

Preventing In-Facility Pressure Ulcers as a Patient Safety Strategy

A Systematic Review

Nancy Sullivan, BA, and Karen M. Schoelles, MD, SM

Complications from hospital-acquired pressure ulcers cause 60 000 deaths and significant morbidity annually in the United States. The objective of this systematic review is to review evidence regarding multicomponent strategies for preventing pressure ulcers and to examine the importance of contextual aspects of programs that aim to reduce facility-acquired pressure ulcers. CINAHL, the Cochrane Library, EMBASE, MEDLINE, and PreMEDLINE were searched for articles published from 2000 to 2012. Studies (any design) that implemented multicomponent initiatives to prevent pressure ulcers in adults in U.S. acute and long-term care settings and that reported pressure ulcer rates at least 6 months after implementation

were selected. Two reviewers extracted study data and rated quality of evidence. Findings from 26 implementation studies (moderate strength of evidence) suggested that the integration of several core components improved processes of care and reduced pressure ulcer rates. Key components included the simplification and standardization of pressure ulcer-specific interventions and documentation, involvement of multidisciplinary teams and leadership, use of designated skin champions, ongoing staff education, and sustained audit and feedback.

Ann Intern Med. 2013;158:410-416.

For author affiliations, see end of text.

www.annals.org

THE PROBLEM

Pressure ulcers are largely preventable, but pressure ulcer rates continue to escalate at an alarming rate. Between 1995 and 2008, incidence increased by as much as 80% (1). An estimated 2.5 million patients will develop a pressure ulcer annually in the United States (2); more than 1 million patients are affected annually in U.S. acute and long-term care settings (3). Because of the forecasted increase in populations most at risk for pressure ulcers (for example, obese, diabetic, and elderly patients), rates are predicted to continue to increase.

Preventing this problem is important not only to protect patients from harm but also to reduce costs of caring for them. Morbidity caused by pressure ulcers can lead to requirements for more care and resources and a longer inpatient stay. In some cases, late-stage pressure ulcers can even lead to life-threatening infections. In fact, 60 000 U.S. patients die annually of complications related to hospital-acquired pressure ulcers (2).

The objective of this review is to review the evidence on implementation of multicomponent strategies for preventing pressure ulcers, focusing on the importance of contextual aspects of programs to reduce the likelihood of facility-acquired pressure ulcers. We focus on implementation of multicomponent initiatives because a patient safety strategy designed to address multiple factors is believed to be more effective than single-component initiatives in preventing this condition.

See also:

Web-Only

CME quiz (Professional Responsibility Credit)
Supplement

PATIENT SAFETY STRATEGIES

Strategies aimed at preventing pressure ulcers may consist of individual or multicomponent interventions or a series of interventions and may include system-level changes. A systematic review by Reddy and colleagues (4) included 59 prevention studies that addressed impaired mobility, impaired nutrition, or impaired skin health, mostly in patients in acute care settings. The authors concluded that using support surfaces, regularly repositioning the patient, optimizing nutritional status, and moisturizing sacral skin are appropriate strategies for preventing pressure ulcers. Other reviews and guidelines stress the importance of initial and repeated assessment of patients' risk, tailored care for individuals found to be at increased risk, and regular skin examinations (5–17).

Many organizations endorse the concept of bundling care practices (for example, standardized risk assessment and regular repositioning), which typically include 3 to 5 evidence-based practices that “when performed collectively and reliably, have been proven to improve patient outcomes” (18). Some recommend having an identifiable theme (such as “Save Our Skin”) (1, 19). Besides bundling care practices, experts recommend that attention be paid to organizational and care coordination components (1, 20). Organizational components include selecting lead team membership, establishing policies and procedures, evaluating quality processes, educating staff, using skin champions, and communicating written care plans. Care coordination components include creating a culture of change and establishing regular meetings to facilitate communication, collegiality, and learning.

REVIEW PROCESSES

This review was done in parallel with another Agency for Healthcare Research and Quality (AHRQ)-sponsored systematic review on specific interventions for preventing pressure ulcers (for example, different kinds of support surfaces, heel supports, nutritional supplementation, and

repositioning). We searched CINAHL, the Cochrane Library, EMBASE, MEDLINE, and PreMEDLINE for articles published from 2000 to September 2012 and the gray literature by using keywords related to the concepts of pressure ulcer prevention efforts, barriers, and settings. Searches were restricted to English-language literature. We identified 587 abstracts, from which 95 full-text articles were reviewed in more detail, yielding 51 articles contributing data to this review. We selected studies of any design that implemented multicomponent initiatives in acute and long-term care settings in the United States. Studies were included if they considered multicomponent pressure ulcer preventive measures (such as evidence-based clinical decision tools combined with training and education), targeted adult populations, and reported pressure ulcer rates 6 months after implementation.

Two independent reviewers screened publications for inclusion; 26 studies (18 acute care, 8 long-term care) met inclusion criteria. The reviewers extracted information on context, including influence of external factors (such as state survey deficiencies); descriptions of teamwork, leadership, and safety culture; and implementation tools (such as ongoing performance monitoring). They detailed descriptions of the implementation efforts (such as processes, barriers, and sustainability) in the studies and extracted information about our main (pressure ulcer rates) and secondary (process-of-care measures) outcomes.

