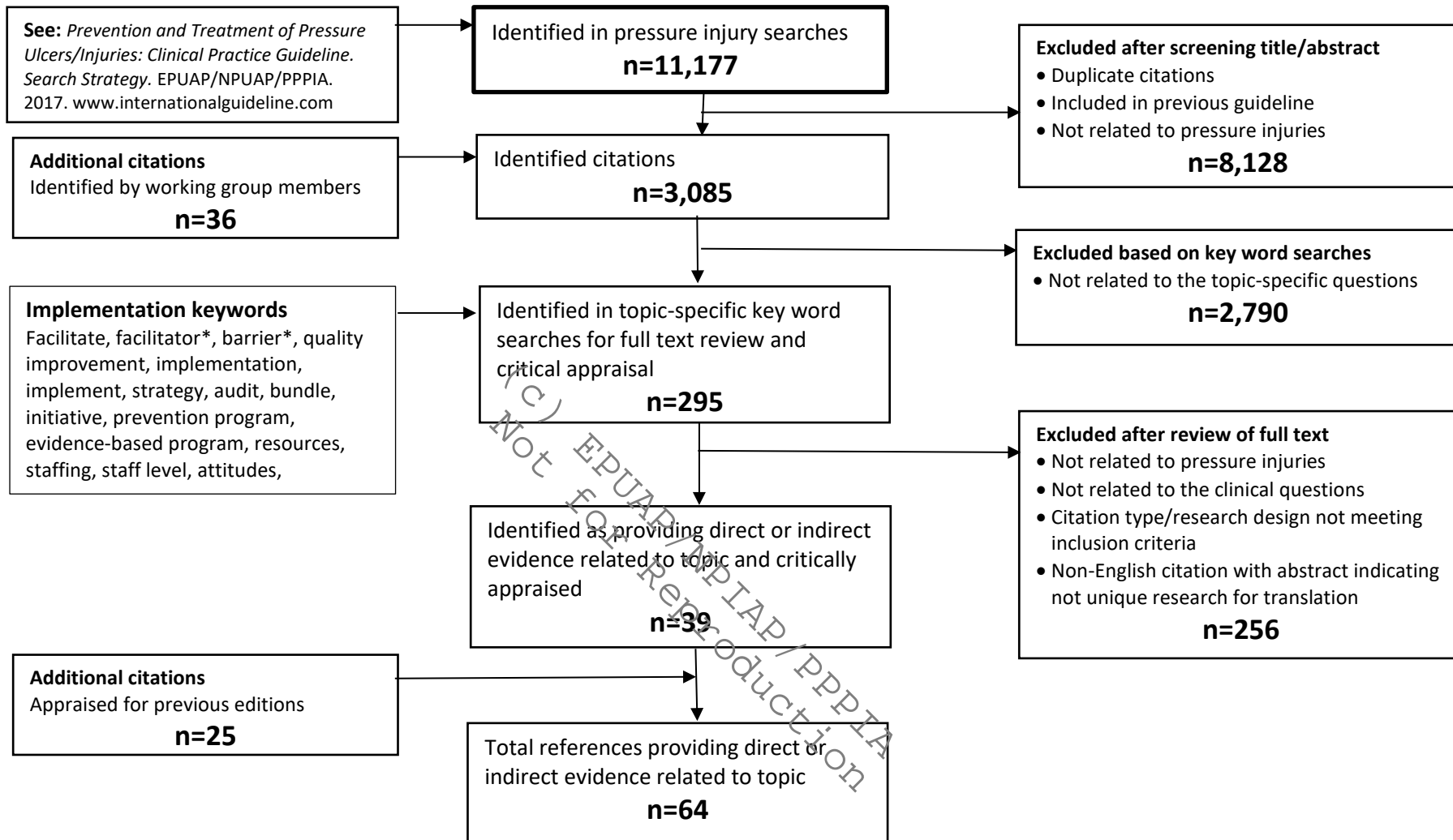


## Implementing Best Practice : Data extraction and appraisals

### Search results for 2019 International Pressure Injury Guideline: Implementing best practice (facilitators and barriers)



European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline. Emily Haesler (Ed.). EPUAP/NPIAP/PPPIA; 2019

## Implementing Best Practice : Data extraction and appraisals

### Articles Reviewed for International Pressure Injury Guideline

The research has been reviewed across three editions of the guideline. The terms pressure ulcer and pressure injury are used interchangeably in this document and abbreviated to PU/PI. Tables have not been professionally edited. Tables include papers with relevant direct and indirect evidence that were considered for inclusion in the guideline. The tables are provided as a background resources and are not for reproduction.

European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline. Emily Haesler (Ed.). EPUAP/NPIAP/PPPIA; 2019

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
<b>Chaboyer et al., 2016</b>	Cluster RCT exploring use of a education and patient engagement ( <b>INTACT trial</b> )	<p>Australian hospitals (n=8) stratified by most recent PU rates</p> <p>Inclusion (services): tertiary referral hospital with &gt; 200 beds delivering medical, surgical and rehabilitation services</p> <p>Inclusion (patients): Aged above 18 years LOS &gt; 48 hours Limited mobility Communicate in English</p> <p>Exclusion: Day surgery, critical care, emergency, maternity, pediatrics, mental health, palliative care</p>	<p>Standard care (n=799)</p> <p>Intervention: standard care plus PU prevention care bundle (PUPCB): (n=799)</p> <p>Founded on patient participation in care and clinical guidelines encouraging patient participation in PUP care with three simple evidence-based messages: 1) Keep moving; 2) Look after your skin; and 3) Eat a healthy diet.</p> <p><b>Structural level</b></p> <ul style="list-style-type: none"> <li>5 minute DVD, information and poster education for patients</li> <li>Face-face patient education within 24 hours of enrollment delivered by nurses or dieticians with &gt; 5 years' experience</li> </ul> <p><b>Professional level</b></p> <ul style="list-style-type: none"> <li>Nurses received 4-8 formal education sessions of 15-30 mins consisting of a Power point, three target messages and promoting patient participation</li> </ul>	<ul style="list-style-type: none"> <li>New HAPU of any stage</li> <li>number of new PU of any stage per 1000 patient follow up days</li> <li>severity of HAPU</li> <li>patient participation using a validated tool</li> <li>Follow up for 28 days or transfer</li> </ul>	<p><b>HAPU of any stage</b></p> <ul style="list-style-type: none"> <li>No significant difference between intervention and control (6.1% versus 10.5%, no significant difference at patient level)</li> <li>Incidence rate 9.6 per 1,000 person-days in intervention group versus 20.1 per 1,000 person-days in control group (incident rate ratio [IRR] 0.48, 95% CI 0.33 to 0.69, p&lt;0.0001)</li> <li>Hazard ration 0.48 (95% CI 0.20 to 1.21 showed 52% reduction in HAPU</li> <li>After cluster adjustment there was no significant different in severity of new PU or patient participation rates PU care scale score intervention 3.3 versus control 3.0, p=0.124)</li> </ul>	<ul style="list-style-type: none"> <li>Blinded, randomized, ITT</li> <li>Low statistical power fur to small number of clusters</li> <li>Overall, the intervention appears to potentially have some effect at the facility level as noted by a large HR, more research needed</li> <li>Patient willingness to engage is limited by clinical state and nurse willingness to actively engage patients</li> <li>Baseline control group may have been at higher risk</li> </ul>	<p><b>Level of evidence: 1</b></p> <p><b>Quality: high</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
<b>Roberts, McInnes, et al., 2017</b>	Process evaluation of the trial by Chaoyer et al 2016 (INTACT trial)	See above	See above	Review of: <ul style="list-style-type: none"> <li>Recruitment processes for clusters and individuals</li> <li>Delivery of intervention to clusters and individuals</li> <li>Qualitative interview with nurses and patients</li> <li>Unintended consequences, context and theory</li> </ul>	<p><b>Delivery of intervention</b></p> <ul style="list-style-type: none"> <li>96.7% of intervention patients received at least one component of intervention</li> <li>86.4% received all components (brochure, poster and DVD)</li> <li>Mean time to deliver intervention was 9.5±5.4 minutes (range 0 to 45)</li> </ul> <p><b>Conclusions: no major failures relating to implementation, lack of statistical significance at the patient level may be due to the study being underpowered</b></p>		<b>Indirect evidence: PU not an outcome measure</b>
<b>Roberts, Wallis, et al., 2017</b>	To identify patients' perceptions and experiences of a pressure ulcer prevention care bundle in hospital i (INTACT trial)	19 Patient participants from the INTACT trial  Participant characteristics : <ul style="list-style-type: none"> <li>53% female</li> <li>mean age 68.8 years</li> <li>mean length of stay 7.8 days (±5.6; range 3-24)</li> <li>mean time since recruitment 6.9 days (± 5.8; range 2-23),</li> <li>74% surgical</li> </ul>	See above	<ul style="list-style-type: none"> <li>Patient's perceptions and experiences of a pressure ulcer prevention bundle</li> <li>Semi-structured interview guide</li> <li>thematic analysis</li> </ul>	<p><b>Theme 1</b> Importance of personal contact in pressure ulcer prevention bundle delivery</p> <p><b>Theme 2</b> Understanding pressure ulcer prevention enhances participation</p> <p><b>Theme 3</b> Individual factors impact patients' engagement in pressure ulcer prevention</p>	<ul style="list-style-type: none"> <li>No interviews conducted with control group participants</li> <li>Findings are specific to the INTACT study – not generalizable</li> <li>19 participants - perhaps missed some views</li> </ul>	<b>Indirect evidence: PU not an outcome measure</b>
<b>Roberts et al., 2016</b>	A qualitative study investigating nurses' experiences with the introduction of the care bundle in trial by Chaoyer et al 2016 (INTACT trial)	Nurse participants were recruited in two hospitals that participated in the intervention (n=18 nurses)  Purposive sampling to attain a diverse range of nurses  Participant characteristics: <ul style="list-style-type: none"> <li>Primarily female (83%)</li> </ul>	See above	<ul style="list-style-type: none"> <li>Semi-structured interviews conducted with nurses</li> </ul>	<ul style="list-style-type: none"> <li>Nurses had a good knowledge of intervention and described increased awareness of PU prevention among patients and other staff members</li> <li>Some nurses felt intervention reflected current practice so would not work</li> <li>Improved communication between patients, nurses and amongst staff was identified as an outcome</li> <li>Intervention encouraged active participant for patients, which meant more holistic care and improved patient mood</li> </ul>	<ul style="list-style-type: none"> <li>Minimal participant details</li> <li>Staff members in only two hospitals were invited</li> <li>Minimal participant details</li> <li>Participation in intervention was not confirmed with observation</li> </ul>	<b>Indirect evidence: PU not an outcome measure</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		<ul style="list-style-type: none"> <li>Experience ranged from 3 to 30 years</li> </ul>			<ul style="list-style-type: none"> <li>Barriers were cognitive impairment of patients, patients having a passive approach to their health care and patients undervaluing PU prevention</li> </ul> <p><b>Author conclusions: The PUPCB reflects current clinical practice guidelines and nurses in this study found the PUPCB was acceptable.</b></p>		
Whitty et al., 2017	To evaluate cost effectiveness of INTACT intervention (INTACT trial)	<ul style="list-style-type: none"> <li>Secondary analysis of INTACT trial, see above</li> </ul>	See above	<ul style="list-style-type: none"> <li>Direct costs related to the intervention and preventative strategies collected from trial data</li> <li>micro-costing data on patient turning and skin care from a 4-week substudy in 317 individuals</li> <li>Included nursing labor and equipment</li> </ul>	<p><b>Cost</b></p> <ul style="list-style-type: none"> <li>care bundle cost AU\$144.91 (95%CI: \$74.96 to \$246.08) more per patient than standard care</li> <li>estimated to cost an additional \$3296 (95%CI: dominant to \$144,525) per pressure ulcer avoided</li> <li>adjusted for length of stay net monetary benefit for care bundle estimated to be -\$2320 (95%CI -\$3900, -\$1175) per patient</li> </ul>	<ul style="list-style-type: none"> <li>length of stay was higher in the care bundle group which contributed to increased costs</li> </ul>	<b>High quality economic analysis</b>
Chaboyer & Gillespie, 2014	To explore nurses views of the barriers and facilitators to the use of a newly devised patient-centered pressure ulcer prevention care bundle (INTACT trial)	<ul style="list-style-type: none"> <li>20 nurses participated @ units in hospital setting. 1 surgical ward and 1 medical ward</li> <li>15 RNs 5 ENs</li> <li>Australia</li> <li>Inclusion criteria not specified</li> <li>Exclusion criteria not specified</li> <li>Age range 22- 62 yrs</li> <li>Years of experience from 1 – 38 yrs</li> </ul>	Exploratory qualitative research	<ul style="list-style-type: none"> <li>Identify barriers and facilitators to the implementation of a patient centered pressure ulcer prevention bundle</li> <li>Single interview with each participant</li> </ul>	<p><b>Theme 1</b></p> <p>Increasing awareness of PUP with both patients and staff via provision of information, Illustrating PUP strategies, reinforcing message</p> <p><b>Theme 2</b></p> <p>Prompting PUP activities: Encouraging patients, prompting patients and staff, helping nurses do their job.</p> <p><b>Theme 3</b></p> <p>Promoting active patient participation: enabling patients, motivating to be responsible</p> <p><b>Theme 4</b></p>	<ul style="list-style-type: none"> <li>Conducted at one site only</li> <li>Participants had varying degrees of familiarity with PUPs care bundle</li> <li>Interviews were brief and responsive to time constraints of the clinical need.</li> <li>Limited number of questions asked</li> <li>Would benefit from further study pre and post implementation to see if it effectively</li> </ul>	<b>Indirect (qualitative)</b>  <b>Quality: high</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
					<p>Barriers to using PUP care bundle: Patient characteristics, acknowledging autonomy, increases nurses work</p> <p><b>Theme 5</b> Integrating the care bundle into routine practice: Incorporating PUP care bundle into routines, involving others, accessing resources</p> <p><b>Author conclusions: The study identified a number of benefits for use of a patient centered care bundle. However, success is dependent of of patients to participate and nurses to incorporate into routines.</b></p>	<ul style="list-style-type: none"> <li>impacts of PU incidencel</li> </ul>	
<b>Webster et al., 2017</b>	Aim of the study to describe care processes staff implement after they discover an individual have a PU and then to determine if intervention impacted subsequent care (INTACT trial)	<ul style="list-style-type: none"> <li>Secondary analysis of INTACT trial, see above</li> </ul>	See above	<ul style="list-style-type: none"> <li>outcomes and care processes between participants who received the pressure ulcer prevention intervention and those in the usual care, control group.</li> <li>care processes according to the pressure ulcer stage.</li> </ul>	<p><b>Care processes</b></p> <ul style="list-style-type: none"> <li>14.3% had a repositioning schedule</li> <li>24.8% had dressing applied</li> <li>12.8% assessed by wound care team</li> <li>15% assessed by occupational therapist</li> </ul> <p>Intervention group more likely:</p> <ul style="list-style-type: none"> <li>to have pressure ulcer documented (OR 0.92 (95% CI 0.07; 0.54);</li> <li>to receive pressure relieving device OR 0.31 (95% CI 0.14; 0.69) or a pressure relieving mattress OR 0.44 (95% CI 0.20; 0.96).</li> <li>Participants with Stage 2 or unstageable ulcers more likely to have dressings applied to their wounds (p = &lt; 0.001)</li> <li>Participants with Stage 2 or unstageable ulcers were more likely than others to be referred to an occupational therapist for protective devices (p = 0.022).</li> </ul> <p><b>Author conclusions : participants who were in the intervention arm were more likely to have improved outcomes</b></p>	<ul style="list-style-type: none"> <li>Retrospective study, findings relied on retrospective documentation</li> <li>Post hoc design after initial study was competed,</li> <li>The initial study was not designed for the follow up study</li> </ul>	<p><b>Level of evidence: 1</b></p> <p><b>Quality: high</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
<b>Tayyib, Coyer, &amp; Lewis, 2015</b>	RCT exploring a PU prevention bundle	<ul style="list-style-type: none"> <li>Two Saudi Arabian critical care ICUs</li> </ul> <p>Inclusion: All admissions aged &gt; 18 years Expected LOS &gt; 24 hours</p> <p>Excluded: Pre-existing PU or PU diagnosed in first 24 hours of study</p>	<p>Hospital level implementation PU prevention bundle: (n=70)</p> <ul style="list-style-type: none"> <li>bundle of best available evidence based on the latest international guidelines including                             <ul style="list-style-type: none"> <li>Risk assessment with 24 hours of admission</li> <li>Skin assessment</li> <li>Skin care</li> <li>Nutrition</li> <li>Repositioning using 3 hourly turn by the clock</li> <li>air mattresses</li> </ul> </li> <li>Education and training of RNs in Braden scale use and other aspects of the care bundle</li> </ul> <p>Or Control with standard care (n=70)</p>	<ul style="list-style-type: none"> <li>28 day followup</li> </ul>	<ul style="list-style-type: none"> <li>PU cumulative incidence</li> <li>Intervention group significantly lower 7.14% vs 32.86%</li> <li>70% lower likelihood of PU in intervention group p &lt;0.001</li> </ul> <p>Significantly fewer Category/Stage I (p=0.02) and Stage II (p=0.026) in intervention ngroup</p>	<ul style="list-style-type: none"> <li>Small sample size</li> <li>Critical care only</li> </ul>	<p><b>Level of evidence: 1</b></p> <p><b>Quality: moderate</b></p>
<b>N. Tayyib, F. Coyer, &amp; P. Lewis, 2016</b>	Cross sectional study <b>exploring nurse attitudes to PU prevention and facilities and barrier sin the ICU</b>	<p>Convenience sample of registered nurses recruited from an ICU in Saudia Arabia (n=60 invited, n=56 consented)</p> <p>Inclusion criteria: Nurse working in the ICU in the study</p> <p>Exclusion criteria: none</p> <p>Characteristics: Mean work experience as nurse 5.94±3.24 yrs 80.4% female 50% bachelor's degree, 46.4% had a diploma, 3.6% had a Master's degree</p> <ul style="list-style-type: none"> <li></li> </ul>		<ul style="list-style-type: none"> <li>Demographic information</li> <li>Potential barriers and potential facilitators to optimal skin care measured using the Barriers and Facilitators tool that was tested for construct and content validity</li> <li>RNs' attitudes toward PI care and prevention in the ICU measured using previously validated Attitude towards Pressure Injury Prevention (APuP) tool</li> </ul>	<p><b>Attitudes to PI prevention</b></p> <ul style="list-style-type: none"> <li>73.44% positive attitude to PI prevention</li> <li>Mean score for consideration of impact of PI on patients and society was low (68%)</li> <li>mean priority subscale score was low (69%) meaning nurses considered PI prevention as a secondary priority in their routine work</li> </ul> <p><b>Barriers to PI prevention</b></p> <ul style="list-style-type: none"> <li>Moderate level of ability to overcome barriers was reported</li> <li>Multiple regression found items related to time (p=0.011), limitation of the nurse's knowledge (p=0.022) and the documentation format used in the ward (p=0.046) were significant barriers to providing optimal skin care</li> </ul> <p><b>Facilitators to PI prevention</b></p> <ul style="list-style-type: none"> <li>Multiple regression found ease of obtained pressure redistribution surfaces</li> </ul>	<ul style="list-style-type: none"> <li>Single unit in a hospital</li> <li>Self-selecting population</li> <li>Self-reported information without any correlation by observation</li> <li>PU not an outcome measure</li> </ul>	<p><b>Indirect evidence: PU not an outcome measure</b></p> <p><b>Quality: high</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
					(p=0.007), collaboration with interdisciplinary teams (p=0.02) and availability of appropriate skin care products (p=0.015) were significant facilitators to providing optimal skin care		
<b>N. Tayyib, F. Coyer, &amp; P. A. Lewis, 2016</b>	observational prospective study design evaluating the implementation of a high impact intervention care bundle directed at preventing the development of PUs	<ul style="list-style-type: none"> <li>Participants were nurses In Arabian ICUs participating in the trial by Tayyib et al 2015</li> <li>Number of participants :</li> <li>11 RNs, a response rate of 18% ( Of the 60 ICU nurses)</li> <li>Characteristics:                             <ul style="list-style-type: none"> <li>female (91%)</li> <li>64% had bachelor's degree</li> </ul> </li> </ul>	See above	Outcome Measures : <ul style="list-style-type: none"> <li>PU prevention bundle compliance checklist</li> <li>RNs self-evaluation using a Likert scale tool and open questions that evaluated perception of compliance and satisfaction in general</li> <li>cumulative incidence of HAPU at the time points</li> <li>Administered at 4 time points – 2,4,6 and 8 weeks after intervention</li> </ul>	<b>Compliance</b> <ul style="list-style-type: none"> <li>78.1% ( mean score=22.43) of participants had a high level of compliance in the implementation of the PU prevention bundle</li> <li>There were no significant differences between demographic characteristics and the compliance score.</li> <li>There was a significant effect for time in the implementation compliance (Wilks Lambda = 0.29, F (3, 8) = 6.35, p&lt;0.016)</li> <li>PU incidence was not influenced by the compliance level of participants.</li> </ul>	<ul style="list-style-type: none"> <li>Small sample size</li> <li>Low response rate of 18% and date from Self-report bias may be had response bias</li> <li>a care bundle cannot expect 100% compliance to all elements of complex intervention</li> </ul>	<b>Indirect evidence: PU not an outcome measure</b>
<b>Crawford, Corbett, &amp; Zuniga, 2014</b>	To reduce the incidence of Hospital Acquired Pressure Ulcers across 21 Hospitals through the introduction of a quality improvement initiative	Located in California Included 21 hospitals across health care region Collaboration between Regional risk management & patient care services	Review & refine SKIN bundle, BRADEN Risk assessment tool used  <b>Organizational level</b> <ul style="list-style-type: none"> <li>SKIN Bundle of assessment and management protocol</li> <li>Regional steering committee assessed strategy, infrastructure, and processes and addressed barriers; the partnership with regional risk management and patient care services staff</li> <li>data analysis and action teams at each of the hospitals.</li> <li>Regional and hospital leaders provided robust and visible sponsorship.</li> </ul>	<ul style="list-style-type: none"> <li>Primary measures - :</li> <li>Rate of all stage HAPU'S (stages I-IV) per 1000 pt days</li> <li>Rate of stage III, IV &amp; unstageable HAPU'S per 1000 days</li> <li>HAPU defined as a pressure ulcer not present during the first 24 hrs of admission</li> <li>First 2 yrs of program:</li> </ul>	<b>HAPUs</b> <ul style="list-style-type: none"> <li>Decrease of 1.37 (95% confidence interval) for all stage HAPU's per 1000 patient days</li> <li>Average rate declined from 2.03 to 0.66 (95% CI)</li> <li>By 2012 (4) yrs rate decreased to 0.59</li> <li>Decrease of 0.13 of rate of stages III-IV, Unstageable HAPU's</li> <li>Average rate declined from 0.18 to 0.04 (CI 95%)</li> <li>Increased by 2012 to 0.09</li> </ul> <b>Implementation of a multifaceted, multidisciplinary approach reduces HAPU rates across 21 hospitals. The outcomes have been included as part of the safety and quality culture in the health region and has led to other improvement in preventable conditions such as falls</b>	<ul style="list-style-type: none"> <li>generalizability of population not known</li> <li>No adjustment for decrease in bed days and increased acuity of inpatient care</li> <li>Barriers identified: Lack of appropriate pressure support surfaces initially</li> <li>Limited clinical experience of nurses with expertise in skin care to ensure use of SKIN bundle appropriately</li> </ul>	<b>Level of evidence: 2</b>  <b>Quality: low</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	Level of evidence: 2
Shieh et al., 2018	Pretest, posttest investigating a QI program that included a reminder system	Participants were inpatient populations at two hospitals in US	Organizational level Nursing interventions based on international guideline Risk assessment to determine extreme and high risk Reminder system – individuals at high risk were flagged (visual reminder on high risk patient beds)	<ul style="list-style-type: none"> <li>• HPAU – unclear how these were addressed and documented</li> </ul>	<b>HAPU</b> <ul style="list-style-type: none"> <li>• 67% reduction in HAPU from 12/1,000 patient days to 0.4 per 1,000 patient days over 4 years</li> </ul>	<ul style="list-style-type: none"> <li>• Unclear if blinded</li> <li>• Unclear how PUs identified</li> <li>• Similarities between cohorts not reported</li> <li>• Flagged patients at very high risk <math>\leq</math> 12 Braden score or Braden score <math>&lt;</math> 18 plus two additional risk factors</li> </ul>	<b>Quality: high</b>
Fisher, Grosh, & Felty, 2016	Retrospective pre and post introduction study to determine if the introduction of a nurse-led quality improvement rounds would improve outcomes related to HAPIs	Population: inpatients to a US cardiac ward admitted from Oct 2011-2013- (n= 1733 patients with 11, 646 Braden scale assessments in the pre-intervention group and 1871 patients with 16, 152 Braden scale assessments in the post-intervention group) <ul style="list-style-type: none"> <li>• The criterion for exclusion- patients on observational status, admission of less than 24 hours, those who died on the unit</li> <li>• All patients who met the inclusion criteria were included in the study (From Oct 2011-October 2013)</li> </ul>	daily quality nursing quality rounds in relation to the development of HAPIs	<ul style="list-style-type: none"> <li>• Documentation</li> <li>• Speed of interventions</li> <li>• No significant decline</li> <li>• Prevalence of pressure injuries</li> <li>• Retrospective study, Extracted EMR data.</li> </ul>	<ul style="list-style-type: none"> <li>• Patients in the postintervention group were more accurately scored at risk following focused education on completion of the Braden Scale score and implementation of daily quality rounds. I</li> <li>• In the preintervention period, 36.5% of patients were identified as being at risk, as compared with 47.8% in the postintervention period (<math>P &lt; 0.001</math>, odds ratio (OR)=3.25, 95% CI=2.51-4.20).</li> <li>• Time to implement intervention: In preintervention period, 2.2 hours, versus postintervention period, 0.6 hour (<math>P &lt; 0.001</math>, hazards ratio (HR) =3.31, 95% CI=3.04-3.61)</li> <li>• <b>No</b> statistically significant decrease in the unit's overall HAPU rate. (0.6% of versus 0.4%)</li> </ul> <p><b>Author comments: Study demonstrated a cultural shift but no significant decrease in pressure ulcer prevalence</b></p>	1) Results not generalizable 2) Patients who did not spend their entire hospital stay on the unit were excluded 3) Retrospective data	<b>Quality: high</b>
Beinlich & Meehan, 2014	Pretest-posttest quasi experiment investigation	<ul style="list-style-type: none"> <li>• 511 bed acute care teaching hospital in US</li> </ul>	A multidisciplinary program was developed to address barriers to preventing hospital-acquired pressure ulcers..	HAPUs and Cost analysis	<b>PI prevalence</b> <ul style="list-style-type: none"> <li>• Pre and post intervention (introduction of resource nurses) demonstrated decreased HAPU (77% decrease) and a</li> </ul>	<ul style="list-style-type: none"> <li>• No confidence intervals or p values reported</li> </ul>	<b>Level of evidence: 2</b>



