

Evidence to Decision Frameworks: Nutrition for Prevention and Treatment of Pressure Injuries

Clinical question What are accurate and effective methods for assessing nutritional status of individuals with or at risk of pressure injuries?

Recommendation 4.1 **Conduct nutritional screening for individuals at risk of a pressure injury.**

Option: Conducting a nutritional screening using a valid screening tool
Comparison: Not conducting nutritional screening using a screening tool.

Background: There is an association between being malnourished and developing a pressure injury.^{1,2} Using a tool to screen for malnutrition may identify individuals at risk of a pressure injury who require a comprehensive nutritional assessment to enable care planning to address this risk factor for pressure injuries.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence?	<table border="0"> <tr> <td>N/A</td> <td>Very low</td> <td>Low</td> <td>Moderate</td> <td>High</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	N/A	Very low	Low	Moderate	High	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>Effectiveness of nutritional screening in preventing pressure injuries</p> <ul style="list-style-type: none"> Screening using the Malnutrition Universal Screening Tool (MUST) led to faster introduction of a nutritional intervention than when no screening was performed. More individuals received a nutritional intervention (8.1% vs 6.1%, p<0.01) and there was a subsequent 50% drop in pressure injuries (p=not reported).³ (Level 3, low quality) <p>Effectiveness of nutrition screening in identifying individuals at risk of pressure injuries</p> <ul style="list-style-type: none"> In older hospitalized adults (n=422), MNA[®] score was significantly associated with pressure injuries in a multivariable logistic analysis after adjusting for total protein, albumin, cholinesterase and triglyceride, (odds ratio [OR] 0.715, 95% CI 0.546 to 0.937, p=0.01).⁴ (Level 3 prognostic, low quality) 14.7% of people identified as being malnourished using the MNA[®] went on to develop a pressure injury, compared to no people screened as being well nourished or at risk of being malnourished.⁵ (Level 1 prognostic, moderate quality) Individuals screened as being malnourished using MUST were significantly more likely to develop a pressure injury (odds ratio [OR] 7.013, 95% confidence interval [CI] 2.152 to 23.506, p=0.007), while those screened as being at risk of malnourishment using MUST also were significantly more likely to develop a pressure injury (OR 3.398, 95% CI 1.209 to 9.552, p=0.020).⁶ (Level 3 prognostic, moderate quality) <p>Effectiveness of nutrition screening in identifying individuals with pressure injury risk factors</p> <ul style="list-style-type: none"> Individuals (n=274) screened on admission as having malnutrition using the MNA[®] were significantly more likely to have risk factors associated with pressure injuries including being on bed rest (p<0.05), having a fracture (p<0.05) and being admitted to hospital (p<0.05).⁵ (Level 1 prognostic, moderate quality) Individuals (n=471) screened on admission using the MUST were more likely to be identified as having factors associated with pressure injury risk including low body mass index (BMI; <18.5; odds ratio [OR]=7.893; 95% confidence interval [CI] 1.783 to 28.932, p=0.003), high BMI (>28; OR=2.861; 95% CI 1.068 to 8.458, p=0.047), MUST status of at-risk of malnutrition (OR=3.398 95% CI 1.209 to 9.552 p=0.020) MUST status of malnourished (OR=7.013 95% CI 2.152 to 23.506 p=0.007), recent weight loss (OR=2.356, 95% CI 1.097 to 5.721, p=0.027).⁶ (Level 3, moderate quality) In a rehabilitation setting, being screened with the MNA[®] on admission as having malnutrition was significantly associated with having other risk factors for pressure injuries, including dependence in ADL (p=0.102).⁷ (Level 4, low quality)
	N/A	Very low	Low	Moderate	High								
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	Is there important uncertainty about how much people value the main outcomes?	<table border="0"> <tr> <td>Important uncertainty or variability</td> <td>Possibly important uncertainty or variability</td> <td>Probably no important uncertainty or variability</td> <td>No important uncertainty or variability</td> <td>N/A</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	Important uncertainty or variability	Possibly important uncertainty or variability	Probably no important uncertainty or variability	No important uncertainty or variability	N/A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
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No	Probably No	Uncertain	Probably Yes	Yes	N/A										
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RESOURCE USE	How substantial are the resource requirements?	<table border="0"> <tr> <td>Not clear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	Not clear	Not substantial	Probably not substantial	Probably substantial	Substantial	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<p>Resource requirements</p> <p>There is no evidence on resources required to implement nutritional screening. However, conducting nutritional screening is not considered to be time consuming.¹⁰ (<i>Expert opinion</i>)</p> <p>Resource use</p> <p>Screening using the MUST led to faster introduction of nutritional intervention compared to no nutritional screening (mean time < 24 hours versus 2.3 days). This led to an 8.8% reduction in cost of hospitalization of individuals with pressure injuries (p<0.01).³ (<i>Level 3, low quality</i>)</p>
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PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available
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No	Probably No	Uncertain	Probably Yes	Yes	Varies										
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FEASIBILITY	Is the option feasible to implement?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Conducting a nutrition screening is feasible in all settings (<i>Expert opinion</i>)
No	Probably No	Uncertain	Probably Yes	Yes	Varies										
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Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings
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Strength of recommendation	Strong negative recommendation: Definitely don't it	Weak negative recommendation: Probably don't do it	No specific recommendation	Weak positive recommendation: Probably do it	Strong positive recommendation: Definitely do it
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Justification	Direct evidence from a moderate quality Level 1 prognostic study ⁵ and two Level 3 prognostic studies ^{4,6} indicates that being identified as malnourished or at risk for malnutrition through nutritional screening is associated with being more likely to be at pressure injury risk and more likely to develop a pressure injury. Evidence from a low quality Level 3 study ³ suggests that implementation of nutritional interventions occurs faster in individuals identified at nutritional risk through nutritional screening, and this is associated with up to 50% reduction in pressure injury rates, decreased length of hospital stay, which could lead to decreased healthcare costs.				

Clinical question What are accurate and effective methods for assessing nutritional status of individuals with or at risk of pressure injuries?

Recommendation 4.2 **Conduct a comprehensive nutrition assessment for individuals at risk of a pressure injury who are screened to be at risk of malnutrition and for all individuals with a pressure injury.**

Option: Conducting a comprehensive nutrition assessment that includes key indicators of nutritional status.

Comparison: Not conducting a nutrition assessment.

Background: The nutrition care process, adapted by the Academy of Nutrition and Dietetics in 2003, is comprised of four steps: nutrition assessment, nutrition diagnosis, nutrition intervention and nutrition monitoring and evaluation. The assessment step includes assessing food/nutrition related history, anthropometric measurements, biochemical data and medical tests and procedures.¹²

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE				
BENEFITS & HARMS OF THE PRACTICE	What is the overall certainty of the evidence?	<i>No included studies</i> <input type="checkbox"/>	<i>Very low</i> <input checked="" type="checkbox"/>	<i>Low</i> <input type="checkbox"/>	<i>Moderate</i> <input type="checkbox"/>	<i>High</i> <input type="checkbox"/>	<p>Effectiveness for complete pressure injury healing</p> <ul style="list-style-type: none"> People with Category/Stage II or III pressure injuries (n=100) who received an intervention that included nutritional assessment by a dietitian had significantly better rates of healing on Bates-Jensen Wound Assessment Tool at two weeks (38% versus 2%, p<0.05) and at 3 weeks (37% versus 23.4%, p<0.05) compared with a group that were assessed and managed by a physician only.¹³ (<i>Level 2, low quality</i>) <p>Adverse events</p> <p>There are no documented undesirable outcomes from conducting nutritional assessment.</p>
	Is there important uncertainty about how much people value the main outcomes?	<i>Important uncertainty or variability</i> <input type="checkbox"/>	<i>Possibly important uncertainty or variability</i> <input type="checkbox"/>	<i>Probably no important uncertainty or variability</i> <input checked="" type="checkbox"/>	<i>No important uncertainty or variability</i> <input type="checkbox"/>	<i>No known undesirable outcomes</i> <input type="checkbox"/>	
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	Do the desirable effects outweigh the undesirable effects?	<i>No</i> <input type="checkbox"/>	<i>Probably No</i> <input type="checkbox"/>	<i>Uncertain</i> <input type="checkbox"/>	<i>Probably Yes</i> <input checked="" type="checkbox"/>	<i>Yes</i> <input type="checkbox"/>	
			Strength of Evidence: B2 (Level 2 studies of low quality providing direct evidence, plus indirect evidence)				

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS												
RESOURCE USE	How substantial are the resource requirements?	<table border="0"> <tr> <td>Not clear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> <td>Varies</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Not clear	Not substantial	Probably not substantial	Probably substantial	Substantial	Varies	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available.
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No	Probably No	Uncertain	Probably Yes	Yes	Varies										
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Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input type="checkbox"/>	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings <input type="checkbox"/>	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i> <input type="checkbox"/>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings <input checked="" type="checkbox"/>	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings <input type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input type="checkbox"/>	Strong positive recommendation: Definitely do it <input checked="" type="checkbox"/>
Justification	One low quality Level 2 study ¹³ provided evidence that that a nutrition assessment, as one component of a complex nutritional intervention program, contributed to increased pressure injury healing as measured on the Bates-Jensen Wound Assessment Tool. Recognized standards of practice suggest that a comprehensive nutrition assessment involves a systematic process of collecting, verifying, and interpreting data related to nutritional status. ¹⁵				

Clinical question What are accurate and effective methods for assessing nutritional status of individuals with or at risk of pressure injuries?