We assessed study quality using the 19-item Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines (21). We paid particular attention to a subset of the items we thought were important for implementation studies, such as the following: 1) describes the intervention and its component in sufficient detail that others could reproduce it, 2) presents data on changes observed in the care delivery process and changes observed in measures of patient outcomes, 3) reports on study limitations, and 4) interprets possible reasons for differences between observed and expected outcomes. Our assessment did not consider other requirements in the SQUIRE guidelines such as including an abstract, describing the local problem, or reporting funding. We considered a study to be high quality if it reported 8 to 10 items, moderate quality if it reported 5 to 7 items, and low quality if it reported fewer than 5 required items.

The **Supplement** (available at www.annals.org) completely describes the search strategies, provides an article flow diagram, and provides evidence tables.

This review was supported by AHRQ, which had no role in the selection or review of the evidence or the decision to submit the manuscript for publication.

BENEFITS AND HARMS

Benefits

Twenty-six studies met inclusion criteria. Eighteen studies were conducted in acute care settings and 8 in long-

Key Summary Points

Despite being largely preventable, pressure ulcer rates are escalating in the United States.

Moderate-strength evidence suggests that implementing multicomponent initiatives for pressure ulcer prevention in acute and long-term care settings can improve processes of care and reduce pressure ulcer rates.

Key components of successful implementation efforts include: simplification and standardization of pressure ulcer-specific interventions and documentation, involvement of multidisciplinary teams and leadership, designated skin champions, ongoing staff education, and sustained audit and feedback.

term care settings. Study designs were mostly time series assessments of changes before, during, and after implementation of the intervention. Other designs included randomized, controlled trials (22–24) and a controlled before-and-after (24). Several of the studies were identified from a 2011 review of nurse-focused quality improvement interventions in hospitals (25) and a 2012 review of comprehensive programs for preventing pressure ulcers (5). Of the 26 studies, 9 were high-quality, 14 were moderate-quality, and 3 were low-quality.

Nine core components of programs for pressure ulcer prevention, in addition to specific patient care practices, have been associated with a reduction in incidence or prevalence of pressure ulcers. **Appendix Tables 1 and 2** (available at www.annals.org) show which components and patient care practices were used in the 18 studies in acute care settings and the 8 studies in long-term care settings. Studies showed that most organizations educated and trained staff (96%), developed or revised their protocols for assessment and documentation of wounds (96%), performed quality audits and provided feedback to staff (81%), adopted the Braden Scale for Predicting Pressure Sore Risk (61%), and redesigned documentation processes and reporting (58%).

In the 18 studies of pressure ulcer prevention programs in U.S. hospitals, study authors described multiple patient care interventions or cited clinical practice guidelines or resources that describe specific interventions to reduce patients' risk for pressure ulcers. The hospital caregivers performed initial and repeated risk assessments (such as the Braden Scale), followed by tailored interventions chosen from a menu of options based on a risk category or specific risk factors. These interventions included support surfaces (for example, specialized mattresses and heel supports), getting patients out of bed or frequently repositioning those who were bed-bound, moisture management (including incontinence interventions and skin care products), mechanical means of reducing friction and

shear forces on body areas at greatest risk, nutritional assessments or interventions, and hydration. Pressure ulcer prevention programs that were used in the 8 studies in long-term care facilities typically referenced guidelines or other resources developed by their state's quality improvement organizations.

Twenty-four studies reported at least some improvement in pressure ulcer rates. Two additional studies reported that process-of-care quality measures improved but that pressure ulcer rates did not (26, 27). Statistically significant reductions in pressure ulcer rates were reported in 11 (42%) of 26 studies (median reduction, 82% [range 67% to 100%]) (24, 28–37). Of the 13 studies with improvements not reaching statistical significance, 5 reported improvements in both pressure ulcer rates and process-of-care measures (19, 38–41).

The implementation of a multicomponent strategy by Walsh and colleagues (2009) reduced pressure ulcer prevalence (12.8% to 0.6%), increased focused communication among patient caregivers, and improved clinician behavior and clinical processes once other improvements were recognized (38). Young and colleagues streamlined online policies (from 7 to 1) and reduced time spent documenting skin care, which resulted in “clinically relevant reductions” in development of nosocomial pressure ulcers (19). In 1 year, pressure ulcer rates were reduced by 82.8% (from 2.8% to 0.48%) at 1 rehabilitation hospital. Lynch and Vickery (39) reported that streamlining documentation increased timely and accurate completion from 60% to 90% in 90 days. Delmore and colleagues (41) reported a reduction in incidence (from 7.3% to 1.3%) and reduction in time for collection of prevalence and incidence data (from 8 hours to 2.5 hours).

In the long-term care setting, implementation of the on-time approach in 10 participating facilities led to reductions in prevalence of pressure ulcers for 7 facilities, reductions in the average number of in-house pressure ulcers (all stages) for 8 facilities, and reductions in the average number of certified nursing assistant documentation forms for 10 facilities (35). Another study (37) reported a statistically significant reduction in pressure ulcer incidence (28.3% vs. 9.3%) and improvements in identifying patients as “high-risk” (increase from 22.3% and 28.0%). Milne and colleagues (40) reported reducing prevalence from 41% to 4.2% after increased monitoring of patients with nasal canulas (pulmonary unit) and increased attentiveness to heel offloading, support surfaces, and proper positioning (spinal cord injury and trauma unit). Of the 396 charts reviewed after implementation, fewer than 1% had missing data. A review of 45 patient charts showed that wound teams consistently determined staging and wound cause in more than 90% of cases.

Harms

No harms were reported for the patient safety strategies that were used to prevent pressure ulcers.