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Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	intervention to reduce hospital-acquired pressure ulcers by addressing barriers		<b>Professional level</b> <ul style="list-style-type: none"> <li>Included introduction of 8 resource nurses</li> <li>Peer-peer learning/teaching resource nurses are empowered to change practice</li> </ul>		<ul style="list-style-type: none"> <li>No confidence intervals or p values reported</li> </ul> <b>Cost savings</b> <ul style="list-style-type: none"> <li>cost analysis demonstrating \$95, 120 savings</li> <li>No confidence intervals or p values reported</li> </ul> <b>Author conclusions: Resource nurse programs encourages staff nurses to explore causative factors related to PU development</b>	<ul style="list-style-type: none"> <li>No power analysis was reported for sample size calculations</li> </ul>	<b>Quality: moderate</b>
<b>Anderson et al., 2015</b>	Examined the effectiveness of a universal pressure ulcer prevention bundle applied to intensive care unit patients combined with proactive semi-weekly WOC nurse rounds	<ul style="list-style-type: none"> <li>Study conducted in ICUs in USA (n= 327; n=181 in pre phase and 146 in post phase)</li> <li>Inclusion criteria</li> <li>At least 18 years of age</li> <li>admitted to ICU</li> </ul> <p>Exclusion criteria</p> <ul style="list-style-type: none"> <li>Less than 18 years</li> <li>presence of a PU,</li> <li>previous study enrollment,</li> <li>length of stay &lt; 24 hours</li> </ul> <p>Participant characteristics</p> <ul style="list-style-type: none"> <li>Age= mean 62.71</li> <li>Mean Braden score 15.03</li> <li>Mean BMI 28.50</li> <li>Mean ICU LOS = 129</li> </ul>	<p>Compared the use of:</p> <ul style="list-style-type: none"> <li>use of a standard guideline with referrals to the WOC nurse based on risk (181, pre)</li> <li>WOC RNs as a bedside educator during semi-weekly rounds for initiating a pressure ulcer prevention bundle (n=146, post) to</li> </ul>	<ul style="list-style-type: none"> <li>Braden Scores were collected on all participants</li> <li>Pressure ulcers were staged as 1-4 or sDTI or mucosal pressure injuries, medical device related pressure ulcers</li> </ul>	<p><b>Pressure ulcer incidence</b></p> <p>Pre= 15.5% Post= 2.1% 50% of all pressure injuries were related to medical devices</p> <p><b>Adherence by staff to the prevention bundle</b></p> <ul style="list-style-type: none"> <li>WOC nurse rounds increased the adherence by staff to the prevention bundle (p&lt;.001)</li> <li>Composite adherences scores showed a significant difference between the pre and post phases (increased positive outcomes) for repositioning (p=0.015) and elevation of heels (p&lt;.001).</li> </ul> <p><b>Author conclusions: that a pressure ulcer prevention bundle in combination with semi-weekly WOC nurse rounds was effective in decreasing pressure ulcer occurrences. And increased staff adherence to repositioning and heel elevation</b></p>	<ul style="list-style-type: none"> <li>Study did not control for historical difference between the study phases.</li> <li>New ICU opened during the study affecting enrollment.</li> <li>Did not test the prevention bundle impact separately from the WOC nurse impact.</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: moderate</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
Sving, Högman, Mamhidir, & Gunningberg, 2014	To evaluate whether a multi-faceted, unit-tailored intervention related to evidence-based pressure ulcer prevention affects:- performance prevalence knowledge and attitudes	<ul style="list-style-type: none"> <li>Participants were recruited in general hospital (3 surgical and 2 medical Units) in Sweden (n= 506 patients (251+255))</li> <li>275 nurses (145+130)</li> <li>Inclusion criteria: <ul style="list-style-type: none"> <li>age ≥18 y;</li> <li>verbally consenting adult patients,</li> <li>admitted to the units before midnight on PU prevalence surveys' days</li> </ul> </li> <li>Exclusion criteria: not specified</li> <li>Participant characteristics:  <u>Total Pre-test:</u> 52% man, 48% women; Age (mean) 69 y; Days at unit 7,3; Norton ≤ 20 risk patients 21%  <u>Total Post-test:</u> 48% man, 52% women; Age (mean) 68 y; Days at unit 7,8; Norton ≤ 20 risk patients 21%  <u>At-risk patients Pre-test:</u> 58% man, 42% women; Age (mean) 76 y; Days at unit 11;  <u>At-risk patients Post-test:</u> 54% man, 46% women; Age (mean) 75 y; Days at unit 11.</li> </ul>	<ul style="list-style-type: none"> <li>Introduction: information and inventory of equipment – first-line manager</li> <li>- 1 day training – RN and AN</li> <li>- Quality measurement and feedback of performed prevention and PU prevalence</li> </ul>	<ul style="list-style-type: none"> <li>Point prevalence surveys of PU (EPUAP)</li> <li>PU prevention activities</li> <li>Nurses knowledge Pressure Ulcer Knowledge Assessment Tool (PUKAT) and attitudes towards PU prevention (APuP tool)</li> <li>PU Risk Assessment Scale: Norton</li> <li>14 month followup</li> </ul>	<p><b>Prevalence of pressure injuries</b></p> <ul style="list-style-type: none"> <li>Category/Stage I to IV no change 11% (both pre-test and post-test)</li> <li>Category/Stage II to IV increased from 6% at pre-test to 8.7% post-test</li> <li>Incidence of PU in at risk patients increased from 8.4% pre-test to 9% post-test</li> </ul> <p><b>Competency</b></p> <ul style="list-style-type: none"> <li>Documented risk assessment increased in at-risk patients from 60% pre-test to 86% post-test; p = 0.008</li> <li>Offloading on heels increased in at-risk patients from 7.8% at pre-test to 32% post-test</li> <li>Pressure injury prevention interventions (excluding pressure-reducing mattresses) in at risk patients increased from 29% pre test to 52% post test (p = 0.009)</li> <li>Pressure injury prevention interventions (excluding pressure-reducing mattresses) in all patients increased from 8% pre test to 18% post test (p = 0.001)</li> </ul> <p><b>Knowledge</b></p> <ul style="list-style-type: none"> <li>Nurses knowledge about PU prevention: 57% pre-test; 63% post-test; p &lt; 0.001</li> <li>RN mean knowledge scores: 50% pre-test; 64% post-test; p = 0.003</li> <li>-AN mean knowledge scores: 51% pre-test; 59% post-test; p = 0.015</li> </ul> <p><b>Author conclusions: significantly more patients received PU prevention after the intervention, but the prevalence of PU remained unchanged.</b></p>	<ul style="list-style-type: none"> <li>Limitations: intervention not clearly described</li> <li>Insufficient training in order to improve PU prevention</li> <li>PU prevention knowledge test results: bias due to statistical inadequate test (some participants have filled out both tests)</li> </ul>	<p>Level of evidence: 2</p> <p>Quality: Low</p>

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## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
Antonio & Conrad, 2013	To implement a proactive wound care improvement program (WCI) aimed at reducing pressure injury point prevalence and economic improvement.	<ul style="list-style-type: none"> <li>Study conducted in acute, sub acute and residential aged care services in an Australian regional center hospital (n=648)</li> </ul>	<ul style="list-style-type: none"> <li>Staff Education and implementation of evidence-based care program</li> <li>Learner-focused, competency-based training program</li> <li>Clinical nurse educators were recruited, trained</li> <li>staff training combined classroom, hands-on clinical training and a train-the trainer program.</li> <li>Three training modules focused on wound management and prevention, assessment</li> <li>and management of pressure injury</li> <li>Other components of quality improvement plan:</li> <li>Planning, leadership, regular auditing, best practice clinical protocol</li> <li>Education,</li> <li>Product formulary, reporting and communication, engagement of patient and families</li> </ul>	<ul style="list-style-type: none"> <li>Organization wide point prevalence survey:2009, 2011, 2012</li> <li>Regular Survey monitoring demographic and patient data and pressure injury point prevalence data</li> <li>Data collection by Skin Integrity Harm Minimization Working group</li> <li>Patient/resident demographics collected</li> <li>Assessment data collected for skin integrity, pressure injury risk, continence, falls risk, wounds, pressure injury and wound care</li> <li>Staff skills and knowledge survey</li> </ul>	<p><b>Pressure Injury Point Prevalence</b> Combined pressure injury point prevalence reduced from 11 % in 2009 to 3.7 % in 2012</p> <p><b>Economic Improvement</b></p> <ul style="list-style-type: none"> <li>Bed day savings improved from \$882,740 in 2011 to \$4,427,684 in 2012.</li> <li>Over the 3 year period an estimated bed day saving of 10.132 bed days in 2012</li> </ul> <p><b>Wound Documentation</b></p> <ul style="list-style-type: none"> <li>Wound care and pressure injury documentation improved</li> <li>improving pressure injury coding and funding</li> </ul> <p><b>Author conclusions: Following implementation of the WCI the prevalence of pressure injuries was reduced in all care settings. The program created an environment of leadership and patient safety.</b></p>	<ul style="list-style-type: none"> <li>Full statistical analysis not conducted</li> <li>not a properly structured RCT</li> <li>Assumption that point prevalence rates reflect annual prevalence rates</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: low</b></p>
Burston, Chaboyer, Gillespie, & Carroll, 2015	Retrospective cohort study investigating a care bundle	<ul style="list-style-type: none"> <li>Participants were those patients discharged from two acute surgical units in a tertiary hospital in Australia between 07/2008 and 12/2010.</li> <li>Pre-period (14 months) n=3558</li> <li>Post-period (13 months) n=3567</li> </ul> <p>Excluded:</p>	<p>Transforming care initiative (aimed at decreasing all adverse events):</p> <ul style="list-style-type: none"> <li>Behind bed white boards to color code need for assistance</li> <li>Bedside handover that included a safety update</li> <li>Interdisciplinary team meetings</li> <li>Clinical communications strategies</li> <li>Signs identifying patient's nurse for the day</li> </ul>	<p><b>Hospital acquired PU</b> An unspecified or unstageable or Category/Stage 1 to 4 PU recorded in the ICD-10 coding as occurring during admission</p>	<ul style="list-style-type: none"> <li>Mean proportion of participants with a HAPU per month in ward one was 0.004 (0.4%) and 0.010 (1%) in ward 2.</li> <li>Reductions are observed in the post-period compared to pre-period, but statistical analysis isn't conducted and raw values are not reported (only graphical).</li> </ul> <p><b>Study conclusions: No consistent association was identified between the intervention and HAPUs.</b></p>	<ul style="list-style-type: none"> <li>Intervention changed the way care was conducted in wards</li> <li>Results are reported per ward rather than for overall trial – this may influence outcomes</li> </ul>	<p><b>Level of evidence: 3</b></p> <p><b>Quality: moderate</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		<ul style="list-style-type: none"> <li>• Second and subsequent admissions of same patient</li> <li>• Second and subsequent PUs on same patient</li> </ul> <p>Characteristics:</p> <ul style="list-style-type: none"> <li>• No significant difference in pre and post populations for age, length of stay, primary diagnoses</li> </ul>	<ul style="list-style-type: none"> <li>• Protected meal times</li> <li>• Traffic light system for staff to communicate their workload</li> <li>• Simplified working space</li> <li>• Allied health referral station</li> </ul>				
<b>Sebastian -Viana et al., 2016</b>	Before/after study to explore the impact of onscreen reminders in reducing PU rates	<p>Conducted in a Spanish hospital (n=406 beds, pre-intervention 9263 discharges, post-intervention 9220 discharges)</p> <p>Participant characteristics:</p> <ul style="list-style-type: none"> <li>• Average length of stay approx. 6.8 days</li> <li>• Average patient age approx. 60 years</li> <li>• 53% males</li> <li>• Approximately 2/3rds were medical patients and 1/3 surgical patients</li> <li>• Significant difference in patient dependency levels, with more minimal care patients in pre-intervention phase</li> <li>• Significant difference in PU risk between phases, with higher risk</li> </ul>	<p>A computer reminder system that included date of admission, last PU risk assessment, current PU status, last recorded location and extent of PU was implemented. The system updated whenever computer was turned on and automatically displayed.</p>	<p>Cumulative incidence of facility-acquired PU analyzed as Group A (one year period before intervention) and Group B (one year period after intervention)</p> <p>Confounding factors included mean level of dependency using a validated scale, PU risk measured using Norton scale</p>	<p><b>Univariate analysis</b> (gender, age, average weight, level of dependency and PU risk)</p> <ul style="list-style-type: none"> <li>• Decreased PU risk associated with the intervention</li> <li>• Absolute risk reduction of 0.003, a relative risk reduction of 29.4% and an NNT of 333</li> </ul> <p><b>Author conclusion: an on-screen reminder system that updated every shift was associated with a decrease in PU risk when considering dependency levels and PU risk. Reminding staff to screen for PU risk is associated with decreased PU.</b></p>	<ul style="list-style-type: none"> <li>• Common use of computers does not always involve shut down, so clinicians may not get regular updates</li> <li>• No measure of sustainability</li> <li>• No blinding</li> <li>• Other potential changes may relate to the change (e.g. maturation, Hawthorne effect)</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: Low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		in post-intervention phases					
<b>Stifter et al., 2015</b>	Retrospective cohort study database review to <b>determine relationship between nurse continuity and nurse staff variables with HAPU rates</b>	<p>Database review of care episode at 9 units in 4 hospitals that collected data for 12-24 months (n=24,609 episodes of care)</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> <li>No PUs present on admission</li> <li>Each care episode associated with a unique patient (i.e. multiple hospitalizations not included)</li> <li>Patient aged ≥18yrs</li> <li>Care &gt; 24 hours</li> </ul>	Nurses and patients whose data was available in the into the Hands On Nursing Data System (HANDS) were assigned unique identifiers that allowed linking of nurse's information to each of the care plans of care by that nurse.	<p>HAPU (at least 24 hours post-admission)</p> <p>Admission PU (PU in first 24 hours of admission)</p> <p>Nurse staffing determined through nurse-patient assignments each shift</p> <p>Nurse experience recorded as per cent time cared for by RN with ≥ 2 years' experience</p> <p>Patient PU risk factors using North American Nursing Diagnosis Association categories</p> <p>Logistic regression to determine staffing factors associated with PU risk</p>	<p><b>PU prevalence</b></p> <ul style="list-style-type: none"> <li>Total HAPU n=211 (0.86%)</li> <li>Total admission PU n=685 (2.8%)</li> </ul> <p><b>There was no significant difference between staffing factors between patients who did acquire a PU and those who did not</b></p> <ul style="list-style-type: none"> <li>nurse experience (p=0.82)</li> <li>nurse continuity (p=0.37)</li> <li>nursing patient load (p=0.64)</li> <li>nursing full/part time status(p=0.38)</li> <li>hours worked per patient day (p=0.98)</li> <li>nurse bachelor's' degree education (p=0.70)</li> </ul> <p><b>There was significant differences in patient characteristics between patients who did and did not acquire a PU</b></p> <p>Nutrition (p=0.001)</p> <p>Mobility (p=0.001)</p> <p>Perfusion (p=0.001)</p> <p>Hydration (p=0.001)</p> <p>Skin (p=0.001)</p> <p>Age (p=0.001)</p>	<ul style="list-style-type: none"> <li>Data base review, relied on documentation</li> <li>There was low rate of PU, which limited analysis</li> <li>Admission PU had a broad definition and may have included many HAPU</li> </ul>	<p><b>Level of evidence: 3</b></p> <p><b>Quality: Moderate</b></p>
<b>Mallah, Nassar, &amp; Kurdahi Badr, 2014</b>	Prospective study to determine the effectiveness of a multidisciplinary intervention and to assess which component of the intervention was most predictive of	Conducted in 19 units in a tertiary medical center in Lebanon (Sample size 486 inpatients surveyed over 16 months)	<p>Multi-model program Including:</p> <ol style="list-style-type: none"> <li>Braden scale assessment for patients admitted to study</li> <li>Pressure ulcer staging as per NPUAP-EPUAP guidelines</li> <li>Selection 20 Nurse champions to undertake training &amp; undergo competency assessment for PU prevention &amp; management</li> <li>Education program for all RN's on new protocols and policies</li> </ol>	<ul style="list-style-type: none"> <li>HAPU prevalence before &amp; after intervention</li> </ul>	<p>HAPU</p> <ul style="list-style-type: none"> <li>pre-implementation 6.63%</li> <li>Post implementation 2.47%</li> <li>Overall reduction significant p&lt;0.01</li> </ul> <p><b>This PU prevention program was effective in reducing the prevalence of HAPU's. Skin care and Braden scores were significant predictors of Pu's also. Further investigation into this area should be considered to support these strategies and reduce HAPU's.</b></p>	<ul style="list-style-type: none"> <li>Study was reliant on nursing documentation but there was no guarantee that this was actually applied to pt care</li> <li>Assessing incidence rather than rate may be a more accurate representation o the intervention effectiveness</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: Low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	decreasing Hospital Acquired Pressure ulcers (HAPU)		5. Introduction of electronic reporting system for PU (Quality indicator) Implementation of Prevention Bundle for HAPU			<ul style="list-style-type: none"> <li>Study was limited to 1 facility so cannot be generalized to other facilities</li> </ul>	
<b>Padula et al., 2015</b>	To evaluate the effectiveness of several quality improvement (QI) interventions associated with reduced hospital-acquired pressure ulcer (HAPU) rates	<p>55 academic medical centres in US (n= 5,208 pressure ulcers)</p> <p><b>Inclusion criteria:</b></p> <ul style="list-style-type: none"> <li>Patients ≥18 years</li> </ul> <p><b>Exclusion criteria:</b></p> <ul style="list-style-type: none"> <li>skin condition, pregnancy, hemiplegia, paraplegia, quadriplegia, spina bifida, brain damage, debridement or pedicle graft, stage I or II pressure ulcer</li> <li>transfer from other facility</li> </ul> <p><b>Participant characteristics:</b></p> <ul style="list-style-type: none"> <li>similar for all responding hospitals</li> </ul>	<p>Survey and analysis of clinical data collected from the online Clinical Data Base/Resource Manager (CDB/RM to determine correlations between pressure injury QI activities implemented between 2007 and 2012 to pressure injury reduction rate.</p>	<ul style="list-style-type: none"> <li>Quarterly inpatient data were obtained through online survey</li> <li>Certified Wound Ostomy Continence Nurses (CWOCNs) or other wound experts collected data</li> <li>NPUAP Staging system</li> <li>Follow up period: 2007-2012</li> </ul>	<p>Adoption of QI interventions in participating hospitals increased over the period of observation</p> <p><b>QI intervention association with PU</b></p> <ul style="list-style-type: none"> <li>Five QI interventions associated with clinically meaningful reduction in PI:                             <ul style="list-style-type: none"> <li>leadership initiative: ES 0.001</li> <li>visual tools ES 0.001</li> <li>HAPU staging ES 0.001</li> <li>skin care 0.0011</li> <li>nutrition 0.0011</li> </ul> </li> <li>No staff measures were clinically meaningful</li> <li>No IT interventions were clinically meaningful</li> </ul> <p><b>Reduction in Pressure Injuries</b></p> <p>The greatest reductions in PI rates occurred earlier in the adoption process (p &lt; .05).</p> <p><b>Author conclusion: QI interventions can be effective in implementing evidenced based protocols for the reduction of pressure injuries.</b></p>	<ul style="list-style-type: none"> <li>relied on recollection for QI Interventions dates</li> <li>time of effect of QI interventions could not be determined</li> <li>potential response bias</li> <li>data error risks</li> <li>HAPU rates following introduction of CMS policy were confounded by diagnostic coding procedure</li> <li>lack of incentive to code for HAPU</li> <li>use of quasi-experimental method for causal inference</li> <li>Effect size (<math>\alpha=.05</math>; Power = 0.8); eight hospitals required to adopt each QI intervention per quarter in order for performance of effect size analysis to be clinically meaningful.</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: Low</b></p>
Van Leen, Schols, Hovius, & Halfens, 2014	evaluate the clinical efficacy of the introduction of the 3-step PU prevention	<ul style="list-style-type: none"> <li>Clinical setting in one chain of nursing homes in Netherlands</li> <li>Inclusion:</li> </ul>	<p>Intervention Introduced 2005: PU protocol contains step up care:</p> <ul style="list-style-type: none"> <li>1: All patients receive a standard visco-elastic mattress, with no repositioning</li> </ul>	<ul style="list-style-type: none"> <li>prevalence of PUs,</li> <li>type of mattress, and repositioning were derived from LPZ</li> </ul>	<p><b>PU prevalence rate</b></p> <p>In the period since implementation of 3-step protocol, the PU prevalence rate significantly lower in the intervention nursing homes ( 0.5% in 2005 to 1.8% in 2011) and compared to overall national</p>	<ul style="list-style-type: none"> <li>prevalence study, no causal conclusions could be made.</li> <li>No information was available on whether</li> </ul>	<p><b>Level of evidence: 3</b></p> <p><b>Quality: Low</b></p>