Recommendation 4.3

Develop and implement an individualized nutrition care plan for individuals with or at risk of a pressure injury who are malnourished or who are at risk of malnutrition.

Option: Develop an individualized nutrition care plan with specific interventions for each patient.

Comparison: Standard nutrition care plan or no specific nutrition intervention.

Background: An individualized nutrition care plan is one that is based on the individual's nutritional needs, feeding route and goals of care, as determined by the nutrition assessment. By tailoring a care plan to the individual, specific nutritional deficits can be corrected, and the interventions can be selected as appropriate to the individual.

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Do the desirable effects outweigh the undesirable effects?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
No	Probably No	Uncertain	Probably Yes	Yes	Varies								
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	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS												
RESOURCE USE	How substantial are the resource requirements?	<table border="0"> <tr> <td><i>Not clear</i></td> <td><i>Not substantial</i></td> <td><i>Probably not substantial</i></td> <td><i>Probably substantial</i></td> <td><i>Substantial</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<i>Not clear</i>	<i>Not substantial</i>	<i>Probably not substantial</i>	<i>Probably substantial</i>	<i>Substantial</i>	<i>Varies</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available.
<i>Not clear</i>	<i>Not substantial</i>	<i>Probably not substantial</i>	<i>Probably substantial</i>	<i>Substantial</i>	<i>Varies</i>										
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<table border="0"> <tr> <td><i>No</i></td> <td><i>Probably No</i></td> <td><i>Uncertain</i></td> <td><i>Probably Yes</i></td> <td><i>Yes</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available.
	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>									
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
	Is the option a priority for key stakeholders?	<table border="0"> <tr> <td><i>No</i></td> <td><i>Probably No</i></td> <td><i>Uncertain</i></td> <td><i>Probably Yes</i></td> <td><i>Yes</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	In a recent survey ¹¹ of patient consumers and their informal caregivers, nutrition screening, assessment and planning were not specifically identified as a priority. However, 71.8% (275/383) of respondents to the survey who identified as having experienced or being at risk of a pressure injury and 64% (544/850) of informal caregivers believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for themselves (<i>Indirect evidence</i>).
<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>										
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
FEASIBILITY	Is the option feasible to implement?	<table border="0"> <tr> <td><i>No</i></td> <td><i>Probably No</i></td> <td><i>Uncertain</i></td> <td><i>Probably Yes</i></td> <td><i>Yes</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Developing a nutrition plan is feasible in most clinical settings, but may be more difficult to implement or monitor in some settings (e.g., community) (<i>Expert opinion</i>)
<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>										

Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input type="checkbox"/>	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings <input type="checkbox"/>	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i> <input type="checkbox"/>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings <input checked="" type="checkbox"/>	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings <input type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input type="checkbox"/>	Strong positive recommendation: Definitely do it <input checked="" type="checkbox"/>
Justification	One low quality Level 2 study ¹³ provided evidence that that a multidisciplinary nutritional intervention that included individualized care planning contributed to increased pressure injury healing as measured on the Bates-Jensen Wound Assessment Tool. The standards of practice for the registered dietitian/nutritionist, through the nutrition care process, recommend the development of individualized care plan for individuals with compromised nutritional status needing specific interventions to resolve nutrition diagnosis. ¹⁶				

Clinical question

What nutritional interventions are effective in preventing pressure injuries?
Is there an ideal nutritional regimen to reduce the risk of pressure injuries, and if so, what should it include?

Recommendation 4.4

Optimize energy intake for individuals at risk of pressure injuries who are malnourished or at risk of malnutrition.

Option: Providing individualized energy intake
Comparison: Providing standard energy intake

Background: Malnutrition is a risk factor for pressure injuries. Individuals are frequently unable to meet estimated requirements due to an impairment in spontaneous food intake. The provision of extra calories is an important strategy to improve anabolism. However, individuals at risk of pressure injuries are frequently characterized by an impairment in spontaneous food intake. Nutrition support, which may include artificial nutrition, is a strategy in satisfying nutritional needs.

		JUDGEMENTS					RESEARCH EVIDENCE
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence?	No included studies <input type="checkbox"/>	Very low <input checked="" type="checkbox"/>	Low <input type="checkbox"/>	Moderate <input type="checkbox"/>	High	<p>Effectiveness in preventing pressure injuries Adults in palliative care (n=63) receiving individualized nutritional support meeting or exceeding energy requirements calculated using the Harris-Benedict equation had significantly fewer Category/Stage I pressure injuries than a control group receiving a standard diet (14% versus 46%, p=0.012).¹⁷ (Level 3, low quality)</p> <p>Effectiveness for indirect outcome measure of improved nutritional intake with supplementation</p> <ul style="list-style-type: none"> Hospitalized older adults at risk of pressure injury who received supplementation had significantly higher energy (p=0.006) and protein (p<0.001) intakes in the intervention compared to those who received only the standard hospital diet.¹⁸ (Indirect evidence) Hospitalized adults at risk of pressure injury due to restricted mobility were 5.1 times more likely to have adequate intake of energy (p<0.05) if they received any form of oral nutrition support.¹⁹ (Indirect evidence) <p>Potential adverse events The available evidence did not report on adverse outcomes.</p> <p>Strength of Evidence: B2 – Level 3 or 4 studies (regardless of quality) providing direct evidence, most studies have consistent outcomes and inconsistencies can be explained, additional indirect evidence)</p>
	Is there important uncertainty about how much people value the main outcomes?	Important uncertainty or variability <input type="checkbox"/>	Possibly important uncertainty or variability <input type="checkbox"/>	Probably no important uncertainty or variability <input type="checkbox"/>	No important uncertainty or variability <input checked="" type="checkbox"/>	No known undesirable outcomes <input type="checkbox"/>	
	How substantial are the desirable anticipated effects?	Unclear <input type="checkbox"/>	Not substantial <input checked="" type="checkbox"/>	Probably not substantial <input type="checkbox"/>	Probably substantial <input type="checkbox"/>	Substantial <input type="checkbox"/>	
	How substantial are the undesirable anticipated effects?	Unclear <input checked="" type="checkbox"/>	Not substantial <input type="checkbox"/>	Probably not substantial <input type="checkbox"/>	Probably substantial <input type="checkbox"/>	Substantial <input type="checkbox"/>	
	Do the desirable effects outweigh the undesirable effects?	No <input type="checkbox"/>	Probably No <input type="checkbox"/>	Uncertain <input checked="" type="checkbox"/>	Probably Yes <input type="checkbox"/>	Yes <input type="checkbox"/>	

		JUDGEMENTS	RESEARCH EVIDENCE												
RESOURCE USE	How substantial are the resource requirements?	<table border="0"> <tr> <td>Not clear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Not clear	Not substantial	Probably not substantial	Probably substantial	Substantial	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> An economic modelling found that 95.1% of individuals at risk of pressure injuries provided with an intensive nutrition support program had an overall cost savings for care provided, with the model predicting over \$5 million in savings (AUD, 2003)²⁰ (<i>Moderate quality economic analysis</i>). A meta-analysis of RCTs reporting nutritional interventions to prevent pressure injuries reported mean cost savings versus standard care for a nutritional intervention was \$425 per person (AUD, 2016) and an increase in quality adjusted life years quality adjusted life years (QALY) by an average of 0.005^{21,22} (<i>Moderate quality economic analysis</i>).
Not clear	Not substantial	Probably not substantial	Probably substantial	Substantial	Varies										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available
	No	Probably No	Uncertain	Probably Yes	Yes	Varies									
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
	Is the option a priority for key stakeholders?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	71.8% (275/383) of respondents to a patient/ informal caregiver survey who identified as having experienced a pressure injury or being at risk of a pressure injury believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for themselves. In the same survey, 64% (544/850) of informal caregivers believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for their family member/friend with or at risk of a pressure injury ^{11,14} (<i>Indirect evidence</i>).
No	Probably No	Uncertain	Probably Yes	Yes	Varies										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
FEASIBILITY	Is the option feasible to implement?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	There is large variability in accessibility to appropriate dietary interventions that may be limited by the clinical and geographic setting. Access to dietary expertise is important to providing an appropriate, individualized diet. (<i>Expert opinion</i>)
No	Probably No	Uncertain	Probably Yes	Yes	Varies										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>										

Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input type="checkbox"/>	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings <input type="checkbox"/>	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i> <input type="checkbox"/>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings <input checked="" type="checkbox"/>	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings <input type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input checked="" type="checkbox"/>	Strong positive recommendation: Definitely do it <input type="checkbox"/>
Justification	Indirect evidence suggests that individuals at risk of pressure injuries and with malnutrition who receive nutritional supplementation have improved energy intake. ^{18,19} One low quality level 3 study ¹⁷ in which individuals were provided with individualized energy intake calculated using the Harris-Benedict equation, there was a reduced incidence of pressure injuries. Analyses indicate that this intervention is cost effective in some geographic locations. ²⁰⁻²²				

Clinical question What nutritional interventions are effective in preventing pressure injuries?
Is there an ideal nutritional regimen to reduce the risk of pressure injuries, and if so, what should it include?