IMPLEMENTATION CONSIDERATIONS AND COSTS

Use of a Model or Theory

Of the 26 studies, 6 programs described a model or theory as the basis of their implementation strategy. Several quality improvement approaches were described. The PDSA (Plan, Do, Study, Act) framework used in a 17-hospital-initiative (26) involves 4 improvement cycles: 1) identifying the problem and designing an intervention (Plan), 2) implementing change (Do), 3) evaluating collected data (Study), and 4) implementing what was learned (Act). Courtney and colleagues (32) integrated Six Sigma methods called DMAIC into treatment processes developed for a multisite, not-for-profit facility. Described as a data-driven quality strategy for improving processes, DMAIC consists of 5 interconnected steps: (1) Defining the problem, (2) Measuring the performance, (3) Analyzing the data, (4) Improving the process, and (5) Controlling change (42). Young and colleagues (19) and Chicano and Drolshagen (43) empowered staff at the point of care, which “suggests a model of shared governance where decisions are made at the point of service” (44). Two studies described use of failure mode and effects analysis (40) and Havelock's (1974) model of effective research utilization (24). Of these 6 studies, 2 reported statistically significant reductions in pressure ulcers (24, 32); 1 reported improvements in processes of care (26).

External Factors Motivating Attention to Pressure Ulcer Prevention

Most studies in acute care facilities reported feeling pressure from impending changes in U.S. Centers for Medicare & Medicaid Services reimbursement to implement pressure ulcer prevention strategies. Specifically, subsequent to passage of the Deficit Reduction Act of 2005, the Centers for Medicare & Medicaid Services no longer allows higher diagnosis-related group payments for patients with stage 3 and 4 hospital-acquired pressure ulcers. Additional positive and negative external motivators are described below.

Positive motivators included a stakeholder's commitment to improve patient outcomes and a goal “to be recognized as a quality provider of patient services” (19). The emergence of new guidelines from the American Nurses Association and AHRQ's “revitalized interest” in preventing and treating pressure ulcers was cited by Courtney and colleagues (32). One facility, at which prevalence of hospital-acquired pressure ulcers was lower than national norms, set out to eliminate hospital-acquired pressure ulcers completely (33).

Negative motivators for 1 cancer hospital included the identification of 2 stage 4 pressure ulcers and evidence that pressure ulcer prevalence exceeded the national benchmark by nearly 50% (31). Two facilities reported influence from a G-level citation (a deficiency judged to cause actual harm to residents) (36) and other citations from the Department of Health (37). Two critical incidents (not specified) and

inconsistent documentation were listed as external motivators by Dibsie (45). Additionally, “the frequency with which concerns and incidents were discussed, but went unreported within the internal reporting system” was of concern (45).

Teamwork/Leadership

A majority of studies used multidisciplinary teams with skin champions being described as key team members. Studies typically designated 1 individual (for example, a certified wound ostomy continence nurse) (28, 30, 46) to coordinate prevention efforts.

Two studies provided detailed descriptions of leadership support. Stier and colleagues (34) described support provided to multidisciplinary teams at 1 health care system. Teams consisting of clinical experts from 18 facilities convened to discuss the various risk assessment tools and facility protocols already in place. Multidisciplinary teams then agreed to develop a uniform protocol, skin care formulary, and specialty bed contract. “System leadership (e.g., nurse executives, quality management directors, and senior physicians) provided support to the team at both the system and facility level” vis-à-vis “resources, ensured staff orientation and education, maintained quality control programs, and continually assessed actions to improve performance through system-wide care committee meetings” (34). Dibsie (45) described broadening teamwork from nursing management to a larger group of managers and clinical specialists after “it became evident that serious skin-related issues crossed many areas and could be better handled by the group together.”

Implementation Tools

More than 21 initiatives provided examples of unique tools used for audit and feedback, education and training, and streamlining products and processes. For a complete listing of implementation tools, see the Data Supplement (available at www.annals.org). Audit and feedback (positive and negative) were mentioned as key elements in 20 (80%) preventive initiatives. Hiser and colleagues (46) reported that providing frequent feedback to clinical staff on unit progress helped engage staff members and “allowed them to take credit for the improved clinical outcomes.” Certificates for the most improved units were used as reinforcements. While providing feedback to nursing staff in 1 study, the certified nurse specialists balanced compliments for a job well done with recommendations for improvement (47). In 1 long-term care study, facilitators provided direct feedback to certified nursing assistants regarding data inconsistencies by unit and by shift to help track progress (35). Real-time management feedback in Rosen and colleagues’ study (37) consisted of a prominently displayed thermometer tracking weekly pressure ulcer incidence and positive (\$10 reward) or negative (termination) reinforcement. Weekly informal feedback by nursing supervisors (36), formal weekly walk-rounds (39), and frequent patient positioning audits were also used during implementation

(36). One rehabilitation hospital posted report cards unit-wide, allowing staff to track progress against other units and unit goals (39).

Unique tools used during education and training sessions included enrollment of guest speakers to educate physicians about the role of the certified wound ostomy continence nurse and best-practice interventions for wound care (46). In another study, participants sat on bedpans during 30-minute mandatory sessions as a reminder that pressure ulcers can occur in less than 1 hour (19). This same study tailored educational content for multilevel staffing and measured effectiveness of presentations by posttest survey. Finally, Delmore and colleagues described the involvement of perioperative services in establishing an educational newsletter for the facility’s Skin and Wound Care Web site and hosting a Skin Fair Day (41).

Barriers Solved

Reported barriers to implementation included unmotivated staff (28, 31, 43), staff turnover (23, 24, 27, 35), staff and physician resistance (19, 26, 27), inconsistent documentation (27, 28, 47), difficulties in exporting data (35), and miscommunication between electronic systems (47). Staff disruption of implementation initiatives was the most commonly reported barrier. One study described staff as relatively uninvolved in planning (43), whereas another study described staff members focusing more on the role of wound care products and specialty beds than on nursing care when patients developed in-facility pressure ulcers (31). The launching of monthly to quarterly campaigns (28); perseverance by leadership (43); and use of additional education, mentoring, and support at the unit level (31) were solutions given for motivating staff. Staff reverting to previously unsuccessful practices (27), staff turnover (24, 27, 35), and variations in new staff orientation also slowed program momentum. The development of a strong multidisciplinary team (35), assignment of responsibility for processes to multiple nurses (23), and monthly visits by a state quality improvement organization (27) helped address these issues.

To address concerns regarding inconsistent reporting and documentation, Horn and colleagues (35) worked with long-term care facilities to simplify and standardize certified nursing assistant documentation and translate the information into reports that were used in weekly care planning meetings. Bales and Padwojski (28) responded by recognizing and awarding nursing units in which patients had 0 hospital-acquired pressure ulcers. Initiatives were also challenged by limited resources. Finally, LeMaster (47) indicated that 2 different electronic documentation systems were causing shortfalls in pressure ulcer risk reporting. Transition to 1 universal electronic record system resolved this issue (47).

Sustainability

Several acute and long-term care facilities reported on sustainability or long-term maintenance of prevention ef-

forts. Conducting quarterly prevalence studies (33), requiring registered nurses and licensed practical nurses to demonstrate competency annually (19), and providing monthly updates via intranet to staff of product changes (19) were key to sustaining improvements in 2 studies. McInerney (29) indicated that publicizing improvements in pressure ulcer rates kept staff focused on prevention efforts. One rehabilitation hospital printed quarterly newsletters and attached them to paychecks. The newsletters described findings, results, and new initiatives in pressure ulcer management (39). Other studies describe basing staff bonuses on pressure ulcer incidence (32), establishing a wound care coordinator position (36) and a wound care committee (24), and keeping current regarding “initiatives for improved patient safety, changes in regulatory mandates, and changes in EBP [evidence-based practices]” (38) helped maintain gains.

Cost-Savings

Four studies reported on cost-savings. Two studies (36, 37) referenced a secondary analysis by Xakellis and Frantz (48) that evaluated long-term care and hospital costs for healing 45 pressure ulcers from 30 patients. Rosen and colleagues stated that “based on a mean cost of \$2,700 to treat a single stage II pressure ulcer, reducing the incidence of ulcers by approximately 15 over 12 weeks would yield savings of approximately \$40,000” (37, 48). In 2009, a 151-bed Midwest skilled-nursing facility described cost-savings 4 years after program implementation. After adjusting (using the Consumer Price Index) the 1996 mean cost of treating a patient with a pressure ulcer (\$1115 per month), the authors estimated their cost-savings at \$1617 per pressure ulcer per month, \$10 187 in total monthly savings, and greater than \$122 000 in yearly savings (36).

Estimated cost-savings in the remaining 2 studies (based on an additional cost per case of approximately \$3000) were also significant (29, 32). In 2006, Courtney and colleagues reported that a reduction of hospital-acquired pressure ulcers by 50% to 5% would reduce overall costs by \$2 438 000 (32). In 2008, a 2-hospital system (548 beds) in Naples, Florida (29), estimated cost-savings of approximately \$11.5 million annually as a result of statistically significant reductions in pressure ulcer prevalence.

Effects of Context

Authors of studies in long-term care (27) and acute care (26) settings agreed that the most sustainable interventions were those that were institutionalized. For example, interventions that were less dependent on sufficient staffing (for example, changing to pressure-relieving mattresses and using risk assessment tools) were easier to sustain than interventions that were more dependent on sufficient staffing (such as ensuring that every resident is turned every 2 hours). Horn and colleagues (35) found that full integration of clinical reports derived from documentation by front-line staff (certified nursing assistants) was key to success. Studies also specifically mentioned that nurses taking

ownership (45), as well as promotion and support by leadership (28, 43), were significant factors in achieving goals.

DISCUSSION

Moderate-strength evidence from 26 implementation studies suggests that the integration of a common set of components in pressure ulcer prevention programs could lead to reductions in pressure ulcer rates. Key issues were the simplification and standardization of pressure-ulcer-specific interventions and documentation, involvement of multidisciplinary teams and leadership, designated skin champions, ongoing staff education, and sustained audit and feedback for promoting both accountability and recognizing successes.

Two recent systematic reviews of quality improvement programs to prevent pressure ulcers found improvements in process or ulcer outcomes that were similar to our findings (5, 25). Nurse-focused initiatives led to improvements “on at least one nursing process or patient health outcome measure in the intended direction” in 36 of 39 acute care studies in a 2011 review by Soban and colleagues (25). In a 2012 review by Niederhauser and colleagues (5), 17 of 20 studies reporting on process-of-care measures and outcomes reported improvements in acute and long-term care settings. Both reviews included a listing of core components integrated during implementation. Our review adds to the previous reviews by providing details on implementation of prevention programs, lessons learned (see the **Supplement**), solutions to barriers, and potential cost-savings.

Neither our review nor those by Soban (25) and Niederhauser (5) and their colleagues discussed the effectiveness of individual components included in preventive bundles because the included studies did not focus on the effectiveness of specific intervention components. Nevertheless, most studies included certain aspects of direct patient care: initial and repeated risk assessments and skin examinations; the use of specialized support surfaces (such as special mattresses and overlays); repositioning or mobility protocols; moisture, friction and shear management; and nutrition and hydration. Most studies cited clinical practice guidelines that informed the choice of interventions. Additional limitations of our review included the exclusion of non-U.S. studies, possible selective reporting, and no formal evaluation of the possibility of publication bias. Niederhauser and colleagues (5) speculated that publication bias explains the positive results in most published studies.

All 3 reviews agree on the need for future research to delve deeper into daily care processes to better understand their influence on outcomes. Limitations of the evidence include the lack of information on processes of care and their measurement. In fact, in this review, only 9 of 26 studies included information on both processes and outcome measures. Studies also did not describe study limita-

tions or summarize successes and barriers to implementation, items listed by the SQUIRE guidelines (21) as key to reporting in a discussion.

In 2000, a review of measures to prevent pressure ulcers in older patients in *Making Health Care Safer* (49) included a brief discussion on implementation of pressure-relieving devices specifically noting cost, time, and difficulty in assessing change in pressure ulcer rates after implementation. Since that time, guidance provided by such organizations as the Institute for Healthcare Improvement (6), National Pressure Ulcer Advisory Panel (50), and AHRQ (51) has resulted in successful implementation of bundled evidence-based practices throughout the United States. Although we identified 26 implementation studies (published since 2000), we are concerned about the possibility of publication bias. To continue to understand the influence of context on implementation of strategies to prevent pressure ulcers, we encourage clinicians to report findings regardless of success level and to provide detail on the patient care processes, staff education and training initiatives, and system-level interventions. In addition, future research should report strategies to sustain momentum of preventive programs, a topic rarely discussed in the implementation studies we reviewed. Given the persistent significant morbidity and mortality resulting from pressure ulcers, further study of both system-level and patient care interventions aimed at preventing pressure ulcers is still needed for clinicians and managers to choose the most effective and efficient practices.

From ECRI Institute Evidence-based Practice Center, Plymouth Meeting, Pennsylvania.

Note: The AHRQ reviewed contract deliverables to ensure adherence to contract requirements and quality, and a copyright release was obtained from the AHRQ before submission of the manuscript.

Disclaimer: All statements expressed in this work are those of the authors and should not in any way be construed as official opinions or positions of ECRI Institute, the AHRQ, or the U.S. Department of Health and Human Services.

Acknowledgment: The authors thank Allison Gross, MS, LIS, for performing the literature searches; Lydia Dharia and Katherine Donahue for preparing the manuscript for publication; and Paul G. Shekelle, MD, PhD, for his review and suggestions on earlier versions of the manuscript.

Financial Support: From the AHRQ, U.S. Department of Health and Human Services (contract HHS-290-2007-100621).

Potential Conflicts of Interest: Ms. Sullivan: None disclosed. Dr. Schoelles: *Support for travel to meetings for the study or other purposes (money to institution):* RAND Corporation; *Other (money to institution):* work done by several ECRI staff on *Making Health Care Safer II: An Updated Critical Analysis of the Evidence for Patient Safety Practices for the AHRQ* supported by RAND. Disclosures can also be viewed at www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M12-2655.

Requests for Single Reprints: Nancy Sullivan, BA, ECRI Institute Evidence-based Practice Center, 5200 Butler Pike, Plymouth Meeting, PA 19462-1298; e-mail, nsullivan@ecri.org.

Current author addresses and author contributions are available at www.annals.org.

References

1. Lyder CH, Ayello EA. Annual checklist: the CMS pressure ulcer present-on-admission indicator. *Adv Skin Wound Care* 2009;22:476-84. [PMID: 20026923]
2. Lyder CH. The benefits of a multi-disciplinary approach to the prevention and treatment of pressure ulcers. *Infection Control Today*. 10 August 2011. Accessed at www.infectioncontroltoday.com/news/2011/08/the-benefits-of-a-multi-disciplinary-approach-to-the-prevention-and-treatment-of-pressure-ulcers.aspx on 15 November 2012.
3. Sharkey S, Hudak S, Horn SD, Spector W. Leveraging certified nursing assistant documentation and knowledge to improve clinical decision making: the on-time quality improvement program to prevent pressure ulcers. *Adv Skin Wound Care*. 2011;24:182-8; quiz 188-90. [PMID: 21407045]
4. Reddy M, Gill SS, Rochon PA. Preventing pressure ulcers: a systematic review. *JAMA*. 2006;296:974-84. [PMID: 16926357]
5. Niederhauser A, VanDeusen Lukas C, Parker V, Ayello EA, Zulkowski K, Berlowitz D. Comprehensive programs for preventing pressure ulcers: a review of the literature. *Adv Skin Wound Care*. 2012;25:167-88. [PMID: 22441049]
6. Institute for Healthcare Improvement. *How-to Guide: Prevent Pressure Ulcers*. Cambridge, MA: Institute for Healthcare Improvement; 2011.
7. *Advancing Excellence in America's Nursing Homes. Implementation Guide: Goal 4: Reducing High Risk Pressure Ulcers*. NH Quality Campaign; 2008.
8. Institute for Clinical Systems Improvement. *Pressure ulcer prevention and treatment protocol*. Health care protocol. Bloomington, MN: Institute for Clinical Systems Improvement; 2012.
9. Registered Nurses' Association of Ontario. *Risk assessment & prevention of pressure ulcers 2011 supplement*. Toronto, Ontario, Canada: Registered Nurses' Association of Ontario; 2011.
10. Wound, Ostomy, and Continence Nurses Society. *Guideline for prevention and management of pressure ulcers*. Mount Laurel, NJ: Wound, Ostomy, and Continence Nurses Society; 2010.
11. Association for the Advancement of Wound Care. *Association for the Advancement of Wound Care guideline of pressure ulcer guidelines*. Malvern, PA: Association for the Advancement of Wound Care; 2010.
12. National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel. *Pressure ulcer prevention recommendations*. In: *Prevention and treatment of pressure ulcers: clinical practice guideline*. Washington, DC: National Pressure Ulcer Advisory Panel; 2009.
13. Lyder CH, Ayello EA. Pressure ulcers: a patient safety issue. In: *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*. Rockville, MD: Agency for Healthcare Research and Quality; 2008.
14. American Medical Directors Association. *Pressure ulcers in the long-term care setting*. Columbia, MD: American Medical Directors Association; 2008.
15. Ayello EA, Sibbald RG. Preventing pressure ulcers and skin tears. In: Capuzzi E, Zwicker D, Mezey M, Fulmer T, eds. *Evidence-Based Geriatric Nursing Protocols for Best Practice*. 3rd ed. New York: Springer; 2008.
16. Registered Nurses' Association of Ontario. *Risk assessment & prevention of pressure ulcers*. Toronto, Ontario, Canada: Registered Nurses' Association of Ontario; 2005.
17. Pressure Ulcer Guideline Panel, Agency for Health Care Policy and Research. *Pressure ulcers in adults: prediction and prevention*. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research; 1992.
18. Institute for Healthcare Improvement. *What is a bundle?* 26 April 2011. Accessed at www.ihf.org/knowledge/Pages/ImprovementStories/WhatIsaBundle.aspx on 18 November 2011.
19. Young J, Ernsting M, Kehoe A, Holmes K. Results of a clinician-led evidence-based task force initiative relating to pressure ulcer risk assessment and prevention. *J Wound Ostomy Continence Nurs*. 2010;37:495-503. [PMID: 20736858]

20. Jankowski IM, Nadzam DM. Identifying gaps, barriers, and solutions in implementing pressure ulcer prevention programs. *Jt Comm J Qual Patient Saf.* 2011;37:253-64. [PMID: 21706985]
21. Ogrinc G, Mooney SE, Estrada C, et al. The SQUIRE (Standards for Quality Improvement Reporting Excellence) guidelines for quality improvement reporting: explanation and elaboration. *Qual Saf Health Care* 2008 Oct;17 Suppl 1:i13-32. [PMID: 18836062]
22. Rantz MJ, Hicks L, Petroski GF, Madsen RW, Alexander G, Galambos C, et al. Cost, staffing and quality impact of bedside electronic medical record (EMR) in nursing homes. *J Am Med Dir Assoc.* 2010;11:485-93. [PMID: 20816336]
23. Rantz MJ, Popejoy L, Petroski GF, Madsen RW, Mehr DR, Zwygart-Stauffacher M, et al. Randomized clinical trial of a quality improvement intervention in nursing homes. *Gerontologist.* 2001;41:525-38. [PMID: 11490051]
24. Ryden MB, Snyder M, Gross CR, Savik K, Pearson V, Krichbaum K, et al. Value-added outcomes: the use of advanced practice nurses in long-term care facilities. *Gerontologist.* 2000;40:654-62. [PMID: 11131082]
25. Soban LM, Hempel S, Munjas BA, Miles J, Rubenstein LV. Preventing pressure ulcers in hospitals: a systematic review of nurse-focused quality improvement interventions. *Jt Comm J Qual Patient Saf.* 2011;37:245-52. [PMID: 21706984]
26. Lyder CH, Grady J, Mathur D, Petrillo MK, Meehan TP. Preventing pressure ulcers in Connecticut hospitals by using the plan-do-study-act model of quality improvement. *Jt Comm J Qual Saf.* 2004;30:205-14. [PMID: 15085786]
27. Abel RL, Warren K, Bean G, Gabbard B, Lyder CH, Bing M, et al. Quality improvement in nursing homes in Texas: results from a pressure ulcer prevention project. *J Am Med Dir Assoc.* 2005;6:181-8. [PMID: 15894247]
28. Bales I, Padwojski A. Reaching for the moon: achieving zero pressure ulcer prevalence. *J Wound Care.* 2009;18:137-144. [PMID: 19349933]
29. McInerney JA. Reducing hospital-acquired pressure ulcer prevalence through a focused prevention program. *Adv Skin Wound Care.* 2008;21:75-8. [PMID: 18349734]
30. Ballard N, McCombs A, Deboor S, Strachan J, Johnson M, Smith MJ, et al. How our ICU decreased the rate of hospital-acquired pressure ulcers. *J Nurs Care Qual.* 2008;23:92-6. [PMID: 18281882]
31. Catania K, Huang C, James P, Madison M, Moran M, Ohr M. Wound wise: PUPPI: the Pressure Ulcer Prevention Protocol Interventions. *Am J Nurs.* 2007;107:44-52. [PMID: 17413732]
32. Courtney BA, Ruppman JB, Cooper HM. Save our skin: initiative cuts pressure ulcer incidence in half. *Nurs Manage.* 2006;37:36, 38, 40 passim. [PMID: 16603946]
33. Gibbons W, Shanks HT, Kleinhelter P, Jones P. Eliminating facility-acquired pressure ulcers at Ascension Health. *Jt Comm J Qual Patient Saf.* 2006;32:488-96. [PMID: 17987872]
34. Stier L, Dlugacz YD, O'Connor LJ, Eichorn AM, White M, Fitzpatrick J. Reinforcing organization wide pressure ulcer reduction on high-risk geriatric inpatient units. *Outcomes Manag.* 2004;8:28-32. [PMID: 14740581]
35. Horn SD, Sharkey SS, Hudak S, Gassaway J, James R, Spector W. Pressure ulcer prevention in long-term-care facilities: a pilot study implementing standardized nurse aide documentation and feedback reports. *Adv Skin Wound Care.* 2010;23:120-31. [PMID: 20177165]
36. Tippet AW. Reducing the incidence of pressure ulcers in nursing home residents: a prospective 6-year evaluation. *Ostomy Wound Manage.* 2009;55:52-8. [PMID: 19934464]
37. Rosen J, Mittal V, Degenholtz H, Castle N, Mulsant BH, Hulland S, et al. Ability, incentives, and management feedback: organizational change to reduce pressure ulcers in a nursing home. *J Am Med Dir Assoc.* 2006;7:141-6. [PMID: 16503306]
38. Walsh NS, Blanck AW, Barrett KL. Pressure ulcer management in the acute care setting: a response to regulatory mandates. *J Wound Ostomy Continence Nurs.* 2009;36:385-8. [PMID: 19609158]
39. Lynch S, Vickery P. Steps to reducing hospital-acquired pressure ulcers. *Nursing.* 2010;40:61-2. [PMID: 20975436]
40. Milne CT, Trigilia D, Houle TL, Delong S, Rosenblum D. Reducing pressure ulcer prevalence rates in the long-term acute care setting. *Ostomy Wound Manage.* 2009;55:50-9. [PMID: 19387096]
41. Delmore B, Lebovits S, Baldock P, Suggs B, Ayello EA. Pressure ulcer prevention program: a journey. *J Wound Ostomy Continence Nurs.* 2011;38:505-13. [PMID: 21860330]
42. Terry K. What is DMAIC? iSixSigma. 13 March 2010. Accessed at www.isixsigma.com/methodology/dmaic-methodology/what-dmaic on 10 November 2011.
43. Chicano SG, Drolshagen C. Reducing hospital-acquired pressure ulcers. *J Wound Ostomy Continence Nurs.* 2009;36:45-50. [PMID: 19155823]
44. Porter-O'Grady T. Shared governance. *J Nurs Adm.* 1995;25:8-9. [PMID: 7636580]
45. Dibsie LG. Implementing evidence-based practice to prevent skin breakdown. *Crit Care Nurs Q.* 2008;31:140-9. [PMID: 18360144]
46. Hiser B, Rochette J, Philbin S, Lowerhouse N, Terburgh C, Pietsch C. Implementing a pressure ulcer prevention program and enhancing the role of the CWOCN: impact on outcomes. *Ostomy Wound Manage.* 2006;52:48-59. [PMID: 16464994]
47. LeMaster KM. Reducing incidence and prevalence of hospital-acquired pressure ulcers at Genesis Medical Center. *Jt Comm J Qual Patient Saf.* 2007;33:611-6, 585. [PMID: 18030863]
48. Xakellis GC, Frantz R. The cost of healing pressure ulcers across multiple health care settings. *Adv Wound Care.* 1996;9:18-22. [PMID: 9069752]
49. Agostini JV, Baker DI, Bogardus ST. Chapter 27: prevention of pressure ulcers in older patients. In: *Making Health Care Safer: A Critical Analysis of Patient Safety Practices.* AHRQ publication no. 01-E058. Evidence Report/Technology Assessment no. 43. Washington, DC: Agency for Healthcare Research and Quality; 2001.
50. Pressure ulcer prevention points. Washington, DC: National Pressure Ulcer Advisory Panel; 2007. Accessed at www.npuap.org/wp-content/uploads/2012/03/PU_Prev_Points.pdf on 8 January 2013.
51. On-Time Prevention of Pressure Ulcers: Partnering With Quality Improvement Organizations. Final Report. Rockville, MD: Agency for Healthcare Research and Quality; 2007.

Current Author Addresses: Ms. Sullivan and Dr. Schoelles: ECRI Institute Evidence-based Practice Center, 5200 Butler Pike, Plymouth Meeting, PA 19462-1298.

Author Contributions: Conception and design: N. Sullivan, K.M. Schoelles.

Analysis and interpretation of the data: N. Sullivan, K.M. Schoelles.

Drafting of the article: N. Sullivan.

Critical revision of the article for important intellectual content: N. Sullivan, K.M. Schoelles.

Final approval of the article: K.M. Schoelles.

Obtaining of funding: K.M. Schoelles.

Administrative, technical, or logistic support: N. Sullivan, K.M. Schoelles.

Collection and assembly of data: N. Sullivan, K.M. Schoelles.

52. Kelleher AD, Moorer A, Makic MF. Peer-to-peer nursing rounds and hospital-acquired pressure ulcer prevalence in a surgical intensive care unit: a quality improvement project. *J Wound Ostomy Continence Nurs.* 2012;39:152-7. [PMID: 22415120]

53. Ackerman CL. 'Not on my watch:' treating and preventing pressure ulcers. *Medsurg Nurs.* 2011;20:86-93. [PMID: 21560959]

54. **Institute for Healthcare Improvement.** *Prevent Pressure Ulcers.* Cambridge, MA: Institute for Healthcare Improvement; 2007.

Appendix Table 1. Components of Pressure Ulcer Prevention Studies in U.S. Hospitals, 2000–2012

Study	Multidisciplinary Team	Skin Champion	Education/ Training	Risk Assessment Tool	Review Wound Care Products	Upgrade Automated Systems (Information Technology)	Implement Protocol	Patient Care Interventions	Integrate New Reporting	Audit and Feedback
Kelleher et al, 2012 (52)	×	×	×	×	×		×	RA; MM; F, S; N; RP; SS	×	×
Ackerman 2011 (53)*	×	×	×	×			×	RA; MM; F, S; N; RP; SS	×	×
Delmore et al, 2011 (41)	×	×	×	×	×		×	RA; SE; MM; F, S; N; SS; PEd	×	
Lynch and Vickery, 2010 (39)	×		×		×		×	RA; SE; MM; RP; SS	×	×
Young et al, 2010 (19)	×	×	×	×	×	×	×	RA; SE; MM; F, S; N; RP; SS	×	×
Bales and Padwojski, 2009 (28)†‡§	×		×			×	×	RA; SE; MM; N; RP; SS		×
Chicano and Droishagen, 2009 (43)‡	×		×	×	×		×	RA; MM; F, S; N; RP; SS	×	×
Walsh et al, 2009 (38)	×		×	×	×		×	RA; SE; MM; N; RP; SS		
Dibsie, 2008 (45)		×	×		×		×	MM;SS	×	×
McInerney, 2008 (29)†	×		×	×	×	×	×	RA; RP; SS	×	×
Ballard et al. 2008 (30)†		×	×		×	×	×	RA; MM; F, S; RP; SS	×	×
Catania et al, 2007 (31)*†	×		×	×			×	RA; SE; MM; F, S; N; RP; SS		×
LeMaster, 2007 (47)‡§			×	×		×	×	RA; SE; MM; F, S; N; RP; SS	×	×
Courtney et al, 2006 (32)†		×	×	×	×		×	RA; MM; N; RP; SS	×	×
Gibbons et al, 2006 (33)†§	×		×				×	RA; MM; N; RP; SS		×
Hiser et al, 2006 (46)			×	×			×	RA; MM; F, S; N; RP; SS		×
Lyder et al, 2004 (26)*	×		×			×		RA; SE; N; RP; SS		×
Stier et al, 2004 (34)†	×		×	×	×		×	RA; SE; MM; F, S; RP; SS		×

F, S = interventions to reduce friction and shear on at-risk body areas; MM = moisture management (includes incontinence interventions and skin care products); N = nutrition; PEd = patient and family education; RA = risk assessment (usually Braden scale, typically with repeated assessments during hospital stay); RP = repositioning or increasing activity/time out of bed when possible; SE = frequent skin examinations; SS = support surfaces (includes specialty beds and heel supports or heel elevation).

* Audit only.

† Reported a statistically significant reduction in pressure ulcer rates.

‡ Reduced prevalence/incidence to 0.

§ Describes use of incentives.

Appendix Table 2. Components of Pressure Ulcer Prevention Studies of Long-Term Care, 2000–2012

Study	Multidisciplinary Team	Use of Outside Consultants	Skin Champion	Education/ Training	New Assessment Tool	Upgrade Automated Systems (Information Technology)	Implement Protocol	Featured Patient Care Interventions	Integrate New Reporting	Audit and Feedback
Horn et al, 2010 (35)*†	×	×	×	×	×	×	×	RA; SE; MM; N; RP	×	×
Rantz et al, 2010 (22)*		×				×	×	RP		
Milne et al, 2009 (40)‡	×	×	×	×	×	×	×	RA; MM; N; RP; SS	×	×
Tippet, 2009 (36)†	×	×	×	×	×		×	RA; SE; MM; F, S; N; RP; SS	×	×
Rosen et al, 2006 (37)†	×	×		×			×	RA; SE; RP; AHCPR		×
Abel et al, 2005 (27)		×	×	×	×		×	RA; SE; MM; N; RP; SS; PEd		
Rantz et al, 2001 (23)§		×		×			×	RA; AHCPR	×	×
Ryden et al, 2000 (24)†			×	×			×	RA; MM; F, S; RP		

AHCPR = Agency for Health Care Policy and Research clinical practice guideline on pressure ulcer prediction and prevention; F, S = interventions to reduce friction and shear on at-risk body areas; MM = moisture management (includes incontinence interventions and skin care products); N = nutrition; PEd = patient and family education; RA = risk assessment (usually Braden scale, typically with repeated assessments during hospital stay); RP = repositioning or increasing activity/time out of bed when possible; SE = frequent skin examinations; SS = support surfaces (includes specialty beds and heel supports or heel elevation).

* Study focused on improving communication of observations by nursing assistants using electronic documentation tools.

† Reported a statistically significant reduction in pressure ulcer rates.

‡ Long-term acute care hospital setting.

§ Study focused on use of minimum data set–derived quality indicators for quality improvement efforts.

|| Study focused on involvement of advance practice nurses to improve a variety of quality issues.