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## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	protocol in nursing homes	<ul style="list-style-type: none"> <li>all patients at risk of PUs (Braden ≤ 20)</li> </ul> <p>Comparison cohort:</p> <ul style="list-style-type: none"> <li>All patients at risk of PUs in Dutch nursing homes who participated in annual LPZ survey</li> </ul> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>palliative care, short term rehabilitation, or LOS &lt;30 days.</li> </ul>	<ul style="list-style-type: none"> <li>2: patients who develop signs of category 1 PU receive static air overlay in addition, with no repositioning</li> <li>3: patients who still develop a PU are repositioned every 3 hours at day and 4 hours during the night.</li> <li>4. If 3-step protocol is insufficient because a patient develops a severe PU the mattress is swapped for low-air loss system</li> <li>Nursing staff trained and coached by a specialist wound nurse for 3 months.</li> </ul>	<p>survey from 2002 to 2011</p> <ul style="list-style-type: none"> <li>Overall cost was calculated using the mean price of a leasing contract for the seven most commonly used alternating mattress systems; the actual cost for the static air overlay mattresses was used.</li> </ul>	<p>nursing home sector (8.7% in 2005, <math>p &lt; 0.0195\%</math> CI 0.032 to 0.228 to 3.7% in 2011 <math>p=0.0195\%</math> CI 0.171-0.654 )</p> <p><b>Type of mattresses used</b></p> <ul style="list-style-type: none"> <li>In Dutch nursing homes about 20% of the patients received these alternating or static air additional mattresses for extra PU prevention. In intervention homes, 15.4% of the patients received these 2 types of mattresses (<math>P &lt; 0.001</math>).</li> </ul> <p><b>Author conclusions : 3-step prevention protocol resulted in a sustained reduction of the prevalence of PUs</b></p>	<p>specific prevention strategies were used by other Dutch nursing homes</p> <ul style="list-style-type: none"> <li>Unclear if repositioning was reduced</li> <li>Confounding factors not considered.</li> </ul>	
<b>K. R. Choi, Ragnoni, Bickman n, Saarinen , &amp; Gosselin, 2016</b>	Survey to identify nurse attitudes to PU prevention using a behavioral modeling approach	<p>Participants were recruited on a 10-bed cardiovascular ICU in the US (n=total nurses 33, n= 15 completed surveys)</p> <ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li>Survey</li> </ul>	<ul style="list-style-type: none"> <li>An 11-item questionnaire was developed to measure attitudes, perceived norms and personal agency using Likert scales (face validity was established, but no other measures of reliability or validity)</li> </ul>	<p><b>Nurse attitudes</b></p> <ul style="list-style-type: none"> <li>74% agreed or strongly agreed that patients were at risk of PU</li> <li>86% agreed or strongly agreed that PU prevention is a top priority</li> <li>(86% agreed or strongly agreed that PU prevention was not exclusively a nursing responsibility</li> </ul> <p><b>Nurse perceived norms</b></p> <ul style="list-style-type: none"> <li>100% agreed or strongly agreed that colleagues valued PU prevention</li> <li>33% neither agreed nor disagreed that there was a norm in the unit for evaluating PU risk</li> </ul> <p><b>Personal agency (barriers)</b></p> <ul style="list-style-type: none"> <li>Identified barriers included lack of time (35%), insufficient staff (20%), patients being too high acuity for PU interventions (25%), insufficient supplies/equipment (25%)</li> </ul> <p><b>Conclusions: the root cause of Pus was determined to be a) nurse attitude that they</b></p>	<ul style="list-style-type: none"> <li>No information on participants (e.g. knowledge and experience with PU care)</li> <li>No information on rates of PU</li> <li>Used a non-validated tool</li> <li>No information on recruitment strategy</li> </ul>	<p><b>Indirect evidence: PU not an outcome measure</b></p> <p><b>Quality: low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
					are not solely responsible for PU care, poor sense of personal agency in that nurses do not feel it is possible to prevent oPU and barriers to administering PU care.		
Olsho et al., 2014	Cohort study comparing intervention to a control group to identify impact of AHRQ's On-Time Pressure Ulcer Prevention program in Nursing Homes	<ul style="list-style-type: none"> <li>12 nursing homes in US (n= 3463 residents)</li> <li>Comparison group 13 nursing homes not including On-Time components (n= 2698 residents)</li> </ul> <p>Characteristics:</p> <ul style="list-style-type: none"> <li>Population demographics unclear</li> <li>Comparison group significantly higher rate of Pu at baseline</li> </ul>	<ul style="list-style-type: none"> <li>clinical decision support intervention from 5 reports embedded in IT systems</li> <li>Weekly reports profiling PU risks likely to change (e.g. nutrition, continence) at the patient level</li> <li>Reports:                             <ul style="list-style-type: none"> <li>Nutrition report (monitoring wt changes, decreased meal intake)</li> <li>Weight report</li> <li>Priority report (changes in meal intake, wt loss, incontinence, behavior, new/deteriorating PU's)</li> <li>Trigger report (monitors wt, incontinence, IDC use)</li> <li>Behavior report</li> </ul> </li> <li>Each resident observed before and after On-time component was introduced</li> </ul>	<ul style="list-style-type: none"> <li>PU incidence collected monthly for 12 months</li> </ul>	<p><b>Pressure injury incidence</b> Baseline: 4.6% in intervention facilities Incidence rate reduction implies a reduction in monthly incidence of 59% (2.6 PU's per resident)</p> <p><b>Impacts of On-Time program</b> Trigger report &amp; priority report associated with statistically significant Incidence Rate Ratio (IRR) IRR=0.409 P=0.035</p> <p><b>Outcome 3</b> Cost savings of a 2.6 reduction implies approximate savings of \$20,800 (US) per 100 residents</p> <p>Implementation of the quality improvement program using On-Time PU prevention program is associated with a reduction in PU incidence, implying significant improvements in health outcomes and substantial cost savings</p>	<ul style="list-style-type: none"> <li>Study was targeted at facilities with high baseline prevalence</li> <li>High level of missing data</li> <li>Purposively sampled facilities with high PU rate at baseline</li> </ul>	<p><b>Level of evidence: 3</b></p> <p><b>Quality: Low</b></p>
Beekman et al., 2013	Randomized controlled trial <b>investigating the effect of an electronic clinical decision support system in reducing PUs in an aged care setting</b>	<p>Nursing home wards in Belgium (n = 11 wards, n = 646 residents, n = 118 health care professionals)</p> <p>Resident characteristics: There was no significant difference between groups for basic demographic characteristics</p> <ul style="list-style-type: none"> <li>Approx 60% residents were at risk of PU</li> </ul>	<ul style="list-style-type: none"> <li>Wards were randomized to either the experimental group or control group.</li> <li>Experimental group: (n=6 wards, 225 residents, 65 professionals)</li> </ul> <p><b>Professional interventions</b></p> <ul style="list-style-type: none"> <li>Electronic decision support system</li> <li>Interactive education</li> <li>Monitoring and feed back</li> <li>Reminders</li> </ul>	<ul style="list-style-type: none"> <li>Validated PU Knowledge Assessment Tool assessing professional knowledge of PU prevention</li> <li>Attitude towards Pressure Ulcer tool to assess attitudes toward prevention</li> <li>Knowledge and attitudes was only collected at baseline</li> </ul>	<p><b>PU prevalence</b></p> <ul style="list-style-type: none"> <li>For PUs stage I to IV, there was a significantly lower PU prevalence in the experimental group compared with the control group at the end of the study (7.1% versus 14.6%)</li> <li>For PUs stage II to IV, there was no significant difference in PU prevalence between the experimental group compared with the control group at the end of the study (1.8% versus 2.1%)</li> </ul> <p><b>Knowledge of PU prevention</b></p>	<ul style="list-style-type: none"> <li>A possible Hawthorne-Effect</li> <li>A possible selection bias (drop out in the group of health care professionals due to additional workload)</li> <li>Not all healthcare workers were able to attend the educational activities</li> </ul>	<p><b>Level of evidence: 1</b></p> <p><b>Quality: high</b></p>



## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		<ul style="list-style-type: none"> <li>• &gt;60% were incontinent of urine</li> <li>• Almost 50% were &lt;55kgs</li> </ul> <p>Health care professional characteristics: There was no significant difference between groups for basic demographic characteristics</p> <ul style="list-style-type: none"> <li>• &gt;50% aged over 35 years</li> <li>• Between 40 to 50% were nurse assistants</li> <li>• About 10% were Bachelor Nurses</li> <li>• &gt;50% had more than 11 years' experience</li> </ul>	<ul style="list-style-type: none"> <li>○ Introduction of the key nurse role</li> </ul> <p><b>Organizational interventions</b></p> <ul style="list-style-type: none"> <li>○ Inventory, support on acquisition and support of organization of the delivery of PU preventive materials</li> </ul> <ul style="list-style-type: none"> <li>• Control group: (n=5 wards, 239 residents, 53 professionals) <ul style="list-style-type: none"> <li>○ Hard copy format pressure ulcer prevention protocol</li> </ul> </li> </ul> <p>No additional interventions</p>	<p>and 120 days after implementation</p> <ul style="list-style-type: none"> <li>• PUs prevalence and classification assessed according to</li> <li>• EPUAP/NPUAP Classification</li> <li>• Data was collected at baseline data and five times over 4 months.</li> </ul>	<ul style="list-style-type: none"> <li>• No significant difference was found between baseline and post test (F=1.98, p=0.16)</li> </ul> <p><b>Attitude towards PU</b></p> <ul style="list-style-type: none"> <li>• The experimental group had a significantly higher mean score after the intervention (83.5% versus 72.1%, F=15.12, p&lt;0.001)</li> </ul>		
Baldelli & Paciella, 2008	Quasi-experimental design	<ul style="list-style-type: none"> <li>• Organization-level in US medical center</li> <li>• Conducted in hospital (ICU medical-surgical unit)</li> </ul>	<p><b>Professional intervention</b></p> <ul style="list-style-type: none"> <li>• Pressure Ulcer Prevention Bundle: based on AHRQ and WOCN PU guidelines</li> <li>• 'Turn' clocks as visual reminder</li> <li>• Comprehensive PU education: 45 minute</li> <li>• Compliance: nurse manager responsible for compliance through education and staff reinforcement.</li> <li>• Bedside education/consultation from Certified wound ostomy continence nurses (CWOCN).</li> <li>• Clinical nurse specialist supervising CWOCNs</li> </ul> <p><b>Organizational intervention</b></p>	<ul style="list-style-type: none"> <li>• PU prevalence and incidence</li> <li>• PU prevalence/incidence: assessed by trained nurses</li> </ul>	<ul style="list-style-type: none"> <li>• Intervention vs control for PU prevalence in medical-surgical unit : 9% versus 15%</li> <li>• Intervention vs control for PU incidence in medical-surgical unit : 12% versus 7%</li> <li>• Intervention vs control for PU prevalence in ICU : 20% versus 20%</li> <li>• Intervention vs control for PU incidence in ICU: 3% versus 13%</li> </ul>	<ul style="list-style-type: none"> <li>• No comparison with control group (national benchmark numbers)</li> <li>• Hospital-level instead of patient level analysis.</li> <li>• Drop-out, missing data not reported.</li> <li>• No information on analysis. Descriptive no tests</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
			<ul style="list-style-type: none"> <li>Feedback: PU rates and unit specific rate are posted for staff</li> </ul>				
Milne, Trigilia, Houle, Delong, & Rosenblum, 2009	Quasi-experimental study investigating an <b>organization wide multi-faceted program to decrease PU prevalence</b>	Conducted in a 108-bed long-term acute care Hospital (LTACH) in US	<p><b>Professional intervention</b></p> <ul style="list-style-type: none"> <li>Formation of multi-disciplinary wound care team</li> <li>Wound Care specialty certification for key team members</li> <li>standard wound assessment documentation and internal reporting</li> <li>Staff education (content not described)</li> </ul> <p><b>Structural interventions</b></p> <ul style="list-style-type: none"> <li>Review of wound care products with development of prevention and treatment algorithms</li> <li>Revisions to electronic medical record to facilitate risk assessment; wound prevention, assessment and treatment documentation; and nurse care planning</li> </ul> <p><b>Organizational intervention</b></p> <ul style="list-style-type: none"> <li>Introduction of “guideline” – based pressure ulcer policies and procedure</li> </ul>	<ul style="list-style-type: none"> <li>Point prevalence of facility- acquired PU</li> <li>Monthly measurement pre-intervention (3 months pre intervention, 15 months post intervention)</li> </ul>	Reduction in the prevalence of facility-acquired pressure ulcers from 41% at baseline (pre-intervention) to an average of 4.2% during a 12 month follow up period.	<ul style="list-style-type: none"> <li>No demographic information about subjects</li> <li>No information about residents’ levels of risk.</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: low</b></p>
McInerney, 2008	Time series study investigating a <b>quality improvement initiative introduced</b>	<p>Conducted in 2 US acute care facilities (n=548 beds)</p> <p>Excluded paediatric, obstetric and mental health patients</p>	<p>Multifaceted interventions introduced over a 3 year period:</p> <p><b>Year 1</b></p> <ul style="list-style-type: none"> <li>electronic medical record to assess and document skin care needs</li> </ul>	<ul style="list-style-type: none"> <li>Prevalence of hospital-acquired pressure ulcers.</li> <li>Prevalence of hospital-acquired heel ulcers</li> <li>Prevalence measured every 6 months for 4.5 years.</li> </ul>	<ul style="list-style-type: none"> <li>Pre-intervention prevalence of hospital-acquired pressure ulcers was 12.8% which dropped to 5.1% within 18 months of intervention (Year 1), but still more than 50% of ulcers were heel ulcers.</li> <li>With additional interventions (Years 2, 3) hospital-acquired prevalence rate decreased to 2.0% with no hospital-</li> </ul>	<ul style="list-style-type: none"> <li>Potential Hawthorne effect for Year 1 interventions</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	over a three year period		<ul style="list-style-type: none"> <li>Automatic, electronic consults to the (WOC nurse based on Braden Scale less than 13 (tallied from documentation in the electronic medical record and routed electronically)</li> <li>WOC nurse –generated, evidence-based pressure care</li> <li>Static overlay ordered for every patient with a Braden Score less than 16.</li> <li>hiring another WOC nurse</li> </ul> <p><b>Year 2</b></p> <ul style="list-style-type: none"> <li>Protocol introduced for application of heel protective, one-size-fits-all boot to all patients with end-stage renal disease and all ventilator patients.</li> </ul> <p><b>Year 3</b></p> <ul style="list-style-type: none"> <li>Powered air beds with continuous rotation purchased for most critical care beds.</li> <li>New pressure-reducing mattresses purchased for other (non-critical) hospital beds.</li> </ul>		acquired heel ulcers in July 2005, and 0.7% heel ulcers in July 2006.		
Bales & Duvendack, 2011; Bales & Padwojski, 2009	Quasi-experimental design pre-test/post-test)	Organization-level with no control group <ul style="list-style-type: none"> <li>Conducted in community hospital</li> </ul>	<p><b>Professional intervention</b></p> <ul style="list-style-type: none"> <li>NDNQI training of unit-based ‘champions’ on PU assessment and prevention (2004-2008)</li> <li>Mandatory education sessions (2007-2008)</li> <li>Computer tool for assessment and initial PU care developed by the CWOCN to provide 24-hours support (2007-2008)</li> <li>Music tune reminded the nurses every two hours to turn</li> </ul>	PU prevalence assessed by trained nurses	<p><b>From Bales et al, 2008</b></p> <p>HAPU prevalence</p> <ul style="list-style-type: none"> <li>2004 : 12%</li> <li>2005: 4%</li> <li>Aug 2007: 9.5%</li> <li>Feb 2008 : 4.2%</li> <li>May 2008 : 2.6%</li> <li>Sept 2008: 1.36%</li> <li>Dec 2008 : 0%</li> </ul> <p><b>From Bales et al, 2011</b></p>	<ul style="list-style-type: none"> <li>Historical group</li> <li>Hospital-level instead of patient level analysis.</li> <li>Drop-out, missing data not reported.</li> <li>No information on analysis. Descriptive no tests.</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
			<p>and toilet patients. (March 2008)</p> <ul style="list-style-type: none"> <li>• Skin assessments for patients at risk on admission to emergency department (March 2008)</li> <li>• CWOCN part-time (2004-2007), fulltime (2007-2008); ongoing daily monitoring and evaluation (documentation and measurements) by CWOCN (February 2008)</li> <li>• Evidence based algorithm on PU prevention for surgical unit (August 2008)</li> </ul> <p><b>Organizational intervention</b></p> <ul style="list-style-type: none"> <li>• 'Zero HAPU campaign' flyers (June 2008)</li> <li>• Zero HAPU campaign': staff received a small reward in recognition (June 2008)</li> <li>• Purchase of PU redistributing beds (March 2008)</li> </ul>		<p>HAPU incidence</p> <ul style="list-style-type: none"> <li>• 2008: 77</li> <li>• 2009: 28</li> <li>• 2010: 14</li> <li>• 2011: 0</li> </ul> <p><b>Study conclusions: Staff training had an initial impact on HAPU prevalence. Focus on skin assessments, reminders for repositioning and a nurse responsible for care planning lead to sustained PU prevalence reduction. Financial incentives and purchase of appropriate support surfaces further reduced PU prevalence.</b></p>		
Tippet, 2009	Prospective quasi-experimental	<p>Single nursing home in US</p> <p>Facility characteristics:</p> <ul style="list-style-type: none"> <li>• Average bed census was 137 per month</li> </ul>	<p><b>Professional intervention</b></p> <ul style="list-style-type: none"> <li>• Mandatory staff education: wound fundamentals, Braden scale, wound assessment, treatment, prevention, support surfaces</li> <li>• Evaluate support surface equipment for pressure management</li> </ul> <p><b>Organizational intervention</b></p> <ul style="list-style-type: none"> <li>• Formation of interdisciplinary leadership team</li> <li>• Development of protocols for prevention and treatment</li> <li>• Simplified wound care formulary</li> </ul>	<ul style="list-style-type: none"> <li>• PU incidence and prevalence tracked monthly for 2 years pre-intervention and 4 years post-intervention.</li> <li>• PUs were identified as facility-acquired or present on admission. All PUs classified according to NPUAP guidelines.</li> </ul>	<p><b>PU prevalence</b></p> <ul style="list-style-type: none"> <li>• There was a significant 86% reduction in PU incidence reduction (<math>p &lt; 0.0001</math>) and a greater than 99% PU prevalence reduction</li> <li>• Pre-initiative average monthly PU incidence 5.18%</li> <li>• Post-initiative average monthly PU incidence 0.73% (sustained for 4 years)</li> </ul> <p><b>Financial cost benefit analysis</b></p> <ul style="list-style-type: none"> <li>• Costs included \$27,200 for contract wound consultant, \$11,000 equipment</li> <li>• \$488,000 estimated care savings in reduced PU including \$9,600 savings on skin care products</li> </ul>	<ul style="list-style-type: none"> <li>• Single facility, no randomization, no blinding, no control group or control intervention.</li> <li>• PU identification method not reported</li> <li>• Characteristics of residents and facility were not provided in detail</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: moderate</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
Rantz et al., 2012	Prospective Randomized clinical trial <b>investigating the effect of management support of change in conjunction with research nurse support in reducing PU prevalence</b>	<p>The study was conducted in nursing homes in one US state.</p> <p>Intervention group characteristics:</p> <ul style="list-style-type: none"> <li>• Bed range 36 to 300</li> <li>• 16/29 member of chain</li> <li>• 20/29 for profit</li> <li>• 150% turnover of DON during study</li> <li>• 28% turnover of nursing home administrators during study period</li> </ul> <p>Control group characteristics:</p> <ul style="list-style-type: none"> <li>• Bed range 52 to 246</li> <li>• 15/29 member of chain</li> <li>• 19/29 for profit</li> <li>• 100% turnover of DON during study</li> <li>• 72% turnover of NHA during study period</li> </ul>	<p><b>Professional intervention</b></p> <ul style="list-style-type: none"> <li>• The intervention group (n=29) received the intervention that consisted of: <ul style="list-style-type: none"> <li>○ On site consultations with a research nurse</li> <li>○ Management support of change</li> <li>○ Promotion of team decision making</li> <li>○ Focus efforts of direct care staff on a QI program promoting general care including prevention of skin breakdown.</li> </ul> </li> <li>• The control group (n=29) received: <ul style="list-style-type: none"> <li>○ Monthly videotaped in services and reading materials not directly related to quality improvement strategies and a monthly visit to answer questions regarding educational material</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Outcome of interest to this review was pressure ulcer prevalence as reported on MDS reported quarterly</li> <li>• Follow up period 24months</li> </ul>	<ul style="list-style-type: none"> <li>• The only significant effect on resident outcomes was a reduction in PUs in the intervention group over time (p=0.05)</li> <li>• Odds ratio 1.23 (95% CI 1.00 to 1.51)</li> <li>• There was a cost to facilities with more than 100% staff turnover but this was not significantly greater than the control facilities.</li> <li>• The intervention group had a 9% increase in LPN staffing costs (significance not reported)</li> </ul> <p><b>Conclusion: Program had minimal effect</b></p>	<p>Regression analysis was used to present result findings but the coded table was not labelled for interpretation Very difficult to ascertain magnitude of the intervention result.</p>	<p><b>Level of evidence: 1</b></p> <p><b>Quality: moderate</b></p>
Rantz et al., 2009	Prospective quasi-experiment <b>investigating the effectiveness of providing support in MDS and quality indicator reporting and evidence</b>	<p>All nursing homes in one US state were considered as participants.</p> <ul style="list-style-type: none"> <li>• Group 1: at risk facilities (those identified as having poor QIs) who accepted at least one onsite consultation (n=60)</li> <li>• Group 2: at risk facilities refusing</li> </ul>	<p><b>Professional intervention</b></p> <ul style="list-style-type: none"> <li>• On site consultations with trained post-graduate gerontological nurse providing support and education on use of MDS and quality indicator reporting, evidence based practice and team development. The intervention was not specific to PU management.</li> </ul>	<ul style="list-style-type: none"> <li>• Primary outcomes were indicators of facility quality including stage 1 to 4 pressure ulcers as reported on MDS</li> <li>• Quarterly reporting for 12 months</li> <li>• Other outcomes included falls, depression, use of 9 or more medications, bladder or bowel</li> </ul>	<p>At risk facilities who received consultation (group 1):</p> <ul style="list-style-type: none"> <li>• 22% reduction in PU prevalence overall</li> <li>• 12% reduction in PUs in high risk patients</li> <li>• 41% reduction in bedfast residents</li> <li>• 4% reduction in weight loss</li> </ul> <p>At risk facilities who did not receive consultations (Group 2):</p> <ul style="list-style-type: none"> <li>• 3% increase PU in PU prevalence overall</li> <li>• 11% increase in PUs in high risk patients</li> <li>• 4% increase weight loss</li> </ul>	<p>No random facility assignment Dose of treatment not controlled Level of outcome metrics not similar in groups at baseline Unclear if intervention was effective as facilities who were not at risk had particularly bad outcomes when</p>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	<b>based practice on a variety of resident outcomes including PU prevalence in aged care</b>	<p>onsite consultations (n=32)</p> <ul style="list-style-type: none"> <li>Group 3: non-at-risk facilities accepting at least one onsite consultation (n=129)</li> <li>Group 4: non-at-risk facilities refusing onsite consultations (n=271)</li> </ul> <p>Facility characteristics:</p> <ul style="list-style-type: none"> <li>Average bed size 110</li> <li>71% for profit facilities</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing support from consultant via email and phone.</li> <li>Opportunity for MDS coordinators to network at inter-facility support nights.</li> </ul>	<p>incontinence, urinary tract infection, weight loss, dehydration, bedfast residents, decline in late-loss activities of daily living, and physical restraints</p>	<ul style="list-style-type: none"> <li>35% increase bedfast residents</li> </ul> <p>Non-at risk facilities receiving consultation (Group 3):</p> <ul style="list-style-type: none"> <li>12% increase PU in PU prevalence overall</li> <li>14% increase in PUs in high risk patients</li> <li>29% increase weight loss</li> <li>26% increase bedfast residents</li> </ul>	<p>they engaged in support intervention</p> <ul style="list-style-type: none"> <li></li> </ul>	
Horn et al., 2010	Quasi-experiment interrupted time-series investigating effects of <b>standardized nurse aide documentation and feedback reports on prevalence of facility-acquired PU</b>	Conducted in 11 US long term facilities	<p><b>Professional intervention</b></p> <ul style="list-style-type: none"> <li>Introduction of a standardized documentation form for nurse assistants with highlighted observational triggers (alerting to increased pressure ulcer risk).</li> </ul> <p><b>Organizational interventions</b></p> <ul style="list-style-type: none"> <li>Computer-generated weekly reports (based on NAs documentation) to alert LTC teams to identify:                             <ul style="list-style-type: none"> <li>Completeness of documentation</li> <li>patients with nutrition risk</li> <li>patients with high-risk triggers for pressure ulcer</li> <li>patients with abnormal skin observations</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Multiple measures to evaluate uptake of new documentation system and use of reports.</li> </ul> <p>Principle outcome for patients was facility-acquired pressure ulcers averaged across facilities.</p>	Across facilities (8 out of 10) average facility-acquired PU prevalence decreased by 62% from 12.1% pre-implementation to 4.6% post-implementation.	<ul style="list-style-type: none"> <li>Selection of facilities</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: moderate</b></p>
Boesch et al., 2012	Qualitative Plan Do Study Act (PDSA) investigating a multi-faceted intervention in reducing	<p>Conducted in a academic children's hospital in the US (490 beds)</p> <p>Results included 834 tracheostomy patients</p>	<p><b>Professional intervention</b></p> <p>PDSA cycle frame to implement a bundle that included:</p> <ul style="list-style-type: none"> <li>Pressure ulcer risk (Braden scale) and skin assessment</li> <li>Moisture free device interface</li> </ul>	TPRU rate	<p><b>Mean TRPU rate</b></p> <ul style="list-style-type: none"> <li>Pre-intervention ranged from approx. 3.8% to 16% over 6 months (mean rate 8.1%)</li> <li>During bundle development and implementation ranged from 0% to 12% over 12 months (mean rate 2.6%)</li> </ul>	<ul style="list-style-type: none"> <li>The study is limited to a single hospital unit design and was not a randomized controlled trial</li> </ul>	<p><b>Level of evidence: 2</b></p> <p><b>Quality: moderate</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	tracheostomy-related pressure ulcers (TRPU) in children	and 10,132 tracheostomy patient days.  Patient characteristics: <ul style="list-style-type: none"> <li>• Mean age 2yr 8 mo</li> <li>• 87% ventilator dependent</li> </ul>	<ul style="list-style-type: none"> <li>• Pressure free device interface</li> <li>• Hydrophilic polyurethane foam dressing (Mepilex Lite®) used under tracheostomy tube to wick the moisture away from the stoma and skin surface</li> <li>• Use of extended tracheostomy tube design</li> <li>• Online education on risk and skin assessment for all nurses</li> </ul> <b>Organizational intervention</b> <ul style="list-style-type: none"> <li>• Patient information brochures</li> <li>• Engagement with tracheostomy tube manufacturer to develop and deliver extended tracheostomy tube design</li> <li>• Real time reporting of TRPU</li> </ul> Incorporation of TRPU interventions into electronic record nursing workflow		<ul style="list-style-type: none"> <li>• Post-intervention ranged from 0% to 3% over 10 months (mean 0.3%)</li> <li>• Statistical analysis on effect of extended tracheostomy tube design found a significant reduction in number of TPRUs (p=0.007) and number of days with TRPU (p&lt;0.0001)</li> </ul>	<ul style="list-style-type: none"> <li>• Measurement periods were different for pre-during and post-intervention which influences mean rates</li> <li>•</li> </ul>	
<b>Observational studies</b>							
Hall & Ryan, 2015	Prevalence survey and QI project <b>investigating the effectiveness of a mattress selection matrix in reducing PUs and cost-associated with care</b>	Data was collected at one UK Hospital Trust over a 3 year period month period.  Selection of informants for surveys was not reported. Participant characteristics (either unit or patient level) were not provided. <ul style="list-style-type: none"> <li>•</li> </ul>	Initial surveys on patterns of use and selection choice for dynamic mattresses.  Based on survey findings the Trust established a new contract with a mattress provider that included: <ul style="list-style-type: none"> <li>• Fast delivery of dynamic mattress/chairs</li> <li>• 22 hours/7 days a week access</li> <li>• Partnership with contractor to ensure the Trust processes were followed</li> <li>• New type of dynamic mattress provided to the hospital</li> </ul>	<ul style="list-style-type: none"> <li>• Hospital acquired PUs/month (unstated how these were defined or identified)</li> <li>• Total days rental of dynamic mattress/month</li> </ul>	<ul style="list-style-type: none"> <li>• Hospital acquired PUs reduced steadily from 30-42 in April-June 2012 to 5-6 in May-June 2015.</li> <li>• Total hours rental of dynamic mattress decreased from a peak of 13,000 in Jan-Feb 2014 to 6,500 to 7,000 in May-June 2015. An immediate, large reduction was observed in the month following introduction of the matrix, and the reduction remained sustained over 12 months.</li> </ul> Study conclusions:	<ul style="list-style-type: none"> <li>• No statistical analysis was presented.</li> <li>• Description of new mattress not provided</li> </ul>	<b>Level of evidence: 4</b>  <b>Quality: Low</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
			In addition a SSKIN bundle was introduced: <ul style="list-style-type: none"> <li>SSKIN tools used that prompted staff to consider other pressure prevention strategies</li> <li>Matrix for selection of mattresses developed</li> <li>Dedicated call center within the hospital for approval of dynamic mattresses/chairs</li> </ul>				
<b>Lewis et al., 2017</b>	Cross sectional prevalence study exploring intervention designed to reduce numbers of hospital-acquired pressure injuries was delivered in Counties Manukau Health hospitals.	<ul style="list-style-type: none"> <li>Monthly audits conducted in 5 randomly chosen patients per ward in all hospitals in one county in New Zealand (n ranged from 2,057 to 2,375 across years)</li> <li>Inclusion criteria not reported</li> <li>Exclusion criteria not reported</li> <li>Participant characteristics not reported</li> </ul>	<ul style="list-style-type: none"> <li>Nurse champions provided education, website, e-learning packages and patient information leaflets</li> <li>Review of pressure injury rental equipment</li> <li>Streamlined pressure-relieving equipment decision tree</li> <li>Improved documentation</li> <li>Education packages, ward resource folders, a pressure injury website, e-learning packages and patient information leaflets</li> </ul>	<ul style="list-style-type: none"> <li>Regular monitoring of pressure injury prevalence</li> <li>Audit years 2011 to 2015</li> </ul>	<p><b>pressure injury prevalence</b></p> <p>Category/stage I decreased from 4.86% to 1.36%</p> <p>Category/stage II decreased from 1.49% to 1.23%</p> <p>Category/stage III decreased from 0.38% to 0.13%</p> <p>Category/stage IV decreased from 0.19% to 0%</p> <p><b>Overall costs</b></p> <p>declined from approx. \$26.5 million in 2011 to approx. \$14.2 million in 2015</p>	<ul style="list-style-type: none"> <li>Randomly selected 5 patients per ward, participant characteristics not reported and prevalence rates may not be reflective</li> <li>No statistical analysis</li> <li>No ethics discussed</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>
<b>Richardson, Peart, Wright, &amp; McCullagh, 2017</b>	To reduce the incidence pressure injuries using an evidence based bundle approach	<p>Conducted in four ICUs and HDUs in an NHS hospital in UK over 4 years (n=21,182 patients)</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> <li>All patients admitted to the critical care units</li> </ul>	<p>Implementation and appraisal of technical and non-technical interventions including:</p> <p>evidence appraisals</p> <p>changes to mattresses</p> <p>focussed risk assessment</p> <p>mandating patients at very high risk to be repositioned two hourly</p> <p>staff training to increase awareness</p>	<ul style="list-style-type: none"> <li>Pressure ulcer incidence was measured using DATIX – local incident management system. Leadership by nurse consultant critical care and pressure ulcer task group</li> </ul> <p>4 years followup</p>	<p><b>Outcome 1: Pressure ulcer incidence</b></p> <p>The incidence of pressure ulcers reduced from 8.08/100 patient admissions to 2.97/100 patient admissions. RR of 63% over 4 years with the greatest reduction in stage IV and unstageable pressure injuries.</p> <p>There was an estimated average cost saving of 2.6 million pounds.</p> <p><b>Author conclusions: Over the 4 year period the implemented bundle of interventions</b></p>	<ul style="list-style-type: none"> <li></li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>



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Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
<b>Young, Borris-Hale, Falconio-West, &amp; Chakravathy, 2014</b>	To explore the impact of the Medline pressure ulcer prevention program in one long term care facility	<ul style="list-style-type: none"> <li>One long term care facility in US (n=82 beds, average census was 60 residents with average length of stay 25 days)</li> </ul> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> <li>Resident of the participating LTC facility</li> <li>Participant characteristics:</li> <li>80% of residents had a wound of varying etiologies on admission</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>staff education via web-based education portal</li> <li>free online program, includes pre and post tests</li> <li>Clinical staff training was done for nurses and patient care technicians</li> <li>84 nurses receiving 7.5 hours of in-servicing and 41 patient care technicians receiving 5.5 hours in-servicing.</li> <li>Two clinicians comprising the facility "wound care team" that each spent 4 hours to implement the changes</li> <li>A wound care team was developed, triggers were put into place to highlight when the wound care team</li> <li>Triggers for team assessment:</li> <li>Braden score below 15</li> <li>High or low weight</li> <li>Impaired nutritional status</li> <li>Impaired mobility</li> <li>Incontinence</li> <li>Physicians order for specialty bed</li> </ul>	Medline representatives visited the facility to consult with administration and the wound team to identify products that would align with program goals Monitoring of pressure ulcer prevalence, wound care assessment requests, infections, labor costs of implementing the program	<p><b>Pressure injuries</b> significant reduction when comparing preprogram (mean monthly = 5.9, SD = 2.56) to post program (mean monthly = 0.2, SD = 0.422, p &lt; .0005)</p> <p><b>Care processes</b> No statistical differences in:</p> <ul style="list-style-type: none"> <li>number wound care team assessments</li> <li>number wound care team assessments completed within 72 hours</li> <li>total number of pressure ulcers,</li> <li>number of debridements</li> <li>the total number of wounds that healed during a patients admission</li> </ul> <p><b>Costs</b> The total estimated labor cost of implementation included the time of training and administration at this facility ( \$27,019). Labor costs for implementation average salary (\$25,207)</p>	<ul style="list-style-type: none"> <li>Potential bias as the study was sole sponsored by one company and the company was heavily involved in the study</li> <li>Prior to the study the LTC facility had no formal pressure ulcer prevention program</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>
<b>Tzeng, Grandy, &amp; Yin, 2013</b>	Observations study investigating relationship between nurse response to call lights and	<p>Nine adult noncritical wards in US using data over 2.5 years</p> <p>Characteristics:</p> <ul style="list-style-type: none"> <li>Primarily RN and nursing assistant staffing</li> </ul>	<ul style="list-style-type: none"> <li>Analyzed 207 unit months</li> </ul>	Call light response measured as a proxy for quality of care (taken from database) PU rate abstracted from NDNQI reports	<p><b>Pressure ulcer rates</b> Average Category/Stage II 0.79% (SD 1.83) Across the unit types (medical, surgical, med-surg) there was a significant difference in PU rates (p=0.004)</p> <p><b>Call rate response</b></p>	<ul style="list-style-type: none"> <li>Assumption was that when nurses respond to call lights they also assess pressure injury risk and use preventive strategies</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>

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Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	hospital acquired pressure injuries				<p>Average Staff response time 54.78 (range 10 -fastest to 100 slowest) Mean response time fell between 3.57 mins and 4.23 mins</p> <p><b>Correlation</b> Moderate positive correlation between PU and call light response <math>r=0.229</math>, <math>p=0.001</math></p>	<ul style="list-style-type: none"> <li>• Unequal distribution of PU across unit may influence analysis</li> <li>• No evidence improving response time would decrease PU</li> </ul>	
<b>Peterson et al., 2015</b>	To reduce the incidence of pressure ulcers in a 232-bed, freestanding children's hospital in Western United States.	<ul style="list-style-type: none"> <li>• 232-bed, children's hospital in USA</li> <li>• participant characteristics, nursing unit characteristics and nurse staffing characteristics not described</li> </ul>	<ul style="list-style-type: none"> <li>• Intervention was developed by a taskforce and a PI team and included:                             <ul style="list-style-type: none"> <li>• staff education</li> <li>• documentation changes in EMR</li> <li>• developed hospital-acquired pressure ulcer staging and treatment algorithms</li> <li>• Evidence-based policies incorporating additional risk factors</li> <li>• added tracheostomy specialty nurse to team and initiated practice change re trach site care</li> <li>• daily rounding by tracheostomy specialty nurse,</li> <li>• respiratory care practitioner added to team and initiated practice change re respiratory device preventative care</li> <li>• staff education re respiratory devices</li> <li>• weekly skin rounds on the cardiovascular intensive care unit,</li> <li>• evaluated Z-flo devices and added mattress overlays for neonate's and high risk cardiac surgical patients</li> </ul> </li> </ul>	Sustained reduction in pressure ulcer incidence	<p><b>Pressure injury incidence</b></p> <ul style="list-style-type: none"> <li>• Reduction in pressure ulcer incidence from 3.3 per 1000 patient days in the first quarter of 2010 to 1.7 per 1000 patient days in the second quarter of 2014.</li> <li>• Reportable pressure ulcers reduced by 60% from 2010-2013.</li> </ul>	<ul style="list-style-type: none"> <li>• Indirect evidence</li> <li>• Hospital-level instead of patient-level analysis</li> <li>• Drop out, missing data not reported</li> <li>• Patient characteristics and case mix not described nor taken into consideration</li> <li>• No information on level of risk</li> <li>• Nursing unit and staffing characteristics unknown</li> <li>• Does not consider the:                             <ul style="list-style-type: none"> <li>○ Staff knowledge and attitudes related to pressure injury prevention and management</li> <li>○ Working conditions and workplace culture</li> <li>○ Other time-variant characteristics, e.g., leadership change</li> </ul> </li> <li>• No information on analysis. Descriptive no tests.</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	Level of evidence: 4
Jull, McCall, Chappell, & Tobin, 2016	Observational study <b>testing new methodology to estimate annual prevalence while evaluating QI bundle</b>	<ul style="list-style-type: none"> <li>A cross section prevalence survey conducted in one region of New Zealand using a new prevalence estimate methodology requiring monthly audits. Auditing was conducted for 3 years on a monthly basis</li> <li>Sample size included 2,710 random patients for 2012-2013, 2,745 random patients for 2013-2014 and 2,819 random patients for 2014-2015</li> </ul> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> <li>In hospital on the monthly census night</li> <li>Not in an acute mental health unit, emergency department or delivery suite</li> <li>Includes pediatric wards</li> </ul>	<ul style="list-style-type: none"> <li>QI improvement project was introduced in Year 2, with each stage of intervention introduced gradually on each unit</li> <li>Project included use of A+ SKINE acronym that promote for risk assessment, support surface, keep repositioning, incontinence management, nutrition assessment, family education</li> <li>System of assigning advanced support surfaces was streamlined and allowed central pool staff to initiate support surface rental when required</li> <li>All Category/Stage 3 and 4 PUs were considered a serious event and required root cause analysis, case presentation to Adverse Events review Committee and reporting to the national quality and safety commission</li> </ul>	<ul style="list-style-type: none"> <li>A random sample of patients was generated one/month at midnight ensuring that each unit had 3-14 patients include (depending on unit size)</li> <li>In each unit the randomly selected patients received a skin assessment on the morning of the monthly audit</li> <li>Standardized audit tool used to record skin assessment results</li> <li>Used EPUAP Staging system</li> <li>All Category/Stage 1 PUs were categorized as HAPU</li> <li>All PUs not documented on patient admission were considered to be hospital acquired</li> </ul>	<p><b>HAPU prevalence rate</b></p> <ul style="list-style-type: none"> <li>Average over 3 years :6.3% (95% CI 5.7% to 6.8%)</li> <li>Year 1: 7.9% (95% CI 7.1 to 8.8%)</li> <li>Year 2: 4.8% (95% CI 4.2 to 5.4%)</li> <li>Year 3: 5.6% (95% CI 4.7% to 6.4%)</li> </ul> <p><b>Category/Stage</b> Majority were Category/Stage 1 or 2 PUs</p> <ul style="list-style-type: none"> <li>Year 1: 96.9%</li> <li>Year 2: 98.7%</li> <li>Year 3: 98.5%</li> </ul> <p><b>Anatomical location</b></p> <ul style="list-style-type: none"> <li>sacrum 34.7%</li> <li>heel 20.4%</li> <li>ankle 7.5% elbow 7.1% nose 6.4%</li> <li>ear 4.7%</li> </ul>	<ul style="list-style-type: none"> <li>Sample size was calculated to determine the number of patients required in a monthly audit to provide an accurate annual PU prevalence rate (n=2,880 across the units involved)</li> </ul>	<b>Quality: high</b>
Smith, Ashby, Thomas, & Williams, 2017	To compare the changes in the prevalence of pressure injuries from 2008 to 2014 in relation to staff behavior	<p>Acute/subacute inpatient care in Australia (n=3 937 participants)</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> <li>age 18+ ;</li> <li>verbally consenting</li> <li>acute/subacute beds</li> </ul> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>pediatrics, obstetrics psychiatric units,</li> </ul>	<p>HNELHD Pressure Ulcer Prevention Program's Crystal Model</p> <p>e-learning courses changes in policy for best practice surveillance to provide evidence of PI prevention strategies equipment for PI prevention and management (i.e. provision of</p>	<ul style="list-style-type: none"> <li>Point prevalence surveys of pressure injuries from data collected in 2008 (n=1407), 2010 (n=1331) &amp; 2014 (n=1199)</li> <li>NPUAP Staging system</li> </ul>	<p><b>Prevalence of PI on admission</b> 2008 (n=414): Prevalence of PI – 16.4% 2010 (n=173): Prevalence of PI – 38.7% 2014 (n=130): Prevalence of PI – 36.2%</p> <p><b>Incidence of HAPU</b> 2008 Incidence of PI – 79.5% 2010: Incidence of PI – 61.3% 2014: Incidence of PI – 63.8%</p> <p>Documentation</p>	<ul style="list-style-type: none"> <li>absence of psychometric testing for the survey tool;</li> <li>poor statistical analysis</li> <li>survey restricted to regional area of Australia</li> <li>important results' data only</li> </ul>	<b>Quality: low</b>

## Implementing Best Practice : Data extraction and appraisals

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		operating theatres and undergoing day surgery <ul style="list-style-type: none"> <li>Participant characteristics: Primarily 80-89 and 70-79 years old</li> </ul>	pressure-relieving equipment/device PI prevention assessments wound management to achieve best practice communication to facilitate improvements translation of evidence into practice is reviewed annually		In 2008 17.2% had no documented risk assessment, increased to 19.4% in 2010, 15.7% in 2014 In 2008 74% had no documented repositioning, decreased to 16.5% in 2010, 26% in 2014 Care In 2008, 599% had pressure relieving equipment, decreased to 39.1% in 2010 and 44% in 2014 <b>Author conclusions: a multifactorial model for PI prevention and management appears to reduce the prevalence of PI in inpatient settings.</b>	presented in figures or tables <ul style="list-style-type: none"> <li>Relation between intervention and outcomes not clearly demonstrated</li> <li>Facilities only surveyed 75% of patients, unclear how selections made</li> </ul>	
R. Baier, Butterfield, Patry, Harris, & Gravenstein, 2009; R. R. Baier, Butterfield, Harris, & Gravenstein, 2008	Observational study	<ul style="list-style-type: none"> <li>Organization-level with no control group</li> <li>Conducted in nursing homes</li> </ul>	<b>Structural intervention</b> <ul style="list-style-type: none"> <li>Launch of a website to help nursing homes select performance goals/targets on four outcomes (pressure ulcers, restraints, pain and depression) which allows comparison between peers</li> <li>Quality Improvement Organization (QIO) support (no further information) for a 15% of the nursing homes</li> </ul>	<ul style="list-style-type: none"> <li>Evaluate relative improvements among nursing homes for PU quality measures in high-risk residents</li> <li>PU prevalence assessed with Minimal Data Set (MDS)</li> <li>Relative improvement: 4-quarter average for baseline (target set) and re-measurement (target expired)</li> <li>Nursing home characteristics: Online Survey, Certification and Report (OSCAR) database</li> </ul>	<ul style="list-style-type: none"> <li>Comparison nursing homes which set PU targets and nursing homes which did not set PU targets for relative improvement: 7.0% versus 5.9%; p=0.0004</li> <li>Comparison nursing homes which set PU targets and nursing homes which did not set PU targets for absolute improvement: 0.9% versus 0.8%; p=0.0442</li> <li>Faculty size and relative/absolute improvement for PU: facility size did not affect previously mentioned trend</li> <li>Membership in a multi-facility corporation and relative/absolute improvement for PU: membership in a multi-facility corporation did not affect previously mentioned trend</li> <li>QIO nursing homes and improvement for PU: improvement was independent of QIO program.</li> <li>Non-QIO nursing homes: comparison nursing homes which set PU targets and nursing homes which did not set PU targets for relative improvement: 7.4% versus 6.0%; p&lt;0.0001</li> </ul>	<ul style="list-style-type: none"> <li>Historical group</li> <li>Nursing home-level instead of patient level analysis</li> <li>Drop-out, missing data not reported.</li> <li>Standardization, reliability, validity of measurement unclear.</li> </ul>	<b>Level of evidence: 4</b> <b>Quality: low</b>

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Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	Level of evidence: Quality:
Asimus, Maclellan, & Li, 2011	Observational study	41 Australian inpatient services in one region of Australia <ul style="list-style-type: none"> <li>Organization-level with no control group</li> <li>Conducted in hospital</li> </ul>	<p><b>Professional intervention</b></p> <ul style="list-style-type: none"> <li>Provision of algorithm to guide clinicians in the appropriate selection of equipment (e.g. renting dynamic bed surfaces)</li> <li>Review of surfaces available and access</li> <li>Educational online program (understanding and staging PU, risk assessment, prevention plans)</li> <li>Successful completion recorded on staff record</li> <li>Review of equipment</li> </ul> <p><b>Structural intervention</b></p> <ul style="list-style-type: none"> <li>Replacement of vinyl-covered mattresses with superior high-density foam mattress (scheduled systematic replacement)</li> </ul>	<ul style="list-style-type: none"> <li><b>Evaluate the effectiveness of policy implementation</b></li> <li><b>Identify cost-effective strategies</b></li> <li><b>Pressure Ulcer (PU) prevalence:</b> survey tool</li> <li><b>PU risk assessment:</b> Waterlow risk assessment tool</li> <li><b>Use of risk assessment tool and timing:</b> survey tool</li> </ul>	<ul style="list-style-type: none"> <li>Prevalence PU rate: 29.4% 2008; 23.8% 2009; 13.0% 2010</li> <li>Prevalence HAPUs: 23.4% 2008; 17.2% 2009; 8.0% 2010</li> <li>Number stage III and IV PUs: 14.9% 2008; 13.9% 2010</li> <li>Prevalence PU rate after mattress replacement: significant reduction in hospital-acquired PUs</li> <li>Compliance to risk assessment: 78.9% 2008; 79.2% 2009; 86.8% 2010</li> <li>Prescription of appropriate PU relieving devices: 44% 2008; 71.5% 2009; 90.9% 2010</li> <li>Cost saving related to appropriate PU relieving devices: AUD 500 000 (first year)</li> </ul> <p><b>Study conclusion: Introduction of high specification foam mattress, a decision algorithm for support surface selection and staff education was related to increased risk assessments, appropriate PU support surface selection and sustained reduction in PU prevalence</b></p>	<ul style="list-style-type: none"> <li>Historical control</li> <li>Hospital-level instead of patient level analysis</li> <li>Drop-out, missing data not reported. No information on analysis. Descriptive no tests</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: moderate</b></p>
Thomas, 2008	Prospective quasi-experiment investigating <b>standardized assessment and management across local facilities in reducing PU prevalence</b>	One hospital, one nursing home, and two home health agencies in US	<p><b>Organizational intervention</b></p> <ul style="list-style-type: none"> <li>Regularly at least monthly meetings between staff in four local facilities to determine:</li> <li>Standardized terms for PU</li> <li>Standardized documentation of treatment</li> <li>Wound module for basic education on pressure ulcers</li> <li>Physician order sheet</li> </ul>	Hospital PU incidence measurement strategy not reported	Distribution of interventions to all facilities and health care workers Hospital PU incidence reduced from 53% to 13% over 10 months, and sustained at 12% after a further 6 months	<ul style="list-style-type: none"> <li>No data for nursing homes or home health agencies</li> <li>Hospital data does not provide statistical comparison between pre and post PU incidence</li> <li>No control group / facility, blinding, or randomization</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: low</b></p>
<b>National and state level interventions</b>							
Ma & Park, 2015	Observational study exploring <b>how organizational</b>	National Database of Nursing Quality Indicators® (NDNQI®) (1,381 units in 373	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<b>HAPU prevalence</b> Gathered quarterly through direct inspection of patient skin by trained	<b>Multilevel logistic regression models for factors associated with HAPU rate</b> <ul style="list-style-type: none"> <li>Hospital Magnet status and unit-level work environments were significantly associated</li> </ul>	Skin inspections previously found to have high interrater reliability	<p><b>Level of evidence: 4</b></p>

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	nursing factors at different structural levels are associated with hospital-acquired pressure ulcers (HAPUs) in acute care hospitals	<p>hospitals) and NDNQI nurses survey (n=33,845 RNs) were used to obtain data from member hospitals</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> <li>Medical, surgical and med-surg combined adult units</li> <li>Nurses spending at least 50% of time in direct patient care and minimum 3 months on the unit</li> </ul> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>Psychiatric, obstetric, ICUs</li> <li>Unit with fewer than 5 RN respondents or response rate &lt;50%</li> </ul> <p>Participant characteristics:</p> <p>Hospitals:</p> <ul style="list-style-type: none"> <li>86.6% not-for-profit; 84% &gt; 100 beds; Approx. half had some level of teaching; 32% Magnet status</li> </ul> <p>Nurses:</p> <p>Mean age 38 yrs; 92% female; mean RN tenure 10yrs; mean unit tenure 6yrs; 83% full time workers.</p>		<p>nurses – HAPU was calculated as number of patients with ≥ one HAPU of any stage/1,000 patients.</p> <p><b>Unit nurse work environment</b> Survey collected data on nurse participation in hospital affairs (8 items), foundations for quality of care (9 items), nurse manager ability (4 items); staffing and resource adequacy (7 items), and collegial nurse–physician relations (3 items); each item scored on 4-point Likert-type scale.</p> <p><b>Unit level covariates</b> Unit type, staffing levels, RN skill mix, patient characteristics</p> <p><b>Hospital covariates</b> Ownership status, size, teaching status, Case mix index.</p>	<p>with unit HAPU rate when controlling for hospital- and unit-level covariates</p> <ul style="list-style-type: none"> <li>When hospital-level work environment (indicated as Magnet vs. non-Magnet) and unit-level work environment were both included in the model, Magnet status was no longer significant.</li> <li>Unit work environment remained significant( odds ratio [OR] 0.73, 95% CI 0.56 to 0.93, p=0.13)</li> </ul> <p>Study conclusion: Magnet status has an impact on on HAPU rate but became insignificant when adding unit-level work environments to the model. Unit-specific quality improvement initiatives may deserve more attention.</p>	<p>Limited patient-level data</p> <ul style="list-style-type: none"> <li>Unclear how representative hospitals who choose to participate in NDNQI® are of all hospitals</li> </ul>	<b>Quality: high</b>
<b>Waters et al., 2015</b>	Observational study investigating impact of	US nonfederal hospitals (n=1341 out of 1900 eligible)	<ul style="list-style-type: none"> <li>Change in funding arrangements introduced in 2008 in the US via introduction of Hospital Acquired</li> </ul>	<ul style="list-style-type: none"> <li>Quarterly hospital acquired PU rates for Category/stage III and IV PUs</li> </ul>	<ul style="list-style-type: none"> <li>There was no change in the change in monthly rates over time for Category/Stage III and IV PUs</li> </ul>	<ul style="list-style-type: none"> <li>Does not identify factors associated with decreasing PU rates</li> </ul>	<b>Level of evidence: 4</b>

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Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	<b>changed funding on PU rates in US hospitals</b>	<p>Characteristics of hospitals:</p> <ul style="list-style-type: none"> <li>• 59.7% had 100-399 beds, 22.8% had ≥ 400 beds</li> <li>• 85.8% not for profit hospitals</li> <li>• 86% metropolitan, 11% micropolitan, 3% rural</li> <li>• Mean 48.1% of admissions were Medicare funded</li> <li>• Hospitals participating in study were more often larger and located in urban areas and more likely to be non-profit.</li> </ul>	<p>Conditions (HAC) Initiative that prevents higher level Medicare severity diagnosis related groups (MS-DRG_ recovering costs incurred for patients with the Category/Stage II and IV PU</p>	<ul style="list-style-type: none"> <li>• Assessed by trained nurses using the NQNQI pressure ulcer indicator (reported as reliable).</li> </ul>	<ul style="list-style-type: none"> <li>• The slope indicates that the prevalence decreased from 6 events per 1,000 to 4 events per 1,000 patients over 4 years, with <b>no change in rate of decline associated with the change in funding</b></li> </ul>	<ul style="list-style-type: none"> <li>• Sample was not fully representative of facilities in US</li> <li>• Results per facility/region not reported</li> </ul>	<b>Quality: moderate</b>
S.-H. Bae & Yoder, 2015	<p>Cross sectional study <b>investigating hospital characteristics between rural and non-rural facilities associated with hospital acquired conditions including PUs.</b></p>	<p>Data base reviews, selection of hospitals unclear (n=3,260 hospitals)</p> <p>Data from three databases was used:</p> <ul style="list-style-type: none"> <li>• 2010 American Hospital Association (AHA) Annual Survey</li> <li>• Hospital Compare from the CMS for 2010</li> <li>• rural-urban commuting area code (RUCA) data</li> </ul> <p>Inclusion and exclusion criteria not reported.</p> <p>Facility characteristics:</p> <ul style="list-style-type: none"> <li>• 1,121 (34.4% sample were rural and 2,139</li> </ul>	<ul style="list-style-type: none"> <li>• Univariate descriptive statistics analyzing hospital characteristics and comparing rural to non-rural facilities</li> </ul>	<p>Regional characteristics of facilities</p> <ul style="list-style-type: none"> <li>• Category/Stage III and IV PUs per 1,000 discharges</li> </ul>	<p>Non-rural hospitals had significantly more PUs than rural PUs (0.123±0.247 versus 0.072±0.238, p&lt;0.001)</p> <p>Higher rates of PUs were associated with the following characteristics in both rural and non-rural facilities:</p> <ul style="list-style-type: none"> <li>• hospital size ≥100</li> <li>• greater hospital filled capacity</li> <li>• more hospital discharges paid by Medicare</li> <li>• higher levels of case mix</li> </ul>	<ul style="list-style-type: none"> <li>• States an odds ratio was calculated, but it was not presented in this paper</li> <li>• Selection of facilities is unclear</li> <li>• Facilities were significantly different on many factors and modeling was not reported</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		^%.6% sample were non-rural) <ul style="list-style-type: none"> <li>Significant differences between rural and non-rural for in type of ownership, nurse hours/day, facility size, teaching status, hospital filled capacity.</li> </ul>					
<b>Padula et al., 2016</b>	Retrospective cohort study to explore whether QI interventions influence the incidence of HAPU	Record reviews over a period 5 years in a health service of academic hospitals and medical centers in the US (n=55)	Medicare funding changes that reduced funding for hospital-acquired conditions including PU are thought to have led to an increase in QI interventions to prevent PU	Logistic regression modelling considering QI interventions and changes to Medicare funding policy with respect to hospital acquired conditions Models were controlled for age, gender, length of stay, in-hospital mortality rate, ICU admissions, case-mix index, medical and surgical status, Magenet recognition and standardized evidence based protocols for HAPU prevention	<b>Adoption of QI activities</b> In 2007 7% of facilities had QI interventions in place compared with >15% in 2012 <b>HAPU rates</b> <ul style="list-style-type: none"> <li>Mixed effects model showed that from 2007 to 2012 the change in funding policy was the single greatest factor associated with reduction in HAPU rates</li> <li>Updating the existing PU pressure ulcer prevention protocol was also significantly associated with decrease in HAPU rates</li> </ul>	<ul style="list-style-type: none"> <li>Relied on database information</li> <li>HAPU rates shown graphically and not sufficiently clear to cite</li> <li>No patient-level data available</li> <li>Identification and assessment of PU not reported</li> <li>May be response bias of facilities with only those showing decrease in HPAU rates responding to the survey</li> <li>Comparability of populations not established</li> </ul>	<b>Level of evidence: 3</b>  <b>Quality: Low</b>
<b>Metcalfe et al., 2016</b>	Retrospective cohort study to determine whether a facility's designation as a major trauma center influences PU incidence and other quality indicators	Retrospective database review of all patients in the UK National Hip Fracture Database for a 3.5 year period (n=289 466 fractures)  Inclusion: <ul style="list-style-type: none"> <li>Admitted in survey time</li> <li>Treated for fracture of proximal femur</li> </ul>	Participants were identified according to the hospital type: Treated in hospitals before becoming MTCs (n= 22 190), or treated in hospitals after becoming MTCs (n=25 325) <ul style="list-style-type: none"> <li></li> </ul>	Pressure ulcer incidence during admission	<b>PU incidence</b> <ul style="list-style-type: none"> <li>There was a decrease in PU incidence following the facilities classification as a major trauma center (3.4% vs 4.0%, p&lt;0.001, odds ratio 0.85, 95% CI 0.55 to 1.29, p=0.434)</li> <li>When considering facilities that did not change status, there was no significant difference between non-MTCs (3.3%) and MTCs (3.4%) for PU incidence (p=0.527)</li> </ul>	<ul style="list-style-type: none"> <li>Relied on retrospective data</li> <li>Confounding factors not addressed</li> <li>Method of identifying and assessing PU not reported</li> <li>Non-blinded</li> </ul>	<b>Level of evidence: 3</b>  <b>Quality: Low</b>



## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		<p>Exclusion criteria: Transferred to the center from another institution</p> <p>Participants characteristics:</p> <ul style="list-style-type: none"> <li>• Mean age 82 years</li> <li>• Significant difference between pre and post MTC cohorts in pre-morbid walking ability</li> <li>• ASA score approx. 3 (p=ns)</li> </ul>			<p><b>Author conclusions: Outcomes for patients with a fracture of the hip are equivalent between MTCs and non-MTCs.</b></p>	<ul style="list-style-type: none"> <li>• Uncertain whether PU on admission was addressed</li> </ul>	
Lahmann, Halfens, & Dassen, 2010	Cross-sectional retrospective study investigating guideline use on a nationwide level	<ul style="list-style-type: none"> <li>• National level in Germany</li> </ul> <p>Conducted in 60 nursing homes (n=7377 residents) and 82 acute-care hospitals (n = 28,102 patients)</p>	<ul style="list-style-type: none"> <li>• No intervention</li> <li>• Conducted annual nationwide pressure/ulcer surveys investigating guideline use; risk assessment; use of preventive devices and measures; and overall prevalence and nosocomial prevalence</li> <li>• Individual facilities participated 1 to 3 times</li> </ul>	<ul style="list-style-type: none"> <li>• Percentage of institutions using guidelines and risk assessment tools (structures)</li> <li>• The use of prevention devices and measures (processes).</li> <li>• Prevalence and nosocomial prevalence of pressure ulcers (outcomes).</li> </ul>	<ul style="list-style-type: none"> <li>• Repeated survey participation associated with statistically significant increase in use of guideline and Braden scale and preventive measures/devices</li> </ul> <p><b>Nursing homes</b></p> <ul style="list-style-type: none"> <li>• Those participating in survey twice significant reduction in prevalence of stage I to IV PU by 4.3% and reduction in grade II to IV PU of 1.5% (p=ns).</li> <li>• Prevalence of nosocomial PU decreased for participation 2 and 3 times (p=ns).</li> </ul> <p><b>Hospitals</b></p> <ul style="list-style-type: none"> <li>• Participation in survey twice associated with significant decrease in grade I to IV PU by 4.9% and nosocomial PU by 3.6%; reduction in grade II to IV of 3.9% overall (p=ns) and significant 2.3% reduction in nosocomial ulcers.</li> <li>• Participation in survey thrice (n = 11) showed statistically significant reductions in grade I to IV PU by 7.5% in the second year and another 9.7% in the third year. Similarly, grade II to IV PU significantly decreased by 2.5% in the second year and another 2.8% in the third year.</li> </ul>		<p><b>Level of evidence: 4</b></p> <p><b>Quality: moderate</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
					<ul style="list-style-type: none"> <li>Participation in 3 surveys prevalence of nosocomial grade I to IV PU dropped significantly from 26.3% to 11.3% in the third year and prevalence of grade II to IV PU dropped significantly from 10.2% to 5.2% in the third year.</li> </ul>		
Goode, Blegen, Park, Vaughn, & Spetz, 2011	Retrospective cohort study <b>comparing PU care HAPU in Magnet and non-Magnet hospitals</b>	ICU and general units in Magnet (n = 19) and non-Magnet (n = 35) hospitals <ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li>No intervention</li> </ul>	HAPUs: Quality indicators software developed by AHRQ Staffing data: University Health Systems Consortium operational database <ul style="list-style-type: none"> <li></li> </ul>	<p><b>Nurse staffing</b></p> <ul style="list-style-type: none"> <li>Magnet hospitals had significantly more total hours of care per day than non-Magnet hospitals in general units (p&lt;0.05) but there was no significant difference in ICU (p=ns)</li> <li>Magnet hospital had significantly more RN skill mix than non-Magnet hospitals in general units and ICU (both p&lt;0.05)</li> </ul> <p><b>PU prevalence</b></p> <ul style="list-style-type: none"> <li>There was no significant difference in HAPU between Magnet and non-Magnet hospitals (p&lt;0.10)</li> <li>When adjusting for percentage registered nurses, Magnet status, and Medicare case mix index, total hours per patient day was not significantly related to HAPU in general units or ICU or general units (p=ns)</li> <li>When adjusting for total hours per patient day, Magnet status, and Medicare case mix index percentage of registered nurses was significantly related to HAPU in ICU and general units (p&lt;0.05)</li> <li>When adjusting for total hours per patient day, percentage registered nurses, and Medicare case mix index Magnet status was not significantly related to HAPU in ICU or general units (p=ns)</li> <li>When adjusting for total hours per patient day, percentage registered nurses, and Magnet status Medicare case mix index was significantly related to HAPU in ICU and general units (p&lt;0.05)</li> </ul>	<ul style="list-style-type: none"> <li>Difference in groups poorly described</li> <li>Number of persons asked to participate is not reported.</li> <li>Drop-out not reported</li> <li>No information on validity, reliability of measurements</li> </ul> Confounders: total hours per patient day, percentage registered nurses, Magnet status and Medicare case mix index	<p><b>Level of evidence: 3</b></p> <p><b>Quality: low</b></p>