Good practice statement **Adjust protein intake for individuals at risk of pressure injuries who are malnourished or at risk of malnutrition.**
4.5

Background: Malnutrition is a risk factor for pressure injuries. Individuals are frequently unable to meet estimated requirements due to an impairment in spontaneous food intake. The provision of extra calories is an important strategy to improve anabolism. However, individuals at risk of pressure injuries are frequently characterized by an impairment in spontaneous food intake. Nutrition support, which may include artificial nutrition, is a strategy in satisfying nutritional needs.

SUPPORTING EVIDENCE, WHEN AVAILABLE

Evidence to support the opinion (when available)

Recommended protein intake for most healthy adults under 70 years is 0.8g/kg body weight/day.²³⁻²⁵

Clinical guidelines for older adults who do not have a chronic wound recommend protein intake of at least 1g/kg body weight/day.²³⁻²⁵ The Society for Sarcopenia, Cachexia and Wasting Disease suggests protein intake should be 1 to 1.5 g/kg body weight for older adults,²³ while ESPEN²⁴ recommends that until there is sufficient evidence to available to make additional recommendations a minimum of 1.0g/kg body weight/day for older adults (particularly those at risk of malnutrition), with adjustment based on nutritional status, physical activity, disease status and tolerance.²⁴ One study conducted in older adults recommended protein intake of 1.2 to 1.5 g/kg body weight for older adults with acute or chronic disease, increased to 2.0 g/kg body weight daily for individuals with severe illness or injury²⁶ (*Indirect evidence*).

In critically ill individuals, the ASPEN²⁷ recommend performing ongoing evaluation of protein provision adequacy independently from evaluation of energy provision. Suggestion is made to use a weight-based equation in the range 1.2g/kg/day, particularly in the absence of nitrogen balance studies to assess individual needs.²⁷ The ESPEN recommend a protein goal for critically ill individuals of 1.3g/kg/day, achieved progressively²⁸ (*Indirect evidence*).

In critically ill children, ASPEN recommend a minimum intake of 1.5g/kg/day, while noting that the intake required to achieve positive protein balance may be much higher, therefore early and ongoing monitoring and individualized regimen should be a priority²⁹ (*Indirect evidence*).

Justification

Additional provision of protein is recommended for individuals with acute and chronic disease,²⁶ and older adults.²³ There is currently no research evidence to indicate if higher protein intake reduces the incidence of pressure injuries in individuals at risk. Reputable guidelines²³⁻²⁹ suggest that increasing protein intake in individuals with or at risk of malnutrition who may be at pressure injury risk due to illness and/or older age represents good clinical practice.

Clinical question

What nutritional interventions are effective in supporting pressure injury healing?
Is there an ideal nutritional regimen to promote healing of pressure injuries, and if so, what should it include?

Recommendation 4.6 Provide 30 to 35 kcalories/kg body weight/day for adults with a pressure injury who are malnourished or at risk of malnutrition.

Option: Providing individualized energy intake of at least 30kcal/kg/day

Comparison: Providing standard energy intake

Background: Malnutrition and pressure injuries are closely linked. Malnutrition is a risk factor for pressure injuries and pressure injuries themselves are responsible for a deterioration of nutritional status due to increased energy expenditure and protein and nutrient loss. The provision of extra calories is an important strategy to improve anabolism. However, individuals with pressure injuries are frequently characterized by an impairment in spontaneous food intake. Supplemented nutrition is one strategy in satisfying nutritional needs.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence?	<table border="0"> <tr> <td>No included studies</td> <td>Very low</td> <td>Low</td> <td>Moderate</td> <td>High</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No included studies	Very low	Low	Moderate	High	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Effectiveness for complete pressure injury healing</p> <ul style="list-style-type: none"> In older hospitalized adults receiving tube feeding (n=60), there was no significant difference in complete pressure injury healing between an intervention group (12 weeks of nutritional support calculated using BEE x activity factor 1.1 x stress factor 1.3 to 1.5, mean intake 37.9±6.5 kcalories/kg/day and a control group (standard care, mean intake 29.1±4.9 kcalories/kg/day) (intervention 7/30 [23%] versus control 4/30 [13%])³⁰ (Level 1, moderate quality) <p>Effectiveness for measures of pressure injury healing</p> <ul style="list-style-type: none"> In older hospitalized adults receiving tube feeding (n=60), 12 weeks of nutritional support calculated using BEE x activity factor 1.1 x stress factor 1.3 to 1.5 (mean intake 37.9±6.5 kcalories/kg/day) was associated with improved pressure injury size (p<0.001) and depth (p<0.05) compared to standard care (mean intake 29.1±4.9 kcalories/kg/day). Improvements were statistically significant after eight weeks receiving the intervention.³⁰ (Level 1, moderate quality) Older hospitalized individuals (n=194) receiving an estimated energy requirement (30kcal/kg) and an average protein requirement (0.95g/kg) reported improvements in DESIGN-R tool items for deep pressure injuries (decreased wound depth score, p=0.006; improved granulation tissue score, p=0.015; and improvement in necrotic tissue score, p=0.023). There was no significant change in healing outcomes for superficial pressure injuries.³¹ (Level 3, low quality) Mean total energy intake was significantly higher in a group of individuals (n=40) who achieved improvements in pressure injury condition improvement group versus a group with unimproved pressure injury condition (always >30 kcal/kg versus never >20 kcal/kg, p<0.001).³² (Level 3, low quality) <p>Potential adverse effects</p> <ul style="list-style-type: none"> There was no significant difference in rates of adverse events between older institutionalized adults (n=167) receiving higher caloric intake (mean intake 37.9±6.5 kcalories/kg/day) compared to those receiving a lower caloric intake (mean intake 29.1±4.9 kcalories/kg/day, p=0.60).³³ (Level 3, low quality) <p>Strength of Evidence: B1 (Level 1 studies of moderate or low quality providing direct evidence, plus additional evidence from lower level studies, most studies have consistent outcomes and inconsistencies can be explained)</p>
	No included studies	Very low	Low	Moderate	High								
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>								
	Is there important uncertainty about how much people value the main outcomes?	<table border="0"> <tr> <td>Important uncertainty or variability</td> <td>Possibly important uncertainty or variability</td> <td>Probably no important uncertainty or variability</td> <td>No important uncertainty or variability</td> <td>No known undesirable</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Important uncertainty or variability	Possibly important uncertainty or variability	Probably no important uncertainty or variability	No important uncertainty or variability	No known undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	Important uncertainty or variability	Possibly important uncertainty or variability	Probably no important uncertainty or variability	No important uncertainty or variability	No known undesirable								
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>									
How substantial are the desirable anticipated effects?	<table border="0"> <tr> <td>Unclear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial									
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How substantial are the undesirable anticipated effects?	<table border="0"> <tr> <td>Unclear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
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No	Probably No	Uncertain	Probably Yes	Yes	Varies								
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>								

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE												
RESOURCE USE	How substantial are the resource requirements?	<table border="0"> <tr> <td>Not clear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Not clear	Not substantial	Probably not substantial	Probably substantial	Substantial	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	An economic analysis ³⁴ of a Level 1 study ³⁵ that showed pressure injury healing from increased protein-calorie support (see outcomes above) reported lower mean cost per person in the intervention group (\$3,718 versus \$4,603) and higher incremental cost-effectiveness ratio (ICER; -\$32,532 for 12 weeks and -\$38,726 for 14 weeks), Bootstrapping procedure showing most simulations located in cost savings and greater effectiveness quadrant. At 12 weeks, nutritional intervention reduced pressure injury days (PIDs) by 9.6 per person and costs by \$542 per person, and increased quality-adjusted life years (QALYs) by 0.226 x 10 ⁻² per person. At 16 weeks, nutritional intervention reduced PIDs by 16.2 per person and costs by \$881 per person, and QALYs increased by 0.382 x 10 ⁻² per person (US dollars in 2011) ³⁴ (<i>High quality economic analysis</i>).
Not clear	Not substantial	Probably not substantial	Probably substantial	Substantial	Varies										
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PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available
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	Is the option a priority for key stakeholders?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	71.8% (275/383) of respondents to a patient/ informal caregiver survey who identified as having experienced a pressure injury or being at risk of a pressure injury believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for themselves. In the same survey, 64% (544/850) of informal caregivers believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for their family member/friend with or at risk of a pressure injury ^{11,14} (<i>Indirect evidence</i>).
No	Probably No	Uncertain	Probably Yes	Yes	Varies										
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FEASIBILITY	Is the option feasible to implement?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	There is large variability in accessibility to appropriate dietary interventions that may be limited by the clinical and geographic setting. Access to dietary expertise is important to providing an appropriate, individualized diet. (<i>Expert opinion</i>)
No	Probably No	Uncertain	Probably Yes	Yes	Varies										
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Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input type="checkbox"/>	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings <input type="checkbox"/>	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i> <input type="checkbox"/>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings <input type="checkbox"/>	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings <input checked="" type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input checked="" type="checkbox"/>	Strong positive recommendation: Definitely do it <input type="checkbox"/>
Justification	Direct evidence from a low quality Level 1 study ³⁰ showed no significant difference in complete healing associated with increasing caloric and protein intake using the Harris-Benedict equation with a higher stress factor. A moderate quality Level 1 study ³⁰ and low quality level 3 studies showed improvements in some measures of healing (e.g. DESIGN-R scores). ^{31,32} A moderate quality economic analysis ³⁴ indicated that, although substantial resources may be required, there may be overall cost savings (depending on the geographic and clinical setting) associated with optimizing energy intake achieved through a reduction in pressure injury days and an increase in quality-adjusted life years. Individuals and their informal caregivers identified knowing more about dietary requirements associated with healthy skin as a priority. ^{11,14}				

Clinical question

What nutritional interventions are effective in supporting pressure injury healing?
Is there an ideal nutritional regimen to promote healing of pressure injuries, and if so, what should it include?

Recommendation 4.7

Provide 1.2 to 1.5 g/kg body weight/day for adults with a pressure injury who are malnourished or at risk of malnutrition.

Option: Providing protein supplements at 1.25 to 1.5g/kg body weight
Comparison: No intervention, or intervention that do not include increased protein intake

Background: Malnutrition is a risk factor for pressure injuries. Pressure injuries themselves are also responsible for a deterioration of nutritional status due to increased energy expenditures and loss of proteins and nutrients through the skin. A positive energy and nitrogen balance is essential in wound healing. The provision of extra protein and calories for people with pressure injuries assists in meeting estimated nutrition requirements and improves anabolism. However, people with pressure injuries may have reduced spontaneous food intake. Supplemented nutrition is one strategy in satisfying nutritional needs.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE										
BENEFITS & HARMS OF THE PRACTICE	What is the overall certainty of the evidence?	<table border="0"> <tr> <td>No included studies</td> <td>Very low</td> <td>Low</td> <td>Moderate</td> <td>High</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No included studies	Very low	Low	Moderate	High	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Effectiveness for measures of pressure injury healing</p> <ul style="list-style-type: none"> In institutionalized older adults (n=28), eight weeks of high-calorie, high-protein (1.5±0.2 g/kg/day) nutritional supplement (oral or enteral) containing arginine, zinc and antioxidants was associated with significantly greater reduction in surface area (-1,140.9 ± 669.2mm² versus -571.7 ±391.3mm², p<0.05) and significantly greater reductions in PUSH score (-6.1 ±2.7 versus -3.3 ±2.4, p<0.05) compared to standard hospital diet/support (protein intake, 1.2±0.2 g/kg/day).³⁶ (Level 1, moderate quality) In institutionalized older adults (n=60) receiving tube feeding, twelve weeks of nutritional support calculated using <i>BEE x activity factor 1.1 x stress factor 1.3 to 1.5</i> (mean protein intake 1.62±0.30 g/kg/day) was associated with improved pressure injury size (p<0.001) and depth (p<0.05) compared to standard care (mean protein intake 1.24±0.22 g/kg/day).³⁵ (Level 1, moderate quality) In institutionalized adults (n=71), supplementation with concentrated fortified collagen protein hydrolysate three times daily (total protein 45 g; mean intake ~1.5 g/kg/day) either orally or by feeding tube was associated with greater improvements in PUSH score than placebo supplementation at week 2 (mean score 7.59±4.85 versus 5.3±4.2, p<0.05, at week 6 (mean score 4.55±5.28 versus 3.78±4.66, p<0.05) and at week 8 (mean score 3.55±4.66 versus 3.22±4.11, p<0.05). At 8 weeks the treatment group had a 60% reduction in PUSH score versus 48% in control group, p<0.05).³⁷ (Level 1, low quality) In institutionalized older adults (n=28), high-protein (mean intake 2.1±0.9 g/kg/day) formula (oral or enteral) was associated with a significantly greater reduction in pressure injury surface area compared to baseline (mean area decrease -4.2±7.1cm², p<0.02). Individuals receiving standard-protein formula (mean intake 1.4±0.5 g/kg/day) had no significant change in pressure injury area. Change in pressure injury area was correlated with dietary protein intake (r=0.50, -p<0.01) and with calorie intake (r= -0.41, p<0.03).³⁸ (Level 2, high quality) Mean protein intake was significantly higher in a group of individuals (n=40) who achieved improvements in pressure injury condition improvement group versus a group with unimproved pressure injury condition (always > 45g daily versus approx. 20 g daily, p<0.005).³⁹ (Level 3, low quality) Older hospitalized individuals (n=194) receiving an average protein requirement (0.95g/kg) reported improvements in DESIGN-R tool items for deep pressure injuries (decreased wound depth score, p=0.006; improved granulation tissue score, p=0.015; and improvement in necrotic tissue score, p= 0.023). There was no significant change in healing outcomes for superficial pressure injuries.³¹ (Level 3, low quality) <p>Adverse effects</p> <ul style="list-style-type: none"> No participants receiving high-protein (1.5±0.2 g/kg/day) nutritional supplement (oral or enteral) containing also arginine, zinc and antioxidants experienced adverse effects.³⁶ (Level 1, moderate quality)
	No included studies	Very low	Low	Moderate	High								
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	Is there important uncertainty about how much people value the main outcomes?	<table border="0"> <tr> <td>Important uncertainty or variability</td> <td>Possibly important uncertainty or variability</td> <td>Probably no important uncertainty or variability</td> <td>No important uncertainty or variability</td> <td>No known undesirable outcomes</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Important uncertainty or variability	Possibly important uncertainty or variability	Probably no important uncertainty or variability	No important uncertainty or variability	No known undesirable outcomes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
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How substantial are the desirable anticipated effects?	<table border="0"> <tr> <td>Unclear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
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Do the desirable effects outweigh the undesirable effects?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE
			<ul style="list-style-type: none"> • A small number of participants in one trial experienced minor gastrointestinal intolerance (dyspepsia and/or diarrhea) associated with ONS.⁴⁰ (Level 1, high quality) • Supplementation with concentrated fortified collagen protein hydrolysate (mean protein intake ~1.5 g/kg/day) was associated in no significant difference (p>0.05) compared to control in adverse events including renal laboratory values, nausea/distension or death.³⁷ (Level 1, low quality) • A high protein supplement (average of >0.75g/kg) was not detrimental on renal function for participants, including those with renal insufficiency.³¹ (Level 3, low quality) <p>Strength of Evidence: B1 (Level 1 studies of moderate or low quality providing direct evidence, plus additional evidence from lower level studies, most studies have consistent outcomes and inconsistencies can be explained)</p>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS
RESOURCE USE	How substantial are the resource requirements?	<p>Not clear <input type="checkbox"/> Not substantial <input type="checkbox"/> Probably not substantial <input type="checkbox"/> Probably substantial <input type="checkbox"/> Substantial <input checked="" type="checkbox"/> Varies <input type="checkbox"/></p>	An economic analysis of a Level 1 study ³⁵ reporting improved measures of pressure injury healing from increased protein-calorie support (see outcomes above) reported lower mean cost per person in the intervention group (\$3,718 versus \$4,603) and higher incremental cost-effectiveness ratio (ICER; -\$32,532 for 12 weeks and -\$38,726 for 14 weeks) with bootstrapping procedure showing most simulations located in cost savings and greater effectiveness quadrant. At 12 weeks, nutritional intervention reduced pressure injury days (PIDs) by 9.6 per person and costs by \$542 per person, and increased quality-adjusted life years (QALYs) by 0.226 x 10 ⁻² per person. At 16 weeks, nutritional intervention reduced PIDs by 16.2 per person and costs by \$881 per person, and QALYs increased by 0.382 x 10 ⁻² per person (US dollars in 2011). ³⁴ (<i>High quality economic analysis</i>)
PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<p>No <input type="checkbox"/> Probably No <input type="checkbox"/> Uncertain <input checked="" type="checkbox"/> Probably Yes <input type="checkbox"/> Yes <input type="checkbox"/> Varies <input type="checkbox"/></p>	No evidence available
	Is the option a priority for key stakeholders?	<p>No <input type="checkbox"/> Probably No <input type="checkbox"/> Uncertain <input type="checkbox"/> Probably Yes <input checked="" type="checkbox"/> Yes <input type="checkbox"/> Varies <input type="checkbox"/></p>	71.8% (275/383) of respondents to a patient/ informal caregiver survey who identified as having experienced a pressure injury or being at risk of a pressure injury believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for themselves. In the same survey, 64% (544/850) of informal caregivers believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for their family member/friend with or at risk of a pressure injury. ^{11,14} (<i>Indirect evidence</i>)
FEASIBILITY	Is the option feasible to implement?	<p>No <input type="checkbox"/> Probably No <input type="checkbox"/> Uncertain <input type="checkbox"/> Probably Yes <input type="checkbox"/> Yes <input type="checkbox"/> Varies <input checked="" type="checkbox"/></p>	There is large variability in accessibility to appropriate dietary interventions that may be limited by the clinical and geographic setting. Access to dietary expertise is important to providing an appropriate, individualized diet. (<i>Expert opinion</i>)

Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input type="checkbox"/>	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings <input type="checkbox"/>	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i> <input type="checkbox"/>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings <input type="checkbox"/>	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings <input checked="" type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input type="checkbox"/>	Strong positive recommendation: Definitely do it <input checked="" type="checkbox"/>
Justification	<p>A low quality level 1 study³⁷ reported a significant 12% absolute reduction in pressure injury PUSH scores associated with protein supplementation compared to placebo. A moderate quality Level 1 study³⁵ noted that high intake of protein was associated with significant improvements in pressure injury size and depth compared to low protein intake. A third Level 1 study³⁶ reported reduction in pressure injury size associated with increasing mean protein intake from 1.2g/kg/body weight to a 1.4g/kg/body weight; however the intervention also included added arginine, zinc and antioxidants. A high quality level 2 study³⁸ reported a significant correlation between pressure injury surface area and dietary protein intake. These findings were supported by low quality Level 3 studies^{31,39} that reported significant improvements in tissue type rated on DESIGN-R³¹ and general pressure injury condition³⁹ associated with increasing protein intake. In these studies, there was no impact on renal function of protein intake up to 1.5g/kg body weight/day, although in one Level 1 study a small number of participants experienced minor gastrointestinal intolerance.⁴⁰ A high quality economic analysis³⁴ indicated that a nutrition intervention that included increased protein intake delivered for 16 weeks was associated with reduction in pressure injury days, reduction in care costs and increase in quality-adjusted life years.</p>				

Clinical question Are any nutritional supplements (e.g. formulas, specific vitamins/minerals) effective in reducing risk of pressure injury development?

Recommendation 4.8 Offer high-calorie, high-protein fortified foods and/or nutritional supplements in addition to the usual diet for adults who are at risk of developing a pressure injury and who are also malnourished or at risk of malnutrition, if nutritional requirements cannot be achieved by normal dietary intake.

Option: Putative high calorie, high protein and/or disease-specific nutritional supplements

Comparison: Standard diet or standard supplements

Background: Poor nutritional status and nutritional deficits are risk factors for pressure injury development. Nutritional interventions providing adequate calories and proteins are believed to play a pivotal role in reducing the risk of pressure injuries.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence?	<table border="0"> <tr> <td>No included studies</td> <td>Very low</td> <td>Low</td> <td>Moderate</td> <td>High</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No included studies	Very low	Low	Moderate	High	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>Effectiveness in preventing pressure injuries</p> <ul style="list-style-type: none"> In older adults (n=672), receiving high-protein, high-calorie oral supplementation for ≥15 days was associated with a decreased risk of pressure injury incidence (for no supplementation, relative risk [RR] 1.57, 95% confidence interval [CI], 1.03 to 2.38, p=0.04).⁴¹ (Level 1, low quality) In older adults with fractured femur (n=59), high-protein oral supplement resulted in a non-significant reduction in pressure incidence compared to receiving no supplement for people in a surgical hospital (7.4% vs. 9.3%, p=not reported) and those in a recovery hospital (0% vs 20%).⁴² (Level 1, low quality) In institutionalized adults (n=1,524), there was a decreased likelihood of developing a Category/Stage I to IV pressure injury at 12 weeks associated with enteral disease-specific formula (odds ratio [OR]=0.35, 95% CI 0.16 to 0.77, p=0.009), enteral high-calorie/protein formula (OR=0.48, 95% CI 0.32 to 0.72, p<0.001) and oral medical nutritional supplements (OR 0.57, 95% CI 0.36 to 0.90, p <0.016).⁴³ (Level 3 low quality) In people with fractured femur (n=101), overnight supplementation (1500 kcal; 16 En% from protein) by feeding tube in addition to standard diet for two weeks resulted in no difference in pressure injury incidence compared to not receiving an oral supplement (52% vs 69%, p=0.69).⁴⁴ (Level 1, low quality) In people undergoing hip fracture surgery (n=103), four weeks of high-calorie, high-protein ONS containing containing arginine, zinc and antioxidants did not result in a significant difference in pressure injury incidence compared to no supplements (52.9% vs 57.6%, p=0.42).⁴⁵ (Level 1 high quality) In older institutionalized adults (n=482), a standard supplement for between 3 and 26 weeks did not result in a significantly lower incidence of pressure injuries (9.9% vs. 12%, p=reported as not significant).⁴⁶ (Level 1, low quality) <p>Adverse events None of the studies reported on adverse events.</p> <p>Strength of Evidence: C - A body of evidence with inconsistencies that cannot be explained, reflecting genuine uncertainty surrounding the topic</p>
	No included studies	Very low	Low	Moderate	High								
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	Is there important uncertainty about how much people value the main outcomes?	<table border="0"> <tr> <td>Important uncertainty or variability</td> <td>Possibly important uncertainty or variability</td> <td>Probably no important uncertainty or variability</td> <td>No important uncertainty or variability</td> <td>No known undesirable</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Important uncertainty or variability	Possibly important uncertainty or variability	Probably no important uncertainty or variability	No important uncertainty or variability	No known undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
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	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS												
RESOURCE USE	How substantial are the resource requirements?	<table border="0"> <tr> <td><i>Not clear</i></td> <td><i>Not substantial</i></td> <td><i>Probably not substantial</i></td> <td><i>Probably substantial</i></td> <td><i>Substantial</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<i>Not clear</i>	<i>Not substantial</i>	<i>Probably not substantial</i>	<i>Probably substantial</i>	<i>Substantial</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Economic modelling based on five randomized controlled trials predicted mean cost savings for a nutritional intervention versus standard care was AUD \$425 per person (AUD in 2015).^{21,22} (<i>Moderate quality economic analysis</i>) Modeling of economic outcomes based on a meta-analysis of five small studies in Australian hospitals predicted providing nutritional intervention to be cost-effective, with a predicted mean decreased length of hospital stay of 0.52%.²⁰ (<i>Moderate quality economic analysis</i>) In older people with fractured femur, high protein oral supplement resulted in more favourable recovery phase (p<0.05) and at 6 months (p<0.02), and significantly shorter hospital stay compared to no supplementation (24 days vs 40 days).⁴²
<i>Not clear</i>	<i>Not substantial</i>	<i>Probably not substantial</i>	<i>Probably substantial</i>	<i>Substantial</i>	<i>Varies</i>										
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PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<table border="0"> <tr> <td><i>No</i></td> <td><i>Probably No</i></td> <td><i>Uncertain</i></td> <td><i>Probably Yes</i></td> <td><i>Yes</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available
	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>									
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
	Is the option a priority for key stakeholders?	<table border="0"> <tr> <td><i>No</i></td> <td><i>Probably No</i></td> <td><i>Uncertain</i></td> <td><i>Probably Yes</i></td> <td><i>Yes</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	71.8% (275/383) of respondents to a patient/ informal caregiver survey who identified as having experienced a pressure injury or being at risk of a pressure injury believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for themselves. In the same survey, 64% (544/850) of informal caregivers believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for their family member/friend with or at risk of a pressure injury. ^{11,14} (<i>Indirect evidence</i>)
<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
FEASIBILITY	Is the option feasible to implement?	<table border="0"> <tr> <td><i>No</i></td> <td><i>Probably No</i></td> <td><i>Uncertain</i></td> <td><i>Probably Yes</i></td> <td><i>Yes</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	There is large variability in accessibility to appropriate dietary interventions that may be limited by the clinical and geographic setting. Access to dietary expertise is important to providing an appropriate, individualized diet. (<i>Expert opinion</i>)
<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>										
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Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input type="checkbox"/>	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings <input type="checkbox"/>	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i> <input type="checkbox"/>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings <input checked="" type="checkbox"/>	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings <input type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input checked="" type="checkbox"/>	Strong positive recommendation: Definitely do it <input type="checkbox"/>
Justification	One low quality Level 1 study ⁴¹ found that high-calorie, high-protein supplements were associated with a significant reduction in the incidence of pressure injuries in individuals at risk. This finding was supported by a large, low quality Level 3 study ⁴³ and favorable but non-significant results from a smaller low quality Level 1 study. ⁴² However, other high quality ⁴⁵ and low quality ^{44,46} Level 1 studies showed no significant effect in reducing pressure injury incidence for high calorie, high protein nutritional supplements. The body of evidence is inconsistent, reflecting uncertainty as to the likelihood that the expected benefits will be achieved. However, there are no known undesired effects, and moderate quality economic analyses ²⁰⁻²² reported cost-savings, including shorter hospital stays, associated with the intervention. Individuals and their informal caregivers identified knowing more about dietary requirements associated with healthy skin as a care priority. ^{11,14}				

Clinical question

What nutritional interventions are effective in supporting pressure injury healing?
Is there an ideal nutritional regimen to promote healing of pressure injuries, and if so, what should it include?

Recommendation 4.9

Offer high calorie, high protein nutritional supplements in addition to the usual diet for adults with a pressure injury who are malnourished or at risk of malnutrition, if nutritional requirements cannot be achieved by normal dietary intake.

Option: Offering fortified foods or high protein oral nutritional supplements between meals
Comparison: Offering no additional supplements

Background: Malnutrition is a risk factor for pressure injuries. Pressure injuries themselves are also responsible for a deterioration of nutritional status due to increased energy expenditures and loss of proteins and nutrients through the skin. A positive energy and nitrogen balance is essential in wound healing. The provision of extra protein and calories for people with pressure injuries assists in meeting estimated nutrition requirements and improves anabolism. However, people with pressure injuries may have reduced spontaneous food intake. Artificial nutrition can be used to meet nutritional needs.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE
BENEFITS & HARMS OF THE PRACTICE	What is the overall certainty of the evidence?	<p>No included studies <input type="checkbox"/></p> <p>Very low <input type="checkbox"/></p> <p>Low <input type="checkbox"/></p> <p>Moderate <input checked="" type="checkbox"/></p> <p>High <input type="checkbox"/></p>	<p>Effectiveness for complete healing of Category/Stage II or greater pressure injuries</p> <ul style="list-style-type: none"> In institutionalized older adults receiving a usual hospital diet (n=482), supplementation for between 3 weeks and 26 weeks did not result in a significant difference in complete healing of pressure injuries (41.8% vs. 30.3%).⁴⁶ (Level 1, low quality) In malnourished adults in institutions and home care (n=200), 8-week supplementation with high-calorie, high-protein ONS was associated with a complete pressure injury healing rate of 9.7% (95% confidence interval [CI] 2.1 to 17.3). This was significantly lower than when individuals received high-calorie, high-protein ONS containing arginine, zinc and antioxidants (16.9%; 95% CI 8.2 to 25.6).⁴⁰ (Level 1, high quality) <p>Effectiveness for reduction in size of Category/stage II or greater pressure injuries</p> <ul style="list-style-type: none"> In institutionalized older adults (n=200), 8-week supplementation with high-calorie, high-protein ONS was associated with a mean reduction in surface area of 45.2% (95% CI 38.4 to 52.0). This was less effective than supplementation with a formula that included arginine (mean surface area reduction 60.9%, 95% CI 54.3 to 67.5, p=0.026 between groups).⁴⁰ (Level 1, high quality) In institutionalized older adults (n=28), a high-protein (mean intake 2.1±0.9 g/kg/day) supplement administered orally or enterally was associated with a significant reduction in surface area compared to baseline (mean decrease -4.2±7.1cm², p<0.02). In a group receiving a standard-protein formula (mean intake 1.4±0.5 g/kg/day) no significant change in pressure injury area was noted. Change in pressure injury surface area was correlated with dietary protein intake (r=0.50, p<0.01) and with calorie intake per kg (r= -0.41, p<0.03).³⁸ (Level 2, low quality) <p>Evidence for effect on wound healing scores</p> <ul style="list-style-type: none"> In institutionalized adults (n=71), supplementation with concentrated fortified collagen protein hydrolysate three times daily (total protein 45 g; mean intake approx.1.5 g/kg/day) either orally or by feeding tube was associated with greater improvements in PUSH score than placebo supplementation at week 2 (mean score 7.59±4.85 versus 5.3±4.2, p<0.05, at week 6 (mean score 4.55±5.28 versus 3.78±4.66, p<0.05) and at week 8 (mean score 3.55±4.66 versus 3.22±4.11, p<0.05). At 8 weeks the treatment group had a 60% reduction in PUSH score versus 48% in control group, p<0.05).³⁷ (Level 1, low quality) <p>Potential adverse outcomes</p> <p>A small number of participants in one trial experienced gastrointestinal intolerance (dyspepsia and/or diarrhea) associated with ONS.⁴⁰ (Level 1, high quality)</p> <p>Strength of Evidence: B1 (Level 1 studies of moderate to low quality, plus additional evidence from lower level studies, most studies have consistent outcomes and inconsistencies can be explained)</p>
	Is there important uncertainty about how much people value the main outcomes?	<p>Important uncertainty or variability <input type="checkbox"/></p> <p>Possibly important uncertainty or variability <input type="checkbox"/></p> <p>Probably no important uncertainty or variability <input type="checkbox"/></p> <p>No important uncertainty or variability <input checked="" type="checkbox"/></p> <p>No known undesirable outcomes <input type="checkbox"/></p>	
	How substantial are the desirable anticipated effects?	<p>Unclear <input type="checkbox"/></p> <p>Not substantial <input type="checkbox"/></p> <p>Probably not substantial <input type="checkbox"/></p> <p>Probably substantial <input type="checkbox"/></p> <p>Substantial <input checked="" type="checkbox"/></p>	
	How substantial are the undesirable anticipated effects?	<p>Unclear <input type="checkbox"/></p> <p>Not substantial <input checked="" type="checkbox"/></p> <p>Probably not substantial <input type="checkbox"/></p> <p>Probably substantial <input type="checkbox"/></p> <p>Substantial <input type="checkbox"/></p>	
	Do the desirable effects outweigh the undesirable effects?	<p>No <input type="checkbox"/></p> <p>Probably No <input type="checkbox"/></p> <p>Uncertain <input type="checkbox"/></p> <p>Probably Yes <input type="checkbox"/></p> <p>Yes <input checked="" type="checkbox"/></p> <p>Varies <input type="checkbox"/></p>	

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS
RESOURCE USE	How substantial are the resource requirements?	<p>Not clear <input type="checkbox"/> Not substantial <input type="checkbox"/> Probably not substantial <input type="checkbox"/> Probably substantial <input type="checkbox"/> Substantial <input checked="" type="checkbox"/> Varies <input type="checkbox"/></p>	An economic analysis of a Level 1 study ³⁵ reporting improved measures of pressure injury healing from increased protein-calorie support (see outcomes above) reported lower mean cost per person in the intervention group (\$3,718 versus \$4,603) and higher incremental cost-effectiveness ratio (ICER; -\$32,532 for 12 weeks and -\$38,726 for 14 weeks) with bootstrapping procedure showing most simulations located in cost savings and greater effectiveness quadrant. At 12 weeks, nutritional intervention reduced pressure injury days (PIDs) by 9.6 per person and costs by \$542 per person, and increased quality-adjusted life years (QALYs) by 0.226 x 10 ⁻² per person. At 16 weeks, nutritional intervention reduced PIDs by 16.2 per person and costs by \$881 per person, and QALYs increased by 0.382 x 10 ⁻² per person (US dollars in 2011). ³⁴ (<i>High quality economic analysis</i>)
PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<p>No <input type="checkbox"/> Probably No <input type="checkbox"/> Uncertain <input checked="" type="checkbox"/> Probably Yes <input type="checkbox"/> Yes <input type="checkbox"/> Varies <input type="checkbox"/></p>	No evidence available
	Is the option a priority for key stakeholders?	<p>No <input type="checkbox"/> Probably No <input type="checkbox"/> Uncertain <input type="checkbox"/> Probably Yes <input checked="" type="checkbox"/> Yes <input type="checkbox"/> Varies <input type="checkbox"/></p>	71.8% (275/383) of respondents to a patient/ informal caregiver survey who identified as having experienced a pressure injury or being at risk of a pressure injury believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for themselves. In the same survey, 64% (544/850) of informal caregivers believed that knowing more about what to eat and drink to keep the skin healthy is important or very important in caring for their family member/friend with or at risk of a pressure injury. ^{11,14} (<i>Indirect evidence</i>)
FEASIBILITY	Is the option feasible to implement?	<p>No <input type="checkbox"/> Probably No <input type="checkbox"/> Uncertain <input type="checkbox"/> Probably Yes <input type="checkbox"/> Yes <input type="checkbox"/> Varies <input checked="" type="checkbox"/></p>	There is large variability in accessibility to appropriate dietary interventions that may be limited by the clinical and geographic setting. Access to dietary expertise is important to providing an appropriate, individualized diet. (<i>Expert opinion</i>)

Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input type="checkbox"/>	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings <input type="checkbox"/>	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i> <input type="checkbox"/>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings <input type="checkbox"/>	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings <input checked="" type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input type="checkbox"/>	Strong positive recommendation: Definitely do it <input checked="" type="checkbox"/>
Justification	A large low quality Level 1 study ⁴⁶ reported a mean of approximately 42% pressure injuries reached complete healing when high calorie, high protein supplements were provided, which was around 10% more than for standard diet. A high quality Level 1 study ⁴⁰ reported complete healing rate of around 10%. Differences in healing rates reported in Level 1 studies might be explained by the large variation in intervention duration of between 3 and 26 weeks. Significant reduction in mean pressure injury surface area and significant improvement in PUSH scores was reported in a low quality Level 1 ⁴⁰ and Level 2 ³⁸ studies for high calorie, high protein supplementation compared with standard diets or placebo supplements. Few adverse events were experienced in studies and an economic analysis ³⁴ indicated that supplementation was associated with reductions in costs per individual and increases in quality-adjusted life years associated with more pressure injury-free days. More than two thirds of individuals who have experienced a pressure injury indicated that receiving guidance on diet to promote health was a priority. ^{11,14}				

Clinical question

Are any specific oral nutritional supplements or formula effective in promoting healing of pressure injuries?

Recommendation 4.10

Provide high-calorie, high-protein, arginine, zinc and antioxidant oral nutritional supplements or enteral formula for adults with a Category/Stage II or greater pressure injury who are malnourished or at risk of malnutrition.

Option: High-calorie, high-protein oral nutritional supplement (ONS) containing arginine, zinc and antioxidants

Comparison: Supplements without specific nutrients putatively involved in wound healing, or standard diet

Background: Arginine is a semi-essential amino acid that improves protein anabolism (such as collagen) and cellular growth. It is a donor of nitric oxide, which increases tissue blood flow and acts as an immune response mediator. Zinc is an essential mineral required for the catalytic activity of several enzymes. It contributes to protein and DNA synthesis, immune function, and cellular proliferation. Antioxidants are also relevant in any chronic inflammatory condition. Among these, vitamin C is also actively involved in the synthesis of collagen and acts on fibroblast proliferation and cellular immunity.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence?	<table border="0"> <tr> <td>No included studies</td> <td>Very low</td> <td>Low</td> <td>Moderate</td> <td>High</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No included studies	Very low	Low	Moderate	High	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>Effectiveness for complete healing of Category/Stage II or greater pressure injuries</p> <ul style="list-style-type: none"> In malnourished adults (n=200), eight weeks of high-calorie, high-protein ONS containing arginine, zinc and antioxidants was associated with greater proportion of complete healing compared with a high-calorie, high-protein ONS with no specific nutrients (16.9%, 95% confidence interval [CI] 8.2 to 25.6 versus 9.7%, 95% CI 2.1 to 17.3; p = 0.10). This equated to an adjusted treatment effect (odds ratio [OR]) of 2.16 (95% CI 0.88 to 5.39, p = 0.097). For patients remaining into the study for ≥4 weeks the adjusted OR was 3.71 (95% CI 1.05 to 13.16, p = 0.042).⁴⁰ (Level 1, high quality) In institutionalized older adults (n=245), nine weeks of high-calorie, high-protein ONS containing arginine, zinc and antioxidants (average intake 46g protein, 6.9g arginine, 575mg vitamin C, 87mg vitamin E and 21mg zinc) resulted in complete healing rates: at 3 weeks 7%; at 9 weeks 20%.⁴⁷ (Level 3, low quality) In community-based individuals with spinal cord injury (SCI, n=18), high-calorie ONS containing arginine, zinc, and vitamin C was associated with superior healing with respect to time to complete healing compared to not receiving the ONS (10.5 ± 1.3 weeks versus 21.1 ± 3.7 weeks, p=0.006).⁴⁸ (Level 4, low quality) <p>Effectiveness for complete healing of Category/Stage III or IV pressure injuries</p> <ul style="list-style-type: none"> In adults with SCI (n=34), high-calorie ONS containing arginine, zinc, and vitamin C resulted in a 2.5-fold greater rate of healing in those continuing supplementation until full healing compared with those who ceased taking the supplement (8.5 ± 1.1 weeks vs. 20.9 ± 7.0 wks, p = 0.04).⁴⁹ (Level 4, low quality) <p>Effectiveness for faster healing rate for Category/Stage II or greater pressure injuries</p> <ul style="list-style-type: none"> In community-based individuals with SCI (n=18), a high-calorie ONS containing arginine, zinc, and vitamin C, the intervention group showed superior healing with respect to time to complete healing compared to the control group compared to historical control, (10.5±1.3 weeks versus 21.1±3.7 weeks, p=0.006).⁴⁸ (Level 4, low quality) In adults with SCI (n=34), 2.5 fold greater rate of healing of Category/Stage III and IV pressure injuries was observed in individuals who continued supplementation with high-calorie ONS containing arginine, zinc, and vitamin C until full healing compared with those who ceased the supplement (8.5±1.1 weeks versus 20.9±7.0 weeks, p=0.04).⁴⁹ (Level 4, low quality) <p>Effectiveness for surface area reduction in Category/Stage II or greater pressure injuries</p> <ul style="list-style-type: none"> In malnourished adults (n=200), 8 weeks of high-calorie, high-protein ONS containing containing arginine, zinc and antioxidants was associated with greater mean reduction in surface area compared with a high-calorie, high-protein ONS
	No included studies	Very low	Low	Moderate	High								
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	Is there important uncertainty about how much people value the main outcomes?	<table border="0"> <tr> <td>Important uncertainty or variability</td> <td>Possibly important uncertainty or variability</td> <td>Probably no important uncertainty or variability</td> <td>No important uncertainty or variability</td> <td>No known undesirable</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Important uncertainty or variability	Possibly important uncertainty or variability	Probably no important uncertainty or variability	No important uncertainty or variability	No known undesirable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
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How substantial are the desirable anticipated effects?	<table border="0"> <tr> <td>Unclear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
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Do the desirable effects outweigh the undesirable effects?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE
		<p>with no specific nutrients (60.9%, 95% CI 54.3 to 67.5 versus 45.2%, 95% CI 38.4 to 52.0; $p=0.026$). This equated to an adjusted treatment effect of 18.7%, 95% CI 5.7 to 31.8, $p = 0.017$).⁴⁰ (Level 1, high quality)</p> <ul style="list-style-type: none"> • In adults (n=28) at nutritional risk, eight weeks of high-calorie, high-protein ONS or enteral formula containing arginine, zinc and antioxidants was associated with greater reduction in surface area than a standard hospital diet/support (-1141 ± 669 mm² vs. -571 ± 391 mm², $p<0.05$).³⁶ (Level 1, moderate quality) • In non-malnourished, community-based adults (n=43), eight weeks of high-calorie, high-protein ONS containing arginine, zinc and antioxidants was associated with greater reduction in surface area than a standard hospital diet ($p=0.016$).⁵⁰ (Level 1, moderate quality) • Three-week supplementation with high-calorie, high-protein ONS containing arginine, zinc and antioxidants was associated with significant reduction in median wound area (mean reduction 29%, $p<0.001$; 0.34cm^2 per day).⁵¹ (Level 3, low quality) • In institutionalized older adults, a 9-week supplementation with high-calorie, high-protein ONS containing arginine, zinc and antioxidants 9-week was associated with a significant reduction (53%, $p<0.001$) in mean wound area.⁴⁷ (Level 3, low quality) • Two weeks of individualized nutritional care with ONS containing arginine, zinc, and vitamin C showed no significant difference in median surface area change (-74%, interquartile range, -100 to -33.1] vs. -86% [IQR -100 to -33]) compared with standard diet or ONS without specific nutrients.⁵² (Level 1, low quality) <p>Effectiveness for improvement in Category/Stage II or greater pressure injuries as measured on PUSH</p> <ul style="list-style-type: none"> • After 3 weeks of high-calorie ONS containing arginine, zinc, and vitamin C pressure injuries had a significant improvement in PUSH score (from 9.4 ± 1.2 to 2.6 ± 0.6, $p<0.01$) compared with no PUSH score improvement for ONS without specific nutrients, or for a standard diet.⁵³ (Level 1, moderate quality) • In adults at nutritional risk, 12 weeks of high-calorie, high-protein ONS or enteral formula containing arginine, zinc and antioxidants was associated with greater improvements in PUSH score (-6.1 ± 2.7 versus -3.3 ± 2.4, $p<0.05$) than a standard hospital diet/support.³⁶ (Level 1, moderate quality) • In non-malnourished adults, eight weeks of high-calorie, high-protein ONS containing arginine, zinc and antioxidants was associated with greater improvements in PUSH score than a standard hospital diet (for decline over time by repeated-measures mixed model, $p=0.033$).⁵⁰ (Level 1, moderate quality) • Two weeks of individualized nutritional care with high-calorie ONS containing arginine, zinc, and vitamin C showed no significant difference in change in PUSH score (-1.7cm^2 [IQR -7.2 to -0.5] vs. -1.4 cm² [IQR -2.4 to -0.7]) compared with standard diet or ONS without specific nutrients.⁵² (Level 1, low quality) <p>Effectiveness for other outcome measures</p> <ul style="list-style-type: none"> • Three-week supplementation with a high-calorie, high-protein ONS containing arginine, zinc and antioxidants resulted in a reduction in exudate in infected pressure injuries ($p=0.012$) and reduction in incidence of necrotic tissue ($p= 0.001$).⁵¹ (Level 3, low quality) • In institutionalized older adults, a high-calorie, high-protein ONS containing arginine, zinc and antioxidants for nine weeks resulted in a significant reduction in exudate ($p<0.001$).⁴⁷ (Level 3, low quality) <p>Adverse events</p> <ul style="list-style-type: none"> • A small number of participants in one trial experienced minor gastrointestinal intolerance (dyspepsia and/or diarrhea) associated with ONS.⁴⁰ (Level 1, high quality) <p>Strength of Evidence: B1 (Level 1 studies of moderate to low quality, plus additional evidence from lower level studies, most studies have consistent outcomes and inconsistencies can be explained)</p>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS												
RESOURCE USE	How substantial are the resource requirements?	<table border="0"> <tr> <td>Not clear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Not clear	Not substantial	Probably not substantial	Probably substantial	Substantial	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	A high-calorie, high-protein ONS containing arginine, zinc and antioxidants (twice/daily for eight weeks) cost more money than a high-calorie, high-protein ONS without specific nutrients (mean difference in cost €39.40, 95% CI 31.60 to 47.10, p < 0.001). In a cost analysis including direct care costs (equipment, tests and staffing) administering this ONS resulted in a reduction of overall cost of care (–€74.30, 95% CI –126.1 to –22.5, p = 0.013) with a substantial incremental cost-effectiveness ratio (ICER, ≥95% of points were in the ‘more effective/less expensive’ quadrant). ⁵⁴ (<i>High quality economic analysis</i>)
Not clear	Not substantial	Probably not substantial	Probably substantial	Substantial	Varies										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>										
PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available
	No	Probably No	Uncertain	Probably Yes	Yes	Varies									
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
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No	Probably No	Uncertain	Probably Yes	Yes	Varies										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
FEASIBILITY	Is the option feasible to implement?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	There is large variability in accessibility to appropriate dietary interventions that may be limited by the clinical and geographic setting. Access to dietary expertise is important to providing an appropriate, individualized diet. (<i>Expert opinion</i>)
No	Probably No	Uncertain	Probably Yes	Yes	Varies										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>										

Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it	Weak negative recommendation: Probably don't do it	No specific recommendation	Weak positive recommendation: Probably do it	Strong positive recommendation: Definitely do it
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Justification	<p>There is evidence from a high quality Level 1 study,⁴⁰ to suggest that high-calorie, high-protein oral nutritional supplements containing arginine, zinc and antioxidants are related to significant improvements in measures of pressure injury healing and are more effective than high-calorie, high-protein oral nutritional supplements without specific nutrients. The high quality Level 1 study showed more than three times greater likelihood of a pressure injury healing when a high-calorie, high-protein oral nutritional supplement containing arginine, zinc and antioxidants is provided for more than four weeks.⁴⁰ Three moderate quality level 1 studies,^{50,55,56} a low quality Level 1 study⁵² and low quality Level 4 studies^{51,57,58} provided evidence for improvements in other wound healing measures including surface area reduction and improvements on PUSH scale. There are no known adverse events. A high quality cost analysis⁵⁴ showed the treatment is associated with cost savings to heal a pressure injury compared with no disease-specific nutrient supplementation.</p>				

Clinical question What nutritional interventions are effective in preventing pressure injuries?
Is there an ideal nutritional regimen to reduce the risk of pressure injuries, and if so, what should it include?

Good Practice Statement
4.11 **Discuss the benefits and harms of enteral or parenteral feeding to support overall health in light of preferences and goals of care with individuals at risk of pressure injuries who cannot meet their nutritional requirements through oral intake despite nutritional interventions.**

Background: Malnutrition is a risk factor for pressure injuries. Pressure injuries themselves are also responsible for a deterioration of nutritional status due to increased energy expenditures and loss of proteins and nutrients through the skin. A positive energy and nitrogen balance is essential in wound healing. The provision of extra protein and calories for people with pressure injuries assists in meeting estimated nutrition requirements and improves anabolism. However, people with pressure injuries may have reduced spontaneous food intake requiring nutrition support.

SUPPORTING EVIDENCE, WHEN AVAILABLE

Evidence to support the opinion (when available)

Evidence for preventing pressure injuries

- In adults with a hip fracture (n=129), there was no difference in pressure injury incidence in a group receiving nasogastric feeding plus diet compared with a group receiving standard diet only (52% versus 57%, p=0.012).⁵⁹ (Level 1, low quality)
- In institutionalized adults with swallowing difficulties, nutritional support by percutaneous endoscopic gastrostomy (PEG) resulted in no significant difference in pressure injury incidence compared to usual diet (10.3% in intervention vs. 16% in control).¹⁸ (Level 3, low quality)
- An enteral nutrition regimen in older adults with malnutrition and terminal disease states did not appear to influence prevalence of pressure injuries significantly compared with an oral diet (incidence 24% in control group versus 30% group perceiving enteral nutrition).³³ (Level 3, low quality)
- In institutionalized older adults, receiving enteral disease specific formula for 12 weeks was associated with decreased incidence of Category/Stage I to IV pressure injuries at 12 weeks,⁶⁰ but there was no effect (p=0.19) when Category/Stage I pressure injuries were excluded from the analysis. (Level 3, low quality)

Additional Considerations

- There are no randomized trials addressing the comparison between artificial nutrition and oral nutrition because artificial nutrition must be considered when oral nutrition is not feasible or adequate.

Evidence suggests no significant difference between parenteral and enteral nutritional support routes for pressure injury healing (p=0.91) or absolute risk reduction of death (absolute risk reduction 1.15, 95% CI -2.65 to 4.94, p=0.57).⁶¹ (Level 1)

Adverse events

- Individuals receiving enteral nutrition via a PEG or nasogastric tube had significantly more major complications (e.g. weight loss, pneumonia and death) that were deemed to be related to the intervention compared to individuals receiving an oral diet (61% versus 34%, p<0.01).³³ (Level 3)

Justification

A low quality level 1 study⁵⁹ and three low quality level 3 studies^{18,33,60} indicate that enteral or parenteral feeding have limited impact on pressure injury incidence in individuals at risk.

Due to obvious ethical reasons, there are no randomized trials comparing provision of artificial nutrition (enteral or parenteral) to no intervention in individuals unable to satisfy requirements by spontaneous (normal) oral feeding. In these clinical situations, administering nutrition via other routes (e.g. naso-enteric tube, PEG or parenteral nutrition) may be discussed with the individual and informal caregivers. Although current evidence does not support the use of enteral or parenteral feeding to prevent pressure injuries, consideration should be given to the individual's care goals, overall health and clinical needs beyond pressure injury prevention and treatment.

Clinical question What nutritional interventions are effective in supporting pressure injury healing?
Is there an ideal nutritional regimen to promote healing of pressure injuries, and if so, what should it include?

Recommendation 4.12 **Discuss the benefits and harms of enteral or parenteral feeding to support pressure injury treatment in light of preferences and goals of care for individuals with pressure injuries who cannot meet their nutritional requirements through oral intake despite nutritional interventions.**

Option: Providing enteral or parenteral nutritional supplements

Comparison: Providing nutritional supplements orally, or providing no nutritional supplements

Background: Malnutrition is a risk factor for pressure injuries. Pressure injuries themselves are also responsible for a deterioration of nutritional status due to increased energy expenditures and loss of proteins and nutrients through the skin. A positive energy and nitrogen balance is essential in wound healing. The provision of extra protein and calories for people with pressure injuries assists in meeting estimated nutrition requirements and improves anabolism. However, people with pressure injuries may have reduced spontaneous food intake. Artificial nutrition can be used to meet nutritional needs.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS										
BENEFITS & HARMS OF THE PRACTICE	What is the overall certainty of the evidence?	<table border="0"> <tr> <td>No included studies</td> <td>Very low</td> <td>Low</td> <td>Moderate</td> <td>High</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No included studies	Very low	Low	Moderate	High	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>Effectiveness for improvement in measures of pressure injury healing</p> <ul style="list-style-type: none"> In older hospitalized adults (n=60) receiving tube feeding, 12 weeks of nutritional support calculated using BEE x activity factor 1.1 x stress factor 1.3 to 1.5 (mean intake 37.9±6.5 kcalories/kg/day) was associated with improved pressure injury size (p<0.001) and depth (p<0.05) compared to standard tube feeding (mean intake 29.1±4.9 kcalories/kg/day).³⁵ (Level 1, moderate quality) Older adults (n=28), 65% of whom were tube fed, receiving eight weeks of adequate amounts of energy (≥30 kcal/kg per day) and protein (≥1.2 g/kg/day) showed significant improvements in pressure injury surface area and PUSH score (both p<0.001).³⁶ (Level 1, moderate quality) Individuals with a pressure injury who received PEG supplementation (regimen not reported) were significantly less likely to show improvements in pressure injury healing than individuals who received no PEG supplementation (27.2% improved versus 34.6% improved, odds ratio [OR] 0.66, 95% CI 0.45 to 0.97).⁶² (Level 3, moderate quality) <p>Adverse events</p> <ul style="list-style-type: none"> Individuals receiving enteral nutrition via a PEG or nasogastric tube had significantly more major complications (e.g. weight loss, pneumonia and death) that were deemed to be related to the intervention compared to individuals receiving an oral diet (61% versus 34%, p<0.01).⁶³ (Level 3, low quality) <p>Strength of evidence: B1 - Level 1 studies of moderate or low quality providing direct evidence; most studies have consistent outcomes and inconsistencies can be explained.</p>	<ul style="list-style-type: none"> There are no randomized trials addressing the comparison between artificial nutrition and oral nutrition because artificial nutrition must be considered when oral nutrition is not feasible or adequate. Evidence suggests no significant difference between parenteral and enteral nutritional support routes for pressure injury healing (p=0.91) or absolute risk reduction of death between enteral (absolute risk reduction 1.15, 95% CI -2.65 to 4.94, p=0.57).⁶¹ (Level 1)
	No included studies	Very low	Low	Moderate	High									
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									
	Is there important uncertainty about how much people value the main outcomes?	<table border="0"> <tr> <td>Important uncertainty or variability</td> <td>Possibly important uncertainty or variability</td> <td>Probably no important uncertainty or variability</td> <td>No important uncertainty or variability</td> <td>No known undesirable outcomes</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Important uncