risk patients. Once the problem has been identified, the team designs an intervention for the problem. The team should always consider the cost of the intervention in terms of both economic and staff burden. In the plan phase, the who, what, when, where, why, and problem should be clearly identified.

Do. The purpose of the second step, do, is to implement the change. Pilot testing the intervention is advisable to identify and correct mistakes in the process before implementing the change on a larger scale. Also, the least amount of data should be collected to determine whether the desired outcome is being achieved. For example, if the team is interested in whether support surfaces are being placed on pressure ulcer high-risk patients within 24 hours of admission, the team can randomly select three to five high-risk patients on the pilot unit and evaluate whether the support surface is on the bed.

In this step of the cycle, data analysis should be started and feedback on the intervention sought. If staff members are not complying with the intervention, the QI team should seek to understand and address the barriers. When 80% adherence has been achieved, the solution can be considered a success.

Study. The goal of the third step, study, is to evaluate the collected data to determine what parts of the

Table 1. Performance Measures and Change Interventions for Hospital Pressure Ulcer Quality Improvement

Performance Measures	Change Interventions
Increase tracking of pressure ulcers	Routine chart audits, improved assessment forms, computerized charting, Skin Care Hotline, skin care rounds, reporting via dietary and patient consults
Increase performance and documentation of risk assessments	Increase use of standardized instruments, revised assessment forms, computerized charting, reminder posters, trend analyses to identify high-risk hospital areas
Increase use of prevention protocols	Educational lectures, bedside teaching, performance feedback, standing orders, computerized protocols, reminder posters, documentation flowsheets, protocols kept at bedside, creation of skin care task force, "skin fairs," mandatory viewing of pressure ulcer prevention video for new nursing employees
Increase scheduled repositioning	"Turning clock" kept at bedside
Increase use of pressure-reducing devices in high-risk patients	Cushions taped to chairs, better-quality pillows and/or mattresses
Increase nutritional consults in high-risk patients	Referral forms faxed to nutrition office
Improve accuracy of staging	Validation of staff staging, provision of pocket-sized wound staging card

intervention to keep or change. Moreover, lesson learned should be summarized and new ideas for change generated on the basis of the experience.

Act. In the final step, act, the focus is to implement what was learned in the cycle of change. A new plan should be developed and ready for implementation so that a continuous process of improvement occurs.

Hospital PDSA Cycles

After meetings with the hospitals in May–June 1997, the hospitals then (until March 1998) conducted four PDSA cycles to improve performance of the targeted processes of care. The hospitals also submitted documentation of the cycles to Qualidigm for summarization. Each hospital identified the quality indicator(s) they would work on during the cycles. Table 1 (above) illustrates hospital interventions used for each process of care. Qualidigm presented (via mail) each hospital with its individual data and data from the other 16 hospitals for comparison. One week after sending the individual hospital data, a Qualidigm staff member called the lead hospital representative for a follow-up discussion of each hospital's results. Most hospitals were not surprised at their results because pressure ulcer prevention was not a huge priority for them.

Hospitals' PDSA teams included but were not limited to nurses, dietitians, physical therapists, physicians, and QI specialists. Programs to educate medical and nursing staff on pressure ulcer prevention (for example, staging of pressure ulcers) were implemented. Although most prevention strategies involved nursing, PDSA teams stressed the importance of a multidisciplinary team approach. The creation of skin care teams and standing orders at hospitals required a multidisciplinary approach. Sidebar 1 (page 208) illustrates one hospital's attempts to decrease pressure ulcer incidence by implementing new support surfaces.

Qualidigm hosted bimonthly conference calls with the collaborators to facilitate exchange of ideas and discussion of implementation barriers and solutions and best practices. In alternate months, Qualidigm hosted face-to-face sessions in which the hospital representatives presented their PDSA cycle results to the larger group.

Hospital QI Intervention

The majority of hospitals (15) worked on identifying patients at high risk for pressure ulcers, increasing scheduled repositioning, ordering nutritional consults, and improving the accuracy of staging of pressure ulcers. These activities appeared less costly than changing support surface devices. All hospitals believed that they were doing a good job with skin assessments, a procedure completed during the admission process by the nursing staff.

Sidebar 1. Hospital A's Attempts to Decrease Incidence of Pressure Ulcers

Hospital A, a 130-bed community hospital with a large elderly population, had a well-established pressure ulcer prevention program, which included evidence-based policies, procedures, a product menu, critical pathways, use of a risk scale, a multidisciplinary skin care team, standing orders, a hotline reporting mechanism (Skin Care Hotline), and wound ostomy continence consultation service. The hospital's pressure ulcer incidence rate was below the national average. However, from monthly QI data, it was determined that opportunities still existed for improvement in certain high-risk patient populations.

In the monthly PDSA sharing meetings and conference calls, the hospital showcased its pressure ulcer program, relating the "mechanics" of outcome monitoring, implementation of risk scales, staff education strategies, and product-selection tactics. Project facilitators presented the PDSA cycle and highlighted the benefits of investigating small problems with quick cycles.

Cycle 1

The first improvement cycle focused on the population of respiratory patients. Previous-quarter QI data had uncovered a spike in pressure ulcers of forehead, cheeks, and ears, coincident with the introduction of nasal noninvasive ventilation (NIV) therapy. Although the therapy was successful from a respiratory standpoint, patients suffered a myriad of Stage I and II skin alterations. A plan was devised to train respiratory care practitioners (RCPs) to inspect skin integrity before fitting the mask, to choose an optimal mask type allowing for minimal leakage, and to apply facial hydrocolloid dressings under areas at risk (in collaboration with the RN). Brief training was accomplished during a regular monthly department meeting. The hypothesis was tested for six weeks. RCPs or RNs reported skin alterations via their usual reporting mechanism, the Skin Care Hotline, and clinical nurse specialists (CNSs) did case finding on routine rounds. At the conclusion of the cycle, there were no pressure ulcers from eight episodes on nasal NIV therapy. RCPs demonstrated application of baseline assessment skills and preventive dressings. They requested the ordering of additional mask types to provide a wider range, to include foam, air, gel, and t-bars to safely fit various face sizes. Serendipitously, there was an increase in ear pressure ulcers (from conventional nasal cannula therapy) reported from newly initiated RCPs. As a result of the cycle, PreNIV Skin Assessment became RCP policy, new products were ordered to improve patient care, and an RCP was added to the skin care team. Conference call discussions spurred discussion of additional pressure ulcer risks inherent in the respiratory population.

Cycle 2

The aim of the second cycle was to reduce seating surface pressure ulcers in the orthopedic population. Monthly nosocomial data showed an increase in sacral and ischial pressure ulcers on a particular medical–surgical unit with a predominantly orthopedic census. Hospital protocol required use of static air mattresses and cushions for orthopedic patients. Mattresses were used 99% of the time per previous audits. However, given the hypothesis that chair cushions were not used consistently, the plan was to securely tape static air cushions to all reclining chairs on one unit, collect nosocomial pressure ulcer data through usual mechanisms, and compare the data to previous data. Twenty cushions were taped to chairs on one unit. Housekeeping was instructed in the associated cleaning routine. Outcome data were collected for six weeks through staff reporting, Skin Care Hotline, unit-based representatives, and CNS rounds. The data showed a remarkable decrease in seating surface pressure ulcers during the time period when chair cushion use was already "supplied." Feedback was provided to the caregiver staff, and a policy was set to keep cushions in each room in a designated drawer. During Qualidigm sharing sessions, the facilitators processed the "duct-tape cushion cycle" as an illustration of how to control during test cycles.

Cycles 3 and 4

The third and fourth PDSA cycles focused on nosocomial heel ulcers and prevention techniques.

The Qualidigm facilitators stressed conduction of rapid improvement cycles to avoid getting detained with large, unmanageable systemwide projects. The quick-cycle deadlines trained participants to think differently about PDSA cycles, act on hunches, and test hypotheses.

Performance Measures

The performance measures were selected on the basis of a review of the literature and of the AHRQ pressure ulcer prevention guidelines. Data sources for performance measures included hospital medical records from physicians or nurses and/or checklists developed by the hospitals. The following measures were assessed from the first two calendar days of hospitalization:

1. Identification of high-risk patients (documentation of pneumonia, cerebral vascular accident, or heart failure diagnosis)
2. Skin assessments in high-risk patients (documentation of total body skin assessment completed either by medical or nursing staff)
3. Use of a pressure-reducing device in bed- or chair-bound patients (documentation that pressure-reducing mattress was placed under patient by nursing staff)
4. Repositioning every two hours in bed-bound or every hour in chair-bound patients (documentation on each shift by nursing staff that repositioning occurred)
5. Nutritional consults in malnourished patients (documentation that nutritional consult was ordered by physician)
6. Number of hospital-acquired Stage I pressure ulcers (documentation by physician or nursing staff)
7. Number of hospital-acquired Stage II or greater pressure ulcers (documentation by physician or nursing staff)

The use of a two-calendar-day time frame to determine compliance with performance measures was based on several studies that demonstrated occurrence of pressure ulcers between admission and two days after hospitalization.[16] Further, a two-day time frame was selected to give hospitals ample time to complete the admission process. Hospitals could use any validated pressure ulcer risk assessment tool. The majority (85%) used either the Braden Scale[17] or the Norton Scale[18] to identify patients at risk for pressure ulcer development. The National Pressure Ulcer Advisory Panel pressure ulcer staging system[19] was used in this project.

Case Selection

Up to 160 cases were selected (for a total of 1,955 cases) by Qualidigm from Part A Medicare claims for each hospital during the baseline period (1/1/96–12/31/96), and up to 130 cases were selected (for a total of 891) from each hospital during the follow-up period (10/1/97–3/31/98). Cases were selected randomly from the pool of patients discharged from each hospital with principal discharge diagnoses of pneumonia (ICD-9-CM[20] 482.0–482.9, 485, 486, 507), congestive heart failure (ICD-9-CM 428.0), and cerebrovascular accident (ICD-9-CM 434.91, 436) and with a length of stay $\geq$ 5 days. Such patients had a high probability (risk) of immobility during the hospitalization.[21] A final inclusion criterion assessed from medical records was impaired ambulatory status on Days 1 or 2 of the hospital stay. Cases were excluded if the patient was younger than 65 years or had a Stage II or greater pressure ulcer present at hospital admission. Because the 17 hospitals provided comparable patient care, we decided that each patient would be the unit of measure.

Data Collection

Hospitals were requested to mail copies of the entire medical records of selected cases throughout the hospital to a corporate clinical data abstraction center, where trained medical records abstractors collected the data with an electronic data collection instrument. Reliability of data collection was assessed by randomly selecting a subset of cases for independent data collection by a second abstractor (n = 84 during the baseline period and n = 63 during the follow-up period). Overall interrater reliability was 92.4% during the baseline abstraction and 93.1% during the follow-up abstraction.

Data Elements

Four categories of data elements were abstracted: inclusion and exclusion criteria, patient characteristics, processes of care, and outcomes of care. Patient characteristics, shown in Table 2 (page 210), included history and physical examination findings (for example, bed or chair bound, ambulate with assistance, abnormal skin hydration, bowel or bladder incontinence, motor deficit) and laboratory findings. Process of care variables included hospital admission date and time and process of care performance date and time. Outcome variables included date of hospital discharge, date of death (abstracted from medical records or merged from Medicare mortality files), and date of readmission (merged from Part A Medicare claims).

Table 2. Demographic and Clinical Characteristics of Elderly Hospitalized Patients at Risk for Pressure Ulcers

	1996		1997		
Demographic/Clinical Characteristics	Number	Percentage	Number	Percentage	*p* value
Total population	1,955	—	891	—	
Sex					
Female	1,101	56.3	530	59.5	0.11
Male	854	43.7	361	40.5	0.11
Race					
White	794	93.2	835	93.7	0.64
Nonwhite	130	6.8	56	6.3	0.64
Age in years					
65–74	520	26.6	206	23.1	0.10
75–84	882	45.1	383	43.0	0.29
≥ 85	553	28.3	302	33.9	< 0.01
Admission source					
Home or outpatient	1,468	75.3	657	74.0	0.46
Skilled nursing/intermediate care facility	394	20.2	159	17.9	0.15
Other	88	4.5	72	8.1	< 0.001
Pressure ulcer risk fracture present at admission					
Total lymphocyte count ≤ 1,800/mm	1,453	79.8	657	81.6	0.29
Bed bound or chair bound	1,478	75.6	665	74.6	0.58
Special care unit stay*	1,008	51.6	427	47.9	0.07
Albumin < 3.5 mg/dl	480	45.9	221	47.6	0.53
Ambulate with assistance	477	24.4	226	25.4	0.58
Abnormal skin hydration	407	20.9	360	40.5	< 0.001
Bladder incontinence	343	17.5	135	15.2	0.11
Motor deficit	330	16.9	134	15.1	0.22
Other risk factors†	262	13.4	150	16.8	0.02
Stage I pressure ulcer present on admission	208	10.7	106	11.9	0.3

* Special care units include any inpatient units with monitored beds.

† Other pressure ulcer risk factors include bowel incontinence, comatose, ideal body weight < 80%, wound drainage, and hip fracture.

Data Analysis

Using patients as the unit of analysis, frequencies were calculated for demographics, pressure ulcer risk factors, and development of pressure ulcers. Compliance with each quality indicator was determined by calculating the proportion of patients who received each process of care within two calendar days of hospital admission. The research team determined the most appropriate source for data for each performance measure. For example, for Performance Measure 4—turning every one or two hours—information was obtained from nursing daily assessment forms, which indicated how often the patient was repositioned, as well as the nursing checklist or documentation in the nursing notes that this preventive measure was implemented.

Table 3. Process of Care Performance Within Two Days of Hospitalization Among Elderly Hospitalized Patients at Risk for Pressure Ulcers

	1996		1997–1998		
Process of Care	Percentage	Numerator/ Denominator	Percentage	Numerator/ Denominator	*p* value
Identification of high-risk patients	20.3	365/1,795	35.3	295/835	< .001
Use of a pressure-reducing device in bed- or chair-bound patients	33.6	413/1,228	33.6	199/592	.99
Daily skin assessment in high-risk patients	96.4	1,823/1,890	97.4	839/861	.17
Repositioning every two hours in bed-bound patients or every hour in chair-bound patients	50.9	657/1,294	56.9	350/615	.01
Nutritional consults in malnourished patients	34.3	537/1,564	48.6	343/705	< .001
Staging of acquired Stage I pressure ulcers	17.9	57/319	18.5	27/146	0.87
Staging of acquired Stage II pressure ulcers	22.4	28/125	44.2	23/52	< 0.01

Patients with inadequate documentation ($N = 267$) of the date and time of hospital admission or process of care performance were excluded from analyses.

Results

Patient Characteristics

A total of 1,955 cases were abstracted from 1996, before implementation of the PDSA cycles; 891 cases were abstracted from 1998, after the PDSA cycles were completed. As shown in Table 2, the majority of patients were women, Caucasian, between 75 and 84 years old, and admitted from home. Patients in the follow-up cohort were slightly older (median age 81 versus 80 years, $p < .01$) and were more frequently admitted from a setting other than their home or a skilled nursing/intermediate care facility.

A large percentage of patients from both observation periods had pressure ulcer risk factors. There was a highly significant increase in the percentage of patients who were admitted with abnormal skin hydration/dry skin, from 20.9% in 1996 to 40.5% in 1998 ($p = 0.001$). Overall, patients in the follow-up cohort had more of the miscellaneous risk factors than patients in the baseline cohort (13.4% versus 16.8%, $p = 0.02$) and slightly more Stage I pressure ulcers present at hospital admission.

Process of Care Performance

Performance of most processes of care increased after implementation of the PDSA cycles (Table 3, above). There were significant increases in the identification of high-risk patients within two days of hospital admission, repositioning of bed-bound patients every two hours or chair-bound patients every hour, the use of nutritional consults in malnourished patients, and the staging of acquired Stage II or greater pressure ulcers. Process of care performance was highest for daily skin assessments in both observation periods (96.4% in 1996 and 97.4% in 1998). Staging of acquired Stage I pressure ulcers occurred at 17.9% in 1996 and 18.5% in 1998, and use of pressure-reducing devices in patients who were bed or chair bound also remained low during both observation periods (33.6%).

Outcomes of Care

There was a nonsignificant increase in the percentage of patients admitted with pressure ulcers that progressed to Stage II or higher (Table 4, page 212). The

Table 4. Outcomes of Care Among Elderly Hospitalized Patients at Risk for Pressure Ulcers

	1996		1997		
Outcome of Care	Number	Percentage	Number	Percentage	*p* value
Pressure Ulcer Development					
Admission pressure ulcer that progressed to > Stage II pressure ulcer	29	13.9	23	21.7	0.08
Hospital-acquired Stage I pressure ulcer	319	16.4	146	16.4	0.97
Hospital-acquired > Stage II pressure ulcer	126	6.4	52	5.8	0.53
Hospital-acquired pressure ulcer, any stage	401	20.6	181	20.8	0.90
Length of Stay (days)					
Median	8	—	7.0	—	0.05
Range	5–58	—	5–69	—	—
Mortality					
In-hospital mortality	185	9.5	67	7.5	0.09
30-day mortality	275	15.2	139	15.6	0.79

percentage of patients who developed pressure ulcers of any stage during the hospitalization remained relatively constant. Median length of stay decreased significantly, from 8.0 days (range, 5–58 days) in 1996 to 7.0 days (range, 5–69 days) in 1998 ($p = .05$).

Hospital QI Intervention

Three months into the project, each hospital developed a quality improvement plan (QIP) for pressure ulcer prevention. The majority of hospitals (15) selected to work on identifying high-risk patients for pressure ulcers, increasing scheduled repositioning, ordering nutritional consults, and improving the accuracy of staging of pressure ulcers. These activities appeared less costly than changing support surface devices. Moreover, all hospitals believed that they were doing a good job with skin assessments because that is a procedure completed during the admission process by the nursing staff.

Each hospital identified staff members who would serve as pressure ulcer prevention champions. The QI teams did not want pressure ulcer prevention to be perceived as a nursing issue because it requires the cooperation of a variety of disciplines. Thus, most hospital teams were multidisciplinary, consisting of nursing, medicine, physical therapy, and dietary services staff. The hospitals found that having a multidisciplinary team was extremely helpful in developing educational programs for the various hospital staffs. The hospitals also liked the idea that PDSA cycles could be completed using small numbers of cases to identify improvement areas and implement potential interventions before full-scale implementations, saving time and human resources.

Still, the view that pressure ulcer prevention was a nursing issue was the major barrier identified by hospitals, perhaps because a large number of preventive strategies fall under nursing's purview. Hospital teams spent considerable time reeducating various disciplines about their roles in pressure ulcer prevention. The medical staff were the most resistive to the concept that they play a major role in pressure ulcer prevention. However, teams spent time educating medical staff about their role in prevention, from identifying high-risk patients and ordering nutritional consults to promoting physical activity.

The hospitals found that the most sustainable interventions were those that were institutionalized. For example, two hospitals changed their hospital mattresses to pressure-relieving mattresses. However, interventions that are more dependent on sufficient staffing were more difficult to sustain (for example, ensuring that every resident is turned every two hours).

Discussion

This study documented clinically and statistically significant improvements in four pressure ulcer prevention-related processes of care concurrent with a multifaceted improvement intervention consisting of QIO audit and feedback of performance data, individual hospital PDSA cycles, and multihospital sharing of experience. Although pressure ulcer incidence rates did not decrease significantly, this could have resulted from an increase in case finding, a phenomenon observed in other pressure ulcer studies that have promoted timely skin assessments.[22,23] Alternatively, pressure ulcer incidence rates could have remained stable because of a higher risk of pressure ulcer development in the follow-up cohort of patients. A statistically and clinically significant decrease in length of hospital stay, from 8.0 days in 1996 to 7.0 days in 1998, was consistent with national trends and was probably not a direct result of our QI project. However, it underscores the importance of starting pressure ulcer prevention strategies early in hospitalization to decrease pressure ulcer incidence.[23] In-hospital mortality also declined during the course of the study, although not to a statistically significant degree.

The intervention approach was consistent with current evidence that multifaceted interventions are more efficient than single interventions in changing practice.[24] Audit and feedback of perfomance data, with which hospitals are familiar and which is a core element of all QIO improvement projects, can serve as a catalyst for change[25] and can be modestly effective at improving performance.[26] Finally, our application of the PDSA approach to improving health care, which has been promoted widely,[27] effectively leveraged the resources, expertise, and experience of multiple affiliated and nonaffiliated hospitals and a state QIO in a way that is replicable in other states.

This study found that the indicators that the hospitals targeted showed increases in compliance. Moreover, it found that although the incidence of Stage I pressure ulcers remained consistent for both periods, the percentage of Stage II pressure ulcers progressing to severe stages decreased. This suggests that with increased vigilance, aggressive preventive strategies may decrease pressure ulcer severity.[11]

An additional benefit of using the PDSA cycle approach to QI was the multidisciplinary nature of this intervention. Focusing pressure ulcer prediction and prevention programs on the nursing staff is limited insofar as effective pressure ulcer prevention requires a multidisciplinary effort. The PDSA model assists hospitals in working in multidisciplinary teams and places the onus for improvement on the team rather than on a particular discipline.

There are several limitations inherent in this study. With the retrospective abstraction of medical records, it is possible that processes of care could have been completed but not recorded or could have been recorded but not carried out. Another limitation was the inability to capture processes of care completed from processing until the patient arrived on the unit. Given that a pressure ulcer can develop in two hours, it is possible that an ulcer may have developed before the patient's arrival. In addition, we decided to collapse the results across all hospitals, thus washing out significant improvements by some hospitals. Although not a goal of the study, there was inadequate statistical power to assess relationships between process of care performance and pressure ulcer development. Finally, the absence of a control group of hospitals that received no QI intervention prevented us from definitively attributing the increase in process of care performance to our intervention.

Summary and Conclusion

We have documented opportunities to improve pressure ulcer screening and prevention activities. Additional study is necessary to separate the impact of the hospitals' PDSA cycles and sharing of experience along with QIO audit and feedback of performance feedback from secular trends. J

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