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## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
<b>Staff attitudes/perceptions of PU intervention</b>							
Mirshekari, Targari, & Forouzi, 2017	A cross-sectional study to explore Iranian nurses' attitudes toward PU prevention and to identify nurses' perceived barriers to care in PU prevention	Trauma centers in Iran, convenience sample of nurses (89 RNs)  Inclusion criteria: Working in ICU  Characteristics: <ul style="list-style-type: none"> <li>female (73.9%)</li> <li>62.5% in the youngest age category (20–30 years)</li> <li>88.7% had Bachelors degree and the rest were higher</li> <li>45% had more than 7 years' experience In nursing</li> </ul>		tool to understand the barriers to providing prevention of PUs, previously validated	<b>Perceived barriers to pressure injury prevention</b> <ul style="list-style-type: none"> <li>Poor access to literature</li> <li>Heavy workload/staff shortage</li> <li>Lack of universal guidelines</li> <li>Lack of in-service training</li> <li>Uncooperative patients</li> <li>Presence of other priorities</li> <li>Shortage of pressure-relieving devices</li> <li>Inadequate knowledge</li> <li>Lack of multidisciplinary initiative</li> </ul>	<ul style="list-style-type: none"> <li>self-report data might be susceptible to reporting bias</li> </ul>	<b>Indirect evidence: PU not an outcome measure</b>
Tubaishat , Aljezawi, & Al Qadire, 2013	A cross-sectional study to explore Jordanian nurses' attitudes toward PU prevention and to identify nurses' perceived barriers to care in PU prevention	Four hospitals in Jordan 428 RNs and nurse assistants (n=304 questionnaires returned, response rate of 71%, n=241 analyzed)  Exclusion criteria: <ul style="list-style-type: none"> <li>Nurses with no direct contact with the patients (administration positions, non-bedside nurses)</li> </ul> Characteristics: <ul style="list-style-type: none"> <li>female (58%)</li> <li>61% in the youngest age category (20–29 years)</li> <li>RNs (83%)</li> </ul>	N/A	Outcome Measures: <ul style="list-style-type: none"> <li>nurses' attitudes toward PU prevention measured on a self-administered questionnaire</li> <li>nurses' perceived barriers towards PU prevention practice measured on a self-administered, previously reported scale</li> </ul>	<b>Attitudes to PU prevention</b> <ul style="list-style-type: none"> <li>participant nurses hold positive attitudes regarding pressure ulcers prevention (mean = 3.91).</li> <li>The experience of the participants had a significant effect on the positive attitude (<math>\chi^2[2, n=227]=6.38; [p=0.041]</math>).</li> <li>The positive attitude was enhanced with increased number of years of experience.</li> </ul> <b>Barriers to best practice</b> <ul style="list-style-type: none"> <li>Lack of staff (86.2%)</li> <li>time (83.6%),</li> <li>patient conditions (68.6%)</li> </ul>	<ul style="list-style-type: none"> <li>self-report data might be susceptible to reporting bias</li> <li>56% of responses rate might be susceptible to selection bias</li> </ul>	<b>Indirect evidence: PU not an outcome measure</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
Anand, Kumari, & Nair, 2014	Cross sectional study to assess nurses' practice related to prevention of pressure injury and identifying factors that inhibit and promote nursing practices	<ul style="list-style-type: none"> <li>Nurses recruited in Medical- surgical units of hospital in India (n=100)</li> <li>Nurses working on the medical-surgical units</li> <li>Nil</li> </ul> Age between 20-40 years; 87% female; 67% single, 87% Hindus, 100% had completed general nursing and midwifery program; 37% had 1-2 years experience; 32% working on a surgical ward.	Nurses' practice observed in relation to the prevention of pressure ulcers.	Observational check list having 19 items with a rating scale list of 14 factors to identify promoters and/or inhibitors for pressure injury prevention was used. <ul style="list-style-type: none"> <li>Time sampling used to observe nursing practice</li> <li>3 nurses observed simultaneously for 6 hours during shift</li> <li>Observer not stated</li> <li>No follow-up period</li> </ul>	<b>Quality of nursing</b> <ul style="list-style-type: none"> <li>2 % of nurses observed performing good practice (&lt; 75%); 87% fair practice (50 – 75%), 11 % poor practice (&lt; 50%)</li> <li>Mean score for nurses' practice regarding prevention of pressure injury was 58.36±7.98; (range 41.67- 81.82)</li> <li>Association between personal variables and level of care performed                             <ul style="list-style-type: none"> <li>Age : X<sup>2</sup> 1.002, p= 0.006</li> <li>Gender : X<sup>2</sup> 1.508, p= 0.47</li> <li>Years experience: X<sup>2</sup> 4.173, p =0.653</li> <li>Area of work: X<sup>2</sup> 21.058, p=0.007 significant</li> </ul> </li> </ul> <b>Top 5 promoters identified by nurses</b> <ul style="list-style-type: none"> <li>Teamwork and collaboration</li> <li>Use of pressure ulcer prevention protocol.</li> <li>Use of risk assessment tool (Braden, Norton scale)</li> <li>Involvement of family</li> <li>Communication of risk of developing pressure ulcer to other staff</li> </ul> <b>Top 5 barriers identified by nurses</b> <ul style="list-style-type: none"> <li>Lack of patient co-operation</li> <li>Inadequate skin care products</li> <li>Lack of confidence due to inadequate competency</li> <li>Inadequate supplies of equipment</li> <li>Knowledge deficit for use of equipment and skin products</li> </ul>	<ul style="list-style-type: none"> <li>Nil limitations discussed</li> <li>No discussion on statistical power</li> <li>Non-validated data collection tools</li> </ul>	Indirect evidence (PU not an outcome)  Quality: low
Kaba, Kelesi, Stavropoulou, Moustakas, & Fasoi, 2017	Explore Greek Nurses perceptions related to barriers to and factors influencing care planning	Participants recruited with purposive sampling in long-term experience in rehabilitation setting in Greece (n=7)	Perceived barriers and factors that influence pressure ulcer care were explored using semi-structured interviews using a grounded qualitative theory approach. Participants were introduced/familiar with researcher long before interviews	<ul style="list-style-type: none"> <li>When/how/by whom pressure injuries/other outcomes were measured</li> <li>Staging system used</li> <li>Follow up period</li> </ul>	<b>main category</b> "anarchy" with three subcategories ("interdisciplinary conflicts", "total trust in traditional knowledge", and "devaluation of other's work/role").	<ul style="list-style-type: none"> <li>Small number of participants from other areas of the country or from private hospitals</li> <li>lack of triangulation of</li> </ul>	Indirect (Qualitative research)  Quality: High

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## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	for pressure ulcer treatment	<ul style="list-style-type: none"> <li>Inclusion criteria(not defined)</li> <li>Exclusion criteria (not defined)</li> </ul> <p>Participant characteristics and any baseline differences</p> <ul style="list-style-type: none"> <li>7 nurses (3 university; 4 technical graduates)</li> </ul>		<ul style="list-style-type: none"> <li>Interviews were recorded and transcribed verbatim; analysis was performed using the constant comparative method.</li> <li>Data collection continued until saturation was achieved</li> </ul>	<p>A core category, “against the odds” was identified. The perceived value of interventions to prevent and treat pressure injury outweighs the barriers.</p> <p><b>Authors concluded that many rely on traditional knowledge rather than evidence based practice. They recommend collaborative approaches, interdisciplinary education and collaboration to deliver care consistent with best clinical practice.</b></p>	<ul style="list-style-type: none"> <li>qualitative and quantitative data</li> </ul>	
Ilesanmi & Olabisi, 2014	Cross-sectional study examining interventions and perceived barriers to adequate to pressure injury prevention	<ul style="list-style-type: none"> <li>Convenience sample nurses (n=193) of neurological, orthopedic, intensive care and emergency units of three hospitals in Nigeria</li> </ul> <p>Participant characteristics: Age 31 to 40 (87%); working in neurological and emergency 29.5% and orthopedic 29%</p>	Self-structured questionnaire	<p>Instruments developed by researches after literature review (30 items): (A) demographic data; (B) commonly interventions to pressure injury prevention (answer commonly, occasionally used, not used at all and don't know); (C) perceived barriers to pressure ulcer prevention (5-point Likert scale)</p> <ul style="list-style-type: none"> <li>Instruments B and C evaluated (validity and reliability) by three experts.</li> </ul>	<p>Interventions: mostly used was repositioning patient every two hours and use pillows to reduce tissue load in bony prominences 77.2% each; but talcum powder application and massage bony prominences was showed to be mostly use, 76.6% and 76.2%, respectively, but that interventions are not evidence-based for pressure injury prevention.</p> <p>Barriers: inadequate labor staff 78.2%, lack of adequate sheets 43% and no pressure injury redistribution surfaces 40.4%.</p> <p><b>Author conclusion: some interventions to pressure injury prevention is evidence-based but others did not.</b></p>	<ul style="list-style-type: none"> <li>Small sample</li> <li>Sample just for 3 wards in only three hospitals</li> </ul>	<p><b>Indirect (PU not an outcome)</b></p> <p><b>Quality: Low</b></p>
Ünver, Findık, Özkan, & Sürücü, 2017	Cross sectional study exploring surgical nurses' attitudes for PU prevention	<p>Convenience sample of surgical nurses in Turkey (n=101 of total of n=153)</p> <p>Participant characteristics:</p> <ul style="list-style-type: none"> <li>Age 32.0 ± 6.3 years, female 91.1%, bachelor's degree 81.5%, no previous</li> </ul>	Self-reported questionnaire	<ul style="list-style-type: none"> <li>Nurse Information Form; six items: gender, education level, work unit, age, previous education about pressure injury care and duration of clinical experience</li> <li>Attitude towards Pressure Ulcer</li> </ul>	<p>Mean total attitude score 80.5%; highest score was to 'impact of pressure injury' 85.7% and the lowest 'confidence in the effectiveness of prevention' 53.7%</p> <p>Attitude score of nurses who had previous education about pressure injury was significantly higher than those who didn't (p=0.017; p &lt; 0.05).</p>	<ul style="list-style-type: none"> <li>Data was limited to surgical wards</li> <li>Just one setting</li> <li>Nurses answers could be made from what they think the institution want to know about their attitude</li> </ul>	<p><b>Indirect evidence (PU not and outcome)</b></p> <p><b>Quality: Moderate</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		education on PU 78.7%, clinical experience 72.3 ± 61 months		Prevention Instrument	<b>Author conclusion: surgical nurses had positive attitude towards pressure injury preventions and this was higher in who had previous education about that. Because of that, it's recommended that educational programs could be performed to staff.</b>		
<b>Garrigues, Cartwright, &amp; Bliss, 2017</b>	Attitudes of Nursing Students About Pressure Injury Prevention	Convenience sample of undergraduate nursing students from one accredited nursing school (n=16)  Participant characteristics: <ul style="list-style-type: none"> <li>Half sample had completed two years in the baccalaureate program</li> <li>half in a community college associate degree nursing program</li> <li>all had completed two years of clinical learning experiences</li> </ul>	Interviews	They identified  Data were analyzed by research, after by a method expert and after that by a peer debriefing or independent review. Ambivalent students had little interests in pressure injury prevention because they consider that low priority; and those emerging awareness expressed some interest, and also consider it challenging and time-consuming.	<ul style="list-style-type: none"> <li>Four attitudes categories for pressure injury prevention: ambivalence (n=3), emerging awareness (n=3), committed (n=7) and passionate (n=3) by analyzing interviews contents.</li> <li>Committed students were interested in pressure injury prevention and expressed desire to learn more.</li> <li>Passionate students, believe that pressure injury prevention was essential role in nursing practice for all patients and has a high priority.</li> <li>Observing WOC nurses and other professionals played a role model in be engaged in pressure injury prevention to committed and passionate students.</li> </ul> <p><b>The contribution of this study is that provides beginning descriptions about undergraduate nursing students attitudes and experience of pressure injury prevention</b></p>	<ul style="list-style-type: none"> <li>Small sample from just one nursing school</li> <li>Opinion of who participates could be different from those that didn't participated as a volunteer</li> <li>Answer to be committed or passionate could be made to impress the primary investigator</li> <li>Students knowledge was not investigated</li> <li>Curricular content was not investigated</li> </ul>	<b>Indirect (qualitative)</b>  <b>Quality: high</b>
Florin, Bååth, Gunningberg, & Mårtensson, 2014	Psychometric study exploring the Attitudes Towards Pressure Ulcer Prevention (APuP) instrument in Swedish	Participants were nurses in three tertiary hospitals in Sweden who responded to a survey (n=577 volunteered, n=415 completed survey)  Participant characteristics: <ul style="list-style-type: none"> <li>Registered nurse (n=196) and assistant</li> </ul>	N/A	<ul style="list-style-type: none"> <li>APuP instrument is previously validated by Beeckman et al with content validity 0.87-1.00 for a five factor instrument</li> <li>Factor analysis</li> </ul>	<ul style="list-style-type: none"> <li>Tool was reorganized into a four-factor solution that better represents the Attitudes of Swedish nurses</li> <li>Four factors were priority, competence, importance and responsibility</li> </ul>	<ul style="list-style-type: none"> <li>Minimal generalizability</li> </ul>	<b>Indirect (PU not an outcome)</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		nurses (n=97), student nurses (n=122) <ul style="list-style-type: none"> <li>• Mean age 38±12.2 years</li> <li>• 42% bachelors degree, 56% &gt; 10 years experience</li> </ul>					
Strand & Lindgren, 2010	Descriptive, cross-sectional study <b>investigating attitudes toward PU care in ICU</b>  (also investigated knowledge, see "Nurse knowledge and education" see "Education")	Participants were nursing staff in four ICUs in a Swedish University Hospital (n=315 received survey, n=146 returned survey)  Characteristics: <ul style="list-style-type: none"> <li>• 56.2% worked full time</li> <li>• Mean age 38.8±7.4 years for RNs and 43.5±9.7 for ENs (p=0.001)</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Questionnaire developed from other previously questionnaires.</li> <li>• Pilot testing of instrument prior to distribution.</li> </ul>	<ul style="list-style-type: none"> <li>• nurse attitudes</li> <li>• nurse perceived barriers and opportunities towards PU prevention in the ICU setting.</li> </ul>	<p><b>Current practice in ICU</b></p> <ul style="list-style-type: none"> <li>• 67.6% reported no routines existed for PU risk assessment in their ICU</li> <li>• 97% reported use of pressure relief</li> <li>• 38% reported use of nutritional support</li> </ul> <p><b>Attitudes</b></p> <ul style="list-style-type: none"> <li>• no difference between RN and ENs</li> <li>• Nurses with more education agreed with the statement "all patients are at risk for PU" more often (p=0.014)</li> <li>• Nurses with more education disagreed with the statement "I am less interested in PU prevention than in other aspects of care" more often (p=0.009)</li> </ul> <p><b>Barriers to PU prevention</b></p> <ul style="list-style-type: none"> <li>• 57.8% mentioned lack of time</li> <li>• 28.9% mentioned severely ill patients</li> </ul> <p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• 38% mentioned knowledge</li> <li>• 35.5% mentioned access to pressure relieving equipment</li> </ul> <p><b>Study conclusions: PU prevention was considered important but lack of time and severe morbidity of patients impacted on ability to implement PU care.</b></p>	<ul style="list-style-type: none"> <li>• Response rate was low at 46% (according to the authors) may be due to the length of the questionnaire</li> <li>• No validation of practice in the ICUs</li> <li>• Self-selected response may be from ICU nurses with more interest in area of PU</li> <li>•</li> </ul>	<p><b>Indirect evidence: no association made between attitudes and PU outcomes</b></p> <p><b>Quality: moderate</b></p>
Pekkarinen, Sinervo, Elovainio, Noro, & Finne-	Cross sectional survey <b>investigating the influence of staffing on PU</b>	Conducted in aged care facilities in Finland that had at least 2 years of data (n=66)  724 nurses in the facilities completed surveys.	No intervention	'Time pressure' and 'unfair management' determined through validated nursing staff survey with Likert scored items.	<ul style="list-style-type: none"> <li>• Mean PU prevalence 9.7±6.7% for the year survey conducted.</li> <li>• No significant relationship between unit size and PU prevalence.</li> <li>• Nurse-ranked 'unit time pressure' was significantly related to an increased PU prevalence (p=0.05)</li> </ul>	<ul style="list-style-type: none"> <li>• No comparison group</li> <li>• Total number of eligible units not stated, so the proportion of units volunteering is unclear.</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: high</b></p>

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## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
Soveri, 2008	prevalence in aged care	<p>Characteristics of facilities:</p> <ul style="list-style-type: none"> <li>• Mean resident beds 27 (range 8 to 50)</li> </ul> <p>Characteristics of nurses:</p> <ul style="list-style-type: none"> <li>• 23% RNs, 58% LPNs, 14% NAs, 5% head nurses</li> <li>• Mean time in current job 9±8.6 years</li> </ul>		<p>PU prevalence (stages 1-4) determined from MDS (database review) and adjusted for resident dependency as measured on an Activities of Daily Living Hierarchy</p>	<ul style="list-style-type: none"> <li>• No significant influence of 'perceived unfair management' on PU prevalence (p=0.259)</li> </ul>	<ul style="list-style-type: none"> <li>• Used a non-validated method to calculate PU prevalence.</li> <li>• Unclear how PU presence was assessed initially.</li> <li>• Database data may not be reliable.</li> </ul>	
Beeckman, Defloor, Demarre, Van Hecke, & Vanderwee, 2010	Two-phase-Prospective psychometric instrument validation study reporting the Attitude towards Pressure Ulcer Prevention Instrument (APuP)	<p>Conducted in hospitals (n=2) and psychiatric hospital (n=1) in Belgium and in the Netherlands</p> <p>Initial convenience sample (32-item APuP) of qualified nurses (n=258) and nursing students (n=291)</p> <p>Participant characteristics:</p> <ul style="list-style-type: none"> <li>• 70% aged 25 to 50 years</li> <li>• &gt;50% had more than 10 years' experience in nursing</li> <li>• 65.5% nurses had bachelors degree and 6.2% had masters degree</li> </ul>	<p>No intervention – reliability and validity testing of a psychometric tool measuring attitudes towards pressure ulcer prevention in nurses</p> <p>Original 32-item tool was tested for face value/content validity by PU experts using a Delphi process and pilot tested on 10 nurses/nursing students for clarity, ambiguity, layout and time to complete</p> <p>Tool reduced to 13 items (5 subscales) and tested in a convenience sample of nurses/nursing students</p>	<p><b>Outcome</b></p> <ul style="list-style-type: none"> <li>• Attitudes to pressure ulcer prevention measured using APuP</li> <li>• Test-retest procedure with 1 week interval</li> </ul>	<p><b>Entire APuP instrument</b> Cronbach's <math>\alpha = 0.79</math> Intraclass coefficient (ICC) = 0.88 (95% CI 0.84 to 0.91, p&lt;0.001)</p> <p><b>Personal competency to prevent PU subscale</b></p> <ul style="list-style-type: none"> <li>• Cronbach's <math>\alpha = 0.81</math></li> <li>• ICC = 0.80 (95% CI 0.73 to 0.85, p&lt;0.001)</li> </ul> <p><b>Priority of PU prevention subscale</b></p> <ul style="list-style-type: none"> <li>• Cronbach's <math>\alpha = 0.75</math></li> <li>• ICC = 0.82 (95% CI 0.76 to 0.86, p&lt;0.001)</li> </ul> <p><b>Impact of PU subscale</b> Cronbach's <math>\alpha = 0.79</math> ICC = 0.85 (95% CI 0.80 to 0.89, p&lt;0.001)</p> <p><b>Responsibility in PU prevention subscale</b></p> <ul style="list-style-type: none"> <li>• Cronbach's <math>\alpha = 0.82</math></li> <li>• ICC = 0.83 (95% CI 0.78 to 0.87, p&lt;0.001)</li> </ul> <p><b>Confidence in effectiveness of PU prevention subscale</b></p> <ul style="list-style-type: none"> <li>• Cronbach's <math>\alpha = 0.76</math></li> <li>• ICC = 0.77 (95% CI 0.70 to 0.83, p&lt;0.001)</li> </ul>	<ul style="list-style-type: none"> <li>• Convenience sample</li> <li>• Non-response-bias</li> <li>• Not more than three items per subscale</li> </ul>	<p><b>Indirect evidence (PU not an outcome measure)</b></p>
Bosch et al., 2011	Cross-sectional study investigating relationship between	Nursing homes (n=36) and hospitals (N=25) in the Netherlands	No intervention	<ul style="list-style-type: none"> <li>• Organizational culture: Competing values framework (CVF)</li> <li>• Team climate: Team climate inventory (TCI)</li> </ul>	<ul style="list-style-type: none"> <li>• Group culture and PU prevalence: OR 1.00 (95% CI 0.98-1.02) (adjusted for age, malnutrition and type of ward)</li> <li>• Developmental culture and PU prevalence: OR 1.02 (95% CI 0.98-1.06)</li> </ul>	<ul style="list-style-type: none"> <li>• Confounders included age, malnutrition and type of ward</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: moderate</b></p>



## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	<b>organization culture, team climate, and preventive PU) quality management at ward level and PU prevalence</b>	Questionnaire completed by doctors, nurses and nursing assistants (n=460) •		<ul style="list-style-type: none"> <li>Quality indicators preventive quality management: checklist formulated by a team of experts based on (inter)national guidelines and expert opinion.</li> <li>PU prevalence: point prevalence according to the EPUAP classification</li> </ul>	(adjusted for age, malnutrition and type of ward) <ul style="list-style-type: none"> <li>Hierarchical culture and PU prevalence: OR 0.99 (95% CI 0.97-1.02) (adjusted for age, malnutrition and type of ward)</li> <li>Rational culture and PU prevalence: OR 0.99 (95% CI 0.96-1.02) (adjusted for age, malnutrition and type of ward)</li> <li>Team climate: OR 0.99 (95% CI 0.96-1.02) (adjusted for age, malnutrition and type of ward)</li> <li>Preventive quality management and PU prevalence: OR 0.96 (95% CI 0.88-1.06) (adjusted for age, malnutrition and type of ward)</li> </ul>		
<b>Staffing models (organizational component)</b>							
J. Choi & Staggs, 2014	Descriptive, correlational study to examine correlations among six nurse staffing measures	2397 nursing units in 409 U.S. acute care hospitals.  <b>Hospitals/units</b> critical care (558 units), step-down (406 units), medical (441 units), surgical (339 units), and combined medical-surgical (653 units). Characteristics: one-third (33%) of hospitals > 300 staffed beds one-third (34%) were Magnet-designated hospitals. 47% hospitals were teaching hospitals.  <b>Nurse participants</b> the average age of the 57,223 RN survey respondents was 38, and		Total nursing hours per patient per day (HPPD), RN HPPD, non-RN HPPD, RN skill mix, RN-reported number of assigned patients, RN-perceived staffing adequacy	<b>Staffing profiles</b> <ul style="list-style-type: none"> <li>Total nursing HPPD and RN HPPD) and RN skill mix were significantly correlated with RN-reported number of assigned patients (<math>r</math> range = -0.87 to -0.75).</li> <li>These staffing measures had weaker correlations with RN-perceived staffing adequacy (<math>r</math> range = 0.16 to 0.23).</li> </ul> <b>Pressure injury incidence</b> <ul style="list-style-type: none"> <li>Average UAPU rate across the five unit types was 2.1%, ranging from 4.4% for critical care units to 1.2% for surgical and combined medical-surgical unit</li> <li>Of the six staffing variables, only RN-perceived staffing adequacy and RN skill mix were significantly associated with UAPU odds, the former being the better predictor.</li> <li>An increase of one percentage point in RN mix was associated with an estimated 1.2% reduction in the UAPU odds</li> <li>estimated reduction in UAPU odds associated with a 1-year increase in RN</li> </ul>	<ul style="list-style-type: none"> <li>Cross-sectional data cannot infer a causal relationship between nurse staffing and UAPU occurrence.</li> <li>Sample was limited to units in NDNQI member hospitals that participated in the 2011 NDNQI RN Survey with PES and also submitted data on both pressure ulcers and nurse staffing for the same time period of the RN Survey.</li> <li>Data on patient-level risk factors not available, unit type may not adequately adjust for patient acuity and risk factors</li> </ul>	<b>Indirect evidence: 4</b>  <b>Quality: Moderate</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		average tenure on the current unit was 5.7 years. More than half of the respondents (58.4%) reported having a Bachelor's or higher degree in nursing.			workgroup tenure ranged from 4.6% to 5%.		
Cho, Chin, Kim, & Hong, 2016	Examine relationship between nurse staffing level and work environment correlated with patients adverse events	<ul style="list-style-type: none"> <li>Nurses (N=4,864), facilities (N=58) and patients (N=113,426 – patient hospital discharge)</li> <li>South Korea</li> <li>on the date of data collection</li> <li>Age 28.7 ±5.7</li> <li>Years worked as a nurse: 6.2 ± 5.4</li> <li>Highest education level: 3-years of college 56.2% BSN or higher 43.8%</li> </ul>	Nurse survey data collection	<ul style="list-style-type: none"> <li>Nurse staffing level and work environment: self-questionnaire to report the number of patients each nurse cared for the last shift and Practice Environment Scale of the Nursing Work Index (29 items with five subscales, each one rated on a 4-point Likert scale)</li> <li>Adverse events: ask nurse about frequency (7-point Likert scale) patients had pressure injury after admission</li> </ul>	<ul style="list-style-type: none"> <li>Incidence of pressure ulcer (OR = 1.01, 95% CI = 1.007–1.016 - Multilevel Ordinal Logistic Regression)</li> <li>Patients cared per nurse in the last shift: average of 17.4</li> </ul> <p>The incidence of pressure injury increases when that is poor work environment and larger numbers of patients by nurse</p>	<ul style="list-style-type: none"> <li>results based on cross-sectional data;</li> <li>nurse self-report for outcomes and covariates;</li> <li>incidence rates could have been underestimated or overestimated as they are based on a nurse survey, not a proper prevalence count</li> <li>not consider nurses personal</li> <li>All nurses of selected hospital were invited to participate characteristics; data only from a surgical patients.</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>
Kang, Kim, & Lee, 2016	Observational study <b>comparing nurse-perceived workload to nurse-perceived rate of PU</b>	<p>Participants were nurses recruited in the union training program in South Korea (n=11,731 potential recruits, n=5,654 participants) Only facilities with &gt;10 nurse respondents were included (n=23)</p> <p>Participant characteristics:</p>	N/A	<ul style="list-style-type: none"> <li>Pressure ulcers measured by asking nurses how often PUs occurred over previous year with response on a 4 point Likert scale from not at all to frequently</li> <li>Workload measured as: <ul style="list-style-type: none"> <li>Bed-nurse ratio</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>820 (45.2%) of nurses reported PU had occurred frequently or occasionally in previous year</li> <li>Nurses performing non-nursing tasks were 1.16 times more likely to report more cases of PU</li> <li>In facilities with higher bed-nurse ratios nurses experienced 1.35 times more PU in patients (i.e. smaller workforces experienced more PUs)</li> </ul>	<ul style="list-style-type: none"> <li>No patient characteristics reported</li> <li>Used a non-validated and subjective measure of PU cases</li> <li>Unclear why nurses were performing non-nursing duties (e.g. due to insufficient other staff, preference, lack of</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		<ul style="list-style-type: none"> <li>Primarily female (99%) and Staff nurses (97%)</li> <li>Primarily aged 25 to 29 years (41.7%)</li> <li>Average clinical experience of 3- 6 years was most common (31.7%)</li> <li>Primarily university graduates</li> </ul> <p>Facility characteristics:</p> <ul style="list-style-type: none"> <li>Primarily private hospitals (82.6%)</li> </ul> <p>Primarily nurse-bed ratio of 2.5 to 2.9 (47.8%)</p>		<ul style="list-style-type: none"> <li>Nurse subjective response of how often they perform non-nursing tasks</li> <li>Nurse subjective response of if there is a sufficient workforce</li> </ul>	<ul style="list-style-type: none"> <li>Nurses who reported adequate staffing reported 0.78 times fewer PU cases</li> </ul> <p><b>Author conclusions: Nurses experience of PU and heavy workload are related However, the prevalence of PU was not a valid measurement.</b></p>	<p>perceived nursing work, poor knowledge etc)</p> <ul style="list-style-type: none"> <li>The subjective measures (especially in conjunction) are prone to responder bias</li> </ul>	
<b>S. H. Bae, Kelly, Brewer, &amp; Spencer, 2014</b>	To determine the effect of nurse staffing characteristic on patient falls, falls with injuries, and pressure ulcer prevalence and incidence.	<p>Clinical setting: 35 nursing units (CCC, step-down, med/surg, other) at 3 hospitals in Western New Yor (k511 unit-month data points and 171 unit-quarter data points)</p> <p>Inclusion criteria:</p> <ul style="list-style-type: none"> <li>patient admitted to one of the identified nursing units from October 2010 – March 2012</li> </ul> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>Patient admitted to a nursing unit or in a hospital not identified in the inclusion criteria</li> </ul> <p>Participant characteristics not identified,</p>	No intervention	<ul style="list-style-type: none"> <li>Pressure injury prevalence/incidence : National Database of Nursing Quality Indicators</li> <li>Nursing hours, skills mix, staff turnover</li> </ul>	No statistically significant relationship between nurse staffing characteristics and the prevalence and incidence of pressure injuries.	<ul style="list-style-type: none"> <li>Patient characteristics and case mix not described nor taken into consideration</li> <li>Does not consider nurses knowledge and attitudes, availability and use of equipment, working conditions, workplace culture, Impact of care given by non-nurse staff, other time-variant characteristics, e.g., leadership change</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: Low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
<b>Lee, Blegen, &amp; Harrington, 2014</b>	Cross sectional study exploring relationship between RN staffing and nursing home quality indicators -	195 Nursing Homes operational in 2000 in rural US  <b>Inclusion criteria:</b> <ul style="list-style-type: none"> <li>All nursing homes</li> </ul> <b>Exclusion criteria:</b> <ul style="list-style-type: none"> <li>hospital-based nursing homes, veteran's homes, and specialised care facilities</li> <li>Nursing homes with missing or inaccurate data at baseline (4 in total).</li> <li>One Nursing Home excluded as all residents restrained.</li> </ul>	N/A	<ul style="list-style-type: none"> <li>Extraction of data from 5 data bases</li> <li>Pressure Ulcer as per ICD coding prevalence and RN staffing hours</li> <li>1 year cross-sectional analysis - Secondary data from 5 data bases was extracted and analysed using both the Two-stage least squares regression models for endogenous relationships between RN staffing and the outcome-related quality indicators, and ordinary least squares regression was used for the process-related ones.</li> </ul>	<p><b>Pressure Ulcers</b></p> <ul style="list-style-type: none"> <li>Pressure ulcer prevalence averaged 7.8% with a range of 0–27.8%.</li> <li>Higher RN staffing was associated with a reduction in Pressure Ulcer prevalence by 11.3%. (p&lt;0.01)</li> <li>Medicaid reimbursement rates and the number of medicare patients were associated with higher prevalence of pressure ulcers.</li> </ul> <p>The total explained variance of pressure ulcers was 14.17 percent (F = 96.97, p &lt; .01).</p> <p><b>Conclusion: A threshold RN staffing level may be required in order to have an effect on quality indicators such as pressure ulcer reduction.</b></p>	<ul style="list-style-type: none"> <li>Cross-sectional study focusing on only one state – caution should be used in applying data to other states/countries</li> <li>Data from 2000 – RN staffing levels and then quality indicators may have been different although RN Staffing levels have remained constant</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: moderate</b></p>
<b>Patrician et al., 2017</b>	Prognostic study exploring influence of staffing on PU on Hospital-Acquired Pressure Injury	<ul style="list-style-type: none"> <li>1 643 patients</li> <li>56 Medical-surgical, Stepdown and Critical Care Units in 13 Military Hospitals</li> <li>USA</li> <li>Inclusion criteria and Exclusion criteria not reported</li> <li>Population characteristics: 56% retirees; weekly patient, 22% over 65 and 22% are 45-64 years old</li> </ul>	Variations in LPN Staffing and Nursing Care Hours	<ul style="list-style-type: none"> <li>Annually Pressure injury prevalence surveys at each hospital: a team of nurses visually inspected 100% of available patients</li> <li>NPUAP 2009,2016 Staging criteria</li> <li>Staffing variables: Nursing Care Hours p/ patient p/ day; Nursing Care Hours-skill type; skill mix and workload variables</li> </ul>	<p><b>HAPU</b></p> <p>total sample: 5,6% (92 patients) Prevalence (p &lt; 0,05):</p> <ul style="list-style-type: none"> <li>Critical Care: 15,1%</li> <li>Medical-surgical: 4,46%</li> <li>Step down: 3,18%</li> </ul> <p><b>Associations with PU</b></p> <ul style="list-style-type: none"> <li>No significant associations between any predictor variables (patient, staffing, or workload) and time to HAPI development in either care or step-down units</li> <li>In med-surge units LPN Nursing Care Hours p/ patient p/ day, on day 3: HR=0,27, p &lt; 0.01 were predictive of HAPI development.</li> </ul>	<ul style="list-style-type: none"> <li>Dropped out participants not reported</li> <li>Main confounders not specified</li> <li>Context-related nurse staffing patterns ; different population and work environment from civilian hospitals</li> <li>Studies should be conducted with non-military samples</li> </ul>	<p><b>Level of evidence: 3 prognostic</b></p> <p><b>Quality: Low</b></p>

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		<ul style="list-style-type: none"> <li>Participants characteristics not reported</li> </ul>		<ul style="list-style-type: none"> <li>Follow up period: 4-year study</li> </ul>	<ul style="list-style-type: none"> <li>RN and NA skills mix and hours were not predictive</li> </ul>		
<b>Twigg, Gelder, &amp; Myers, 2015</b>	Observational study <b>investigating association between staffing models and PU</b>	<p>Participants were all adult patients admitted to one hospital in a two year period in Australia (n=36,529)</p> <p>Inclusion: Multiday admission between 1 and 90 days</p> <p>Exclusion:</p> <ul style="list-style-type: none"> <li>Peri-operative, emergency and specialized services including ICU, maternity, pediatrics, neonates, mental health and palliative care</li> </ul> <p>Characteristics:</p> <ul style="list-style-type: none"> <li>Mean length of stay 5.9±6.7 days</li> <li>Mean age 62.8 ±19.9 yrs</li> <li>50.6% males</li> <li>Medical patients 65.2%, surgical patients 34.8%</li> </ul>	<p>Staffing was based on ward category</p> <p>Data was obtained from databases on patient diagnostic criteria (ICD-10) and staffing records</p> <p>Staffing hours were calculated with consideration to on-call times, non-productive hours (e.g. leave) and hand-over periods</p>	<p><b>Nurse sensitive outcomes</b></p> <p>Pressure ulcer ICD-10 codes</p> <p><b>Staffing levels</b></p> <ul style="list-style-type: none"> <li>Understaffing = staff hours worked on any shift were 8 hours less than the mean for that shift (10 hours at night)</li> </ul>	<p><b>Nurse sensitive outcomes – PU</b></p> <p>N=262 PU</p> <p>Prevalence: 0.72%</p> <p>prevalence in patients not exposed to understaffing: 0.39%</p> <p>prevalence in patients not exposed to understaffing: 1.09%</p> <p>prevalence ratio: 2.80</p> <p><b>Logistic regression for understaffed variable</b></p> <p>Pressure ulcer OR 1.07 (95% CI 1.05 to 1.09, p&lt;0.001)</p> <p><b>Conclusions: understaffing may increase risk of PU</b></p>	<ul style="list-style-type: none"> <li>Understaffing was assumed at specific levels without consideration to patient load at the time</li> <li>Relied on database review and accurate ICD-10 coding</li> <li>Assumed that regular staffing was sufficient to prevent PU</li> <li>Only one hospital</li> </ul>	<p><b>Level of evidence: 3 prognostic</b></p> <p><b>Quality: low</b></p>
Mangaco-Borja, 2011	Quality improvement project and prevalence study <b>investigating the impact of a work</b>	<p>A 100-bed long term care skilled nursing facility in US.</p> <ul style="list-style-type: none"> <li>Participants were residents and 30 nursing assistants.</li> </ul>	<ul style="list-style-type: none"> <li>Nursing assistants were assigned to a permanent schedule of patients for whom they provided daily care (defined as the same nursing assistant cares for the same group of patients for at least 85% of the assistants shift).</li> </ul>	<p>Outcome was the quarterly pressure ulcer rate per 1000 patient days (however annual rates were reported in the paper).</p> <ul style="list-style-type: none"> <li>Data for four years was presented</li> </ul>	<p>The overall rate of pressure ulcers decreased from 2.48/1000patient days in 2007 to 0.4/1000patient days in 2010</p>	<p>No indication of who assessed pressure ulcer incidence.</p> <p>No indication of pressure ulcer staging</p> <p>Not clear if patients were at similar risk of</p>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	assignment intervention in aged care on PU rates		Consistent education was also provided to new staff throughout the project.			PU at each time collection point <ul style="list-style-type: none"> <li>No reporting of compliance with the intervention (although this data was collected)</li> </ul>	
Horn, 2008	Retrospective cohort study investigating association between cost-benefit of levels of nurse staffing and PU development in aged care	Long-term care facilities (n=11) in US	No intervention	<ul style="list-style-type: none"> <li>Cost: national database for cost; Bureau of Labor and statistics for wages; Healthcare cost and utilization project fir mean hospital charges; articles of Xakellis and Frantz (1996) for cost of PU</li> <li>PU development : Database designed by an expert multidisciplinary panel.</li> <li></li> </ul>	<b>RN direct care time</b> <ul style="list-style-type: none"> <li>There was a trend or threshold decrease of residents developing PUs for each 10-minute increase in RN direct care time, with lowest complications rates for 30-40 minutes per resident per day.</li> <li>RN direct care time (30-40 minutes per resident per day) and PU development: OR: 0.16</li> </ul> <b>Cost benefit</b> <ul style="list-style-type: none"> <li>societal benefit of \$319,120 per year for a 100-bed high risk nursing home or \$3,191 for 10 to30-40 minutes per resident per day (reduction in adverse event versus increased cost of nurse wages)</li> </ul> After excluding hospitalization saving the total costs increased by \$199,507 for a 100-bed high-risk nursing home	<ul style="list-style-type: none"> <li>Difference in groups poorly described</li> <li>Number of persons asked to participate is not reported.</li> <li>Drop-out not reported</li> <li>No information on validity, reliability of measurements</li> <li>Main outcomes are not identified and entered in the analysis.</li> </ul>	<b>Level of evidence: 3</b>  <b>Quality: low</b>
Konetzka, Stearns, & Park, 2008	Prospective cohort study effect of staffing models in aged care on pressure ulcer development	<ul style="list-style-type: none"> <li>Nursing homes in the US (1,366 facilities, n=399,206 resident assessments).</li> </ul>	No intervention	<ul style="list-style-type: none"> <li>Staffing: Minimal Data Set (MDS) and Online Survey Certification (OSCAR)</li> <li>PU development : MDS</li> <li></li> </ul>	<b>RN hours per resident day and PU development</b> <ul style="list-style-type: none"> <li>There was a significant relationship (p&lt;0.01) when adjusting for time trends, resident level controls (e.g. age and stroke), and facility level controls (e.g. adl, medicare)</li> <li>There was a significant relationship (p&lt;0.01) using conditional logit with tradition two-stage least square approach adjusted for time trends, resident level controls (e.g. age and stroke), and facility level controls (e.g. adl, medicare)</li> <li>There was a significant relationship (p&lt;0.01) using conditional logit with residential-inclusion approach (adjusted</li> </ul>	<ul style="list-style-type: none"> <li>Difference in groups poorly described</li> <li>Number of persons asked to participate is not reported.</li> <li>Drop-out not reported</li> <li>No information on validity, reliability of measurements</li> <li>Confounders: time trends, resident level controls (e.g. age and stroke), and facility level</li> </ul>	<b>Level of evidence: 3</b>  <b>Quality: low</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
					<p>for time trends, resident level controls (e.g. age and stroke), and facility level controls (e.g. adl, medicare)</p> <p><b>Skill mix and PU development</b></p> <ul style="list-style-type: none"> <li>• there was no significant relationship (<math>p&gt;0.05</math>) when adjusted for time trends, resident level controls (e.g. age and stroke), and facility level controls (e.g. adl, medicare)</li> <li>• there was no significant relationship (<math>p&gt;0.05</math>) using conditional logit with tradition two-stage least square approach (also adjusted for above factors)</li> <li>• There was no significant relationship (<math>p&gt;0.05</math>) using conditional logit with residential-inclusion approach) (adjusted for time trends, resident level controls (e.g. age and stroke), and facility level controls (e.g. adl, medicare)</li> </ul>	controls (e.g. adl, medicare)	
Hart & Davis, 2011	Cohort study investigating the association between staffing indicators and hospital-acquired pressure ulcers (HAPU)	Hospitals (n=5, n=26 nursing units) in US	No intervention	<ul style="list-style-type: none"> <li>• Staffing indicators: National database of nursing quality indicators (NDNQI)</li> <li>• HAPU: NDNQI</li> </ul>	<p><b>Medical-surgical units</b></p> <ul style="list-style-type: none"> <li>• factors significantly associated with HAPU:                             <ul style="list-style-type: none"> <li>○ Total nursing care hours/patient day (<math>r=-0.485</math>; <math>p&lt;0.05</math>)</li> <li>○ RN hours per patient day (<math>r=-0.525</math>; <math>p&lt;0.05</math>)</li> <li>○ RN hours by agency staffing (<math>r=0.586</math>; <math>p=0.022</math>)</li> </ul> </li> <li>• factors not significantly related to HAPU:                             <ul style="list-style-type: none"> <li>○ Licensed practical nurse hours per patient day (<math>r=-0.112</math>; <math>p&gt;0.05</math>)</li> <li>○ Unlicensed assistive personnel hours per patient day (<math>r=0.301</math>; <math>p&gt;0.05</math>)</li> </ul> </li> </ul> <p><b>Critical care units</b></p> <p>factors not significantly related to HAPU:</p> <ul style="list-style-type: none"> <li>• Total nursing care hours per patient day (<math>r=-0.119</math>; <math>p&gt;0.05</math>)</li> <li>• RN hours per patient day (<math>r=-0.524</math>; <math>p&gt;0.05</math>)</li> </ul> <p>Licensed practical nurse hours per patient day (<math>r=0.233</math>; <math>p&gt;0.05</math>)</p>	<ul style="list-style-type: none"> <li>• Difference in groups poorly described</li> <li>• Number of persons asked to participate is not reported.</li> <li>• Drop-out not reported</li> <li>• No information on validity, reliability of measurements</li> <li>• Main outcomes are not identified and entered in the analysis.</li> </ul>	<p><b>Level of evidence: 3</b></p> <p><b>Quality: low</b></p>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
Gunninberg, Brudin, & Idvall, 2010	Cross-sectional study <b>investigating relationship between PU prevalence and contextual factors in the hospital organization</b>	Participants were nurse managers in hospitals in Sweden County A: non-university hospital with 565 beds (n=27 nurses) • County B: university hospital with 1000 beds (n=45 nurses)	No intervention	<ul style="list-style-type: none"> <li>Contextual factors: University Health Systems Consortium operational database</li> <li>PU prevalence: EPUAP Minimal Data Set</li> <li></li> </ul>	<p><b>PU prevalence</b></p> <ul style="list-style-type: none"> <li>There was no significant difference in PU prevalence (grade 1 to 4) between university county hospitals and non-university county hospitals (p=0.903)</li> <li>PU prevalence was significantly lower in non-university county hospitals than in university county hospitals when grade 1 PU (p=0.035)</li> </ul> <p><b>PU prevention planning</b></p> <ul style="list-style-type: none"> <li>No significant difference between University county hospitals and non-university county hospitals (p=0.724)</li> <li>No significant difference between University county hospitals and non-university county hospitals for patients with PU grade 1 without prevention plan (p=0.155)</li> <li>University county hospitals were significantly more likely to have PU management guidelines than non-university county hospital (p=0.025)</li> </ul> <p><b>Staffing</b></p> <ul style="list-style-type: none"> <li>University county hospitals had significantly more RNs responsible for PU planning than non-university county hospital (p=0.017)</li> </ul> <p>No significant difference between University county hospitals and non-university county hospitals for number of assistant nurses responsible for PU prevention (p=0.527)</p>	<ul style="list-style-type: none"> <li>Main outcomes are not identified and entered in the analysis.</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: moderate</b></p>
Temkin-Greener, Cai, Zheng, Zhao, & Mukamel, 2012	Cross sectional study <b>investigating influence of working environment on PU prevalence</b>	Nursing homes in one US state (n=162) Direct care workers in the facilities (n=7,418) were invited to participate  Facility characteristics: <ul style="list-style-type: none"> <li>all facilities &gt; 50 beds</li> <li>operating &gt; 2 years</li> </ul>	No intervention	<p>PU prevalence as ascertained from MDS database review</p> <p>Primary work environment outcomes were:</p> <ul style="list-style-type: none"> <li>Staff cohesion and commonality of goals</li> <li>consistent assignment</li> <li>care team models</li> </ul>	<ul style="list-style-type: none"> <li>After controlling for independent resident risk factors and facility characteristics, residents in facilities with stronger staff cohesion have significantly lower odds of PUs (OR=0.958; p =0.035)</li> <li>After controlling for independent resident risk factors and facility characteristics, residents in facilities with self-managed care teams had higher odds of PU (OR=1.001, p=0.001)</li> </ul>	<ul style="list-style-type: none"> <li>No experimental design, correlation data only</li> <li>162 out of 600 and facilities had significant differences to overall possible sample, so possible response bias</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: low</b></p>

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## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		<ul style="list-style-type: none"> <li>no special-needs patients</li> <li>Mean PU prevalence 13.7±6.5% (compared with 14.6±7.1% for all facilities in the state, p=0.064)</li> <li>Significantly more of the facilities were not for profit compared to State statistic (p=0.001)</li> <li>Facilities had a mean LPN hours/resident/day that was significantly higher than the state mean (p=0.001)</li> <li>Facilities had significantly fewer Medicaid residents compared with the State mean (p=0.033)</li> </ul> <p>Participant characteristics:</p> <ul style="list-style-type: none"> <li>50% CNAs, 19% LPNs, 13% RNs, 18% other including allied health</li> </ul>		<ul style="list-style-type: none"> <li>assessed through items on a 7-point Likert scale (previous validation reported)</li> </ul>	<ul style="list-style-type: none"> <li>No association between PU prevalence and formal care teams (p=0.372), nursing hours per patient per day (p=0.615) or primary assignment care model (p=0.262).</li> </ul>	<ul style="list-style-type: none"> <li>Relied on database evidence, may be inaccurate, unable to determine how presence of PU was initially assessed</li> </ul>	
Decker & Castle, 2011	Cross-sectional study <b>investigating the relation between job tenure of NHAs and DONs in aged care with</b>	<ul style="list-style-type: none"> <li>Nursing homes in the US</li> <li>Participants were nursing home administrators (NHA, n=787) and directors of nursing (DON, n=703)</li> </ul>	No intervention	Job tenure NHAs and DONs: National Nursing Home Survey (NNHS) PU prevalence: Minimal Data Set (MDS)	<p><b>NHAs</b></p> <ul style="list-style-type: none"> <li>overall there was no significant relationship between length of time NHA had been in job and PU prevalence: p=0.205</li> <li>job tenure ≥10 years and PU prevalence: p=0.040</li> <li>job tenure 5-9 years and PU prevalence: p=0.377</li> <li>NHA job tenure 3-4 years and PU prevalence: p=0.294</li> </ul>	<ul style="list-style-type: none"> <li>Number of persons asked to participate is not reported.</li> <li>No information on validity, reliability of measurements</li> <li>Unclear if multiple sites are comparable</li> <li>Main outcomes are not identified and</li> </ul>	<p><b>Level of evidence: 4</b></p> <p><b>Quality: low</b></p>

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Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
	prevalence of PU				<p><b>DONs</b></p> <ul style="list-style-type: none"> <li>overall there was a significant relationship between length of time DON had been in position and prevalence of PU ( p=0.008)</li> <li>job tenure ≥10 years and PU prevalence: p=0.026</li> <li>DON job tenure 5-9 years and PU prevalence: p=0.010</li> <li>DON job tenure 3-4 years and PU prevalence: p=0.709</li> </ul>	entered in the analysis.	
<b>Cost effectiveness of quality improvement plans</b>							
Mathiesen, Norgaard, Andersen, Moller, & Ehlers, 2013	To investigate the cost-effectiveness of labour intensive efforts to reduce pressure ulcers	Hospital in Denmark	<p>Standard arm = standard care, no bundle of care</p> <p>PUB arm = 100% of the patients experienced an admission with full adherence to all the elements of the PUB</p> <p>The four elements of the PUB are:</p> <ul style="list-style-type: none"> <li>All newly hospitalized patients assessed for risk of g pressure ulcers.</li> <li>Patients at risk pressure ulcers reassessed daily.</li> <li>Patients at risk should be nutrition screened.</li> <li>Patients at risk should be mobilized optimally and</li> <li>decompression used when repositioning</li> </ul>	<ul style="list-style-type: none"> <li>A decision analytic model was developed to estimate the expected incremental cost-effectiveness ratio (ICER) of the PUB compared to the current practice, standard care.</li> <li>Calculations of costs followed international guidelines for health economic evaluations</li> <li>Only the marginal costs of labour intensive improvements included in the analysis</li> </ul>	<ul style="list-style-type: none"> <li>The potential net savings were estimated to be 38.62 per patient (Euros).</li> <li>During the standard care approach 81.4% did not develop a PU</li> <li>PUB arm, 90.7% did not develop a PU.</li> <li>This equated to a 9.3% reduction in pressure ulcers for the PUB.</li> <li>The survival rate was 99.06% for the standard care approach and 99.53% for the PU.</li> </ul> <p><b>The results indicate that an implementation of the PUB yields both lower costs and greater effects in relation to prevented pressure ulcers and saved lives.</b></p>	<ul style="list-style-type: none"> <li>Based on pilot study</li> <li>Data from one hospital was used to estimate the burden and results of 5 hospitals</li> <li>No sample size</li> <li>No ethics discussed</li> </ul>	<b>Low quality economic analysis</b>
<b>Studies with indirect outcome measures (i.e. do not report pressure injury incidence)</b>							
Latimer, Chaboyer, &	Observational study investigating	Four medical units in two Australian hospitals (units of 25 to 40 beds) (n=241)	<ul style="list-style-type: none"> <li>Audit of the following practices:                             <ul style="list-style-type: none"> <li>PU risk assessment</li> </ul> </li> </ul>	Data collected from charts, observation over 28 days, with 7	<b>Pressure injury assessment</b>	<ul style="list-style-type: none"> <li>Small sample size</li> <li>Two facilities</li> <li>No comparators</li> </ul>	<b>Indirect evidence: PU not an</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
Gillespie, 2016	PU practice in medical units	<p>Inclusion criteria: Patients aged ≥ 18 years Length of stay ≥ 3days Reduced mobility</p> <p>Subsample participant characteristics:</p> <ul style="list-style-type: none"> <li>• Mean age 70 years</li> <li>• Predominantly male</li> <li>• Mean length of stay 5-6 days</li> </ul>	<ul style="list-style-type: none"> <li>○ Prevention management plan</li> <li>○ Use of support surfaces</li> <li>○ Regular repositioning</li> <li>○ Patient education</li> </ul> <p>A subsample of 45 participants at high PU risk were used for data collection on interventions after risk assessment</p>	<p>random days spent in each unit</p> <ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• IN hospital A 71.5% received no assessment and 18.8% had a fully completed assessment</li> <li>• In Hospital B 13.1% had no assessment and 55.3% had a fully completed assessment</li> </ul> <p><b>PU interventions for sub-sample</b></p> <ul style="list-style-type: none"> <li>• IN Hospital A 0% had support surfaces planned and 45.5% had repositioning planned</li> <li>• IN Hospital A 27.3% had support surfaces implemented and 47.1% had repositioning planned</li> <li>• IN Hospital B 41.2% had support surfaces planned and 45.5% had repositioning planned</li> <li>• IN Hospital B 55.9% had support surfaces implemented and 88.2% had repositioning planned</li> <li>• There was no significant relationship between planning and implementing interventions</li> </ul>	<ul style="list-style-type: none"> <li>• Short observation period</li> </ul>	outcome measure
Rolland et al., 2016	Observational study exploring impact of a global intervention on improving quality care in nursing homes	<p>Study was conducted in nursing homes in one region of France (243 volunteered, 175 met inclusion criteria)</p> <p>Inclusion criteria: Facilities: voluntary participation of facility Residents: random selection within facility or all residents for facilities with &lt; 30 residents, living in facility &gt; 30 days</p> <p>Exclusion criteria:</p>	<p>Facilities were assigned to the intervention based on following criteria:</p> <ul style="list-style-type: none"> <li>• presence of a hospital with a geriatric department within the administrative subarea,</li> <li>• voluntary</li> <li>• participation in the study by hospital geriatricians,</li> <li>• presence of ≥ three or nursing homes in the administrative subarea (n=85 facilities commenced, n=77 facilities at 18 months, n=2652 residents at 18 months)</li> </ul> <p>Intervention consisted of:</p>	<ul style="list-style-type: none"> <li>• Questionnaires completed by facility director before and after the intervention</li> <li>• Prevalence of PU risk assessments</li> <li>• Other clinical indicators</li> </ul>	<p><b>Prevalence of assessment of pressure ulcer risk</b></p> <ul style="list-style-type: none"> <li>• Significant improvement in intervention group from baseline to 18 months (mean 26.3 ± 34.9 versus mean 54.0 ± 41.8, p&lt;0.001)</li> <li>• Significant improvement in control group from baseline to 18 months (mean 18.3 ± 31.2 versus mean 32.8 ± 40.5, p&lt;0.001)</li> <li>• Significant difference between groups favoring intervention group (p=0.03)</li> </ul>	<ul style="list-style-type: none"> <li>• PU was not an outcome measure</li> <li>• Residents who dropped out were replaced by other randomly selected residents</li> <li>• Hawthorne effect may have been a factor in improvements</li> <li>• Multi-faceted intervention that was not specifically targeted at PU reduction</li> </ul>	Indirect evidence: PU not an outcome measure

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Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
		<p>Facilities: Participation in any other research studies Residents: Doctor not consenting</p> <p>Participant characteristics:</p> <ul style="list-style-type: none"> <li>72 to 75% females</li> <li>Mean age 85 to 86 years (significantly older in control group, p=0.02)</li> <li>No significant baseline difference in ADL scores, BMI, dementia or other comorbidities, length of stay</li> <li>No significant difference between facilities in staffing level or skills mix</li> </ul>	<ul style="list-style-type: none"> <li>audit of practice and feedback to staff members</li> <li>2 half day meetings with an interprofessional team to develop strategy to address audit results</li> <li>Strategy plans addressed deficits in all areas of care and included internal organization, collaborative organization at the healthcare subarea level and specific areas of training conducted by geriatricians.</li> <li>Control group received audit and feedback intervention only (n=90 facilities commenced, n=86 facilities at 18 months, n=3085 residents at 18 months) (n=90)</li> </ul>				
<b>Jacobson, Thompson, Halvorson, &amp; Zeitler, 2016</b>	Quality improvement project to standardize and streamline PU-related documentation	QI project was conducted in one 1,242 bed academic hospital.	<ul style="list-style-type: none"> <li>Documentation reviews indicated the following areas were poorly documented: skin assessments, repositioning, heel elevation and rewrapping compression bandaging</li> <li>Appropriate charting words were identified</li> <li>Electronic records were redeveloped to include space for documenting the above areas</li> <li>Staff received monthly meetings to discuss documentation and PU preventive care</li> </ul>	<p>Auditing of the documentation of 4 areas of concern: skin assessments, repositioning, heel elevation and rewrapping compression bandaging was conducted on a monthly basis</p> <ul style="list-style-type: none"> <li></li> </ul>	<p><b>Changes in documentation patterns over 12 months</b></p> <ul style="list-style-type: none"> <li>Skin inspection at pressure points documentation increased from 86% records to 93%</li> <li>Heel elevation documentation increased 18%</li> </ul> <p>Documentation of rewrapping compression bandaging increased 6%</p>	<ul style="list-style-type: none"> <li>No direct measure of impact on PU prevalence</li> <li>Characteristics of facilities, patients and nursing workforce not reported</li> <li></li> </ul>	<b>Indirect (PU not an outcome measure)</b>

## Implementing Best Practice : Data extraction and appraisals

Ref	Type of Study	Sample	Intervention(s)	Outcome Measures & Length of Follow-up	Results	Limitations and comments	
			<ul style="list-style-type: none"> <li>Monthly analysis was used to trigger ongoing changes required for documentation system</li> </ul>				
<b>Thomason et al., 2016</b>	Quality improvement project aimed at introducing a PU assessment tool into SCI facilities	<p>Spinal Cord/Disorders Centers in Veterans Affairs facilities in the US (n=23)</p> <p>No facility characteristics reported</p>	<ul style="list-style-type: none"> <li>SCI-PUMT kit designed to increase use of the Spinal Cord Impairment Pressure Ulcer Monitoring Tool (SCI-PUMT) in SCI facilities</li> <li>Kit includes:                             <ul style="list-style-type: none"> <li>4 video presentations</li> <li>A training flyer</li> <li>The SCI-PUMT</li> <li>Staff knowledge and competency tests</li> <li>Two training manikins</li> <li>Guides to using SCI-PUMPT</li> <li>Healing continuum graphs</li> <li>Facility implementation plan</li> <li>Guideline for overcoming barriers to implementation</li> </ul> </li> <li>Implementation strategy included a 15-day educational and strategy conference with clinical champions from SCI centers</li> <li>Availability of kit from website</li> <li>Condensed video conference training offered to staff</li> <li>Five year follow up with conference calls to facilities and ongoing PDSA QI cycle planning at national level with clinical champions</li> </ul>	<ul style="list-style-type: none"> <li>Staff engagement in SCI-PUMT education (number of tool kit downloads from website)</li> <li>Facilitators and barriers (comments from clinical champions)</li> <li>Knowledge levels (pre/post test knowledge conducted at a conference) using a previously validated knowledge tool with 10 questions</li> </ul>	<p><b>Pre-post knowledge test (n=51)</b></p> <ul style="list-style-type: none"> <li>3/10 questions answered correctly by ≥ 85% participants in pre test</li> <li>10/10 questions answered correctly by ≥ 95% participants in post test</li> </ul> <p><b>Staff engagement</b></p> <ul style="list-style-type: none"> <li>30 sites were high adopted with 76-100% of staff received education and used SCI-PUMT</li> <li>More than half the facilities reported ,50% of Pus were assessed with SCI-PUMT</li> <li>3 sites used all components of SCI-PUMT</li> <li>3,254 downloads of kit components from website</li> </ul> <p><b>Facilitators</b></p> <ul style="list-style-type: none"> <li>Improvement in wound care costs</li> <li>Integrated documentation system</li> <li>Education and standardized documentation improved</li> <li>Interprofessional involvement</li> <li>Use of a trajectory graph made identification of stagnate wounds easier</li> <li>Weekly wound rounds facilitated interprofessional approach</li> </ul> <p><b>Barriers</b></p> <ul style="list-style-type: none"> <li>Lack of patient availability on ward rounds</li> <li>Lack of integration into electronic document system</li> <li>Low access to training manikin</li> <li>Lack of buy in from swound care nurses/teams</li> <li>Time and work load constraints</li> </ul>	<ul style="list-style-type: none"> <li>PU prevalence was not an outcome measure</li> <li>No reporting of facility characteristics</li> <li>Connection between intervention and improved patient care or improved knowledge is indirect</li> </ul>	<b>Indirect evidence (PU not an outcome measure)</b>

## Implementing Best Practice : Data extraction and appraisals

**Table 1: Level of Evidence for Intervention Studies**

<b>Level 1</b>	<b>Experimental Designs</b> <ul style="list-style-type: none"> <li>• Randomized trial</li> </ul>
<b>Level 2</b>	<b>Quasi-experimental design</b> <ul style="list-style-type: none"> <li>• Prospectively controlled study design</li> <li>• Pre-test post-test or historic/retrospective control group study</li> </ul>
<b>Level 3</b>	<b>Observational-analytical designs</b> <ul style="list-style-type: none"> <li>• Cohort study with or without control group</li> <li>• Case-controlled study</li> </ul>
<b>Level 4</b>	<b>Observational-descriptive studies (no control)</b> <ul style="list-style-type: none"> <li>• Observational study with no control group</li> <li>• Cross-sectional study</li> <li>• Case series (n=10+)</li> </ul>
<b>Level 5</b>	<b>Indirect evidence:</b> studies in normal human subjects, human subjects with other types of chronic wounds, laboratory studies using animals, or computational models

**Table 2: Levels of evidence for diagnostic studies in the EPUAP-NPUAP-PPPIA guideline update**

<b>Level 1</b>	Individual high quality (cross sectional) studies according to the quality assessment tools with consistently applied reference standard and blinding among consecutive persons.
<b>Level 2</b>	Non-consecutive studies or studies without consistently applied reference standards.
<b>Level 3</b>	Case-control studies or poor or non-independent reference standard.
<b>Level 4</b>	Mechanism-based reasoning, study of diagnostic yield (no reference standard).

**Table 3: Levels of evidence for prognostic studies in the EPUAP-NPUAP-PPPIA guideline update**

<b>Level 1</b>	A prospective cohort study.
<b>Level 2</b>	Analysis of prognostic factors amongst persons in a single arm of a randomized controlled trial.
<b>Level 3</b>	Case-series or case-control studies, or low quality prognostic cohort study, or retrospective cohort study.

### APPRAISAL FOR STUDIES PROVIDING DIRECT EVIDENCE (i.e. ELIGIBLE FOR SUPPORTING AN EVIDENCE-BASED RECOMMENDATIONS)

Each criteria on the critical appraisal forms was assessed as being fully met (Y), partially met or uncertain (U), not met/not reported/unclear (N), or not applicable (NA). Studies were generally described as high, moderate, or low quality using the following criteria:

- High quality studies: fully met at least 80% of applicable criteria
- Moderate quality studies: fully met at least 70% of applicable criteria
- Low quality studies: did not fully meet at least 70% of applicable criteria

## Implementing Best Practice : Data extraction and appraisals

### CROSS SECTIONAL/SURVEY/PREVALENCE STUDIES/OBSERVATIONAL

Endnote ID	Author/year	Focussed question	Sampling method	Representative sample	States number invited participants	Clear outcome measures	Valid reliable outcome measurement	Comparable results for multiple sites	Confounders identified and accounted for	Minimal bias	Reliable conclusions	Level of evidence	Quality
6704	Twigg et al., 2015	Y	Y	Y	Y	Y	N	NA	N	U	U	4	Low
9526	Ma & Park, 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	4	High
9527	Hall & Ryan, 2015	U	U	U	N	Y	N	NA	N	N	N	4	Low
9531	S.-H. Bae & Yoder, 2015	N	N	N	N	Y	N	NA	Y	N	N	4	Low
13696	Harmon, Grobbel, & Palleschi, 2016	Y	U	U	N	Y	U	NA	N	N	N	4	Low
12890	Simon, Maben, Murrells, & Griffiths, 2016	Y	Y	Y	N	N	U	NA	Y	N	Y	4	Moderate
7734	Trinkoff et al., 2015	Y	Y	Y	Y	Y	Y	Y	U	Y	U	4	Moderate
2746	Brosey & March, 2015	Y	Y	Y	N	N	U	NA	N	N	N	4	Low
10924	McCoulough, 2016	U	U	U	N	N	N	U	N	N	N	4	Low
8091	Waters et al., 2015	Y	Y	Y	Y	U	Y	N	N	U	Y	4	Moderate
7633	Anand et al., 2014	N	Y	N	Y	Y	Y	NA	N	U	U	4	Low
2852	S. H. Bae et al., 2014	Y	U	U	Y	Y	U	Y	N	N	N	4	Low
7210	Boltz, Capezuti, Wagner, Rosenberg, & Secic, 2013	Y	U	U	Y	Y	Y	U	N	U	N	4	Low
3206	Boyle, Cramer, Potter, Gatua, & Stobinski, 2014	Y	Y	N	Y	Y	Y	Y	N	Y	Y	4	High
8300	Bredesen, Bjoro, Gunningberg, & Hofoss, 2015	Y	U	Y	N	Y	U	Y	Y	Y	Y	4	Moderate
2822	J. Choi & Staggs, 2014	Y	U	Y	N	Y	U	U	U	Y	Y	4	Moderate
2835	Lee et al., 2014	Y	N	U	Y	Y	U	U	Y	N	Y	4	Moderate
15638	Lewis et al., 2017	Y	N	U	N	N	N	U	N	U	Y	4	Low
13946	Richardson et al., 2017	Y	U	Y	N	N	Y	N	Y	U	Y	4	Low
15064	Smith et al., 2017	Y	N	Y	Y	Y	U	U	N	Y	N	4	Low
6868	Tzeng et al., 2013	Y	Y	U	N	Y	U	N	N	Y	N	4	Low
6353	Young et al., 2014	Y	U	Y	U	Y	Y	NA	Y	U	Y	4	Low

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Endnote ID	Author/year	Focused question	Sampling method	Representative sample	States number invited participants	Clear outcome measures	Valid reliable outcome measurement	Comparable results for multiple sites	Confounders identified and accounted for	Minimal bias	Reliable conclusions	Level of evidence	Quality
8920	Peterson et al., 2015	Y	Y	Y	N	Y	U	NA	N	N	U	4	Low

### RCTS

Endnote ID	Author/year	Focused question	Assignment randomised	Adequate concealment method	Subjects and investigators blinded	Groups comparable at commencement	Only difference btw groups was treatment	Valid, reliable outcome measure	% drop out in study arms is reported and acceptable	Intention to treat analysis	Comparable results for multiple sites	Minimal bias	Reliable conclusions	Level of evidence	Quality
16151	Chaboyer et al., 2016	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	1	High
8962	Tayyib et al., 2015	Y	Y	N	Y	Y	Y	Y	Y	Y	U	Y	Y	1	Moderate

### COHORT STUDIES

Author/year	Focused question	Comparable source populations	States number invited	Likelihood of outcome at enrolment considered	Per cent drop out in study arms is reported	Comparison btw drop outs and participants	Clear outcome measures	Assessment blinded, or discuss potential bias	Valid, reliable assessment with supporting reference	More than one measure of exposure	Confounders identified and accounted for	Provides confidence intervals	Minimal bias	Reliable conclusions	Level of evidence	Quality
6379	Burston et al., 2015	Y	Y	Y	Y	NA	NA	Y	N	Y	Y	N	U	Y	3	moderate
13709	Metcalfe et al., 2016	Y	U	Y	N	NA	NA	N	N	U	N	Y	N	Y	3	Low
9514	Wen et al., 2015	Y	U	Y	N	NA	NA	Y	N	N	U	Y	U	U	3	low
9779	Stifter et al., 2015	Y	Y	Y	Y	NA	NA	Y	NA	Y	U	Y	Y	Y	3	Moderate
10819	Padula et al., 2016	Y	U	N	U	NA	NA	Y	U	U	U	N	N	N	3	low
3004	Van Leen et al., 2014	Y	U	N	N	NA	NA	Y	U	U	N	N	U	N	3	Low
2927	Olsho et al., 2014	Y	U	N	Y	NA	NA	Y	N	U	Y	N	N	N	3	Low



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### PROGNOSTIC STUDIES

	Author/year	Adequate description of baseline characteristics	Satisfactory study attrition	Clear outcome measures/prognostic factors	Range of prognostic factors/confounders measured identified and accounted for	Method of measuring prognostic factor is reported, valid and reliable	Same method of measure of prognostic factor for all	Continuous variables or appropriate cut offs	Percent participants with complete data acceptable	Appropriate imputation method	Confounders/prognostic factors accounted for in analysis	Selective reporting avoided	Adequate sample size (10 PIs per factor)	Level of evidence	Quality
13955	Patrician et al., 2017	Y	Y	Y	Y	U	U	Y	Y	U	N	N	U	3	Low

### QUASI EXPERIMENTAL STUDIES

	Author/year	Focused question	Subjects and investigators blinded	Groups comparable at commencement	Only difference btw groups was treatment	Valid, reliable outcome measurement	Per cent drop out in study arms is reported and acceptable	Intention to treat analysis	Comparable results for multiple sites	Minimal bias	Reliable conclusions	Level of evidence	Quality
10775	Sebastian-Viana et al., 2016	Y	N	N	U	N	N/A	Y	N/A	U	U	2	low
9452	Anderson et al., 2015	Y	N	Y	Y	Y	U	U	NA	U	Y	2	Moderate
7137	Antonio & Conrad, 2013	Y	N	U	U	Y	NA	U	U	U	U	2	Low
7068	Armour-Burton, Fields, Outlaw, & Deleon, 2013	N	N	U	U	U	U	Y	NA	N	N	2	Low
3042	Beinlich & Meehan, 2014	Y	N	Y	Y	Y	U	U	N	Y	Y	2	Moderate
9384	Coyer et al., 2015	Y	N	Y	Y	Y	Y	Y	NA	Y	Y	2	High
2820	Crawford et al., 2014	Y	N	Y	U	Y	U	U	NA	Y	N	2	Low
16249	Fisher et al., 2016	Y	N	Y	Y	Y	NA	Y	N	Y	Y	2	High
2751	Mallah et al., 2014	Y	N	U	U	Y	U	U	N	Y	Y	2	Low
8897	Padula et al., 2015	Y	U	Y	U	U	NA	U	NA	N	U	2	Low
17780	Shieh et al., 2018	Y	N	U	U	U	N/A	U	U	N	U	2	Low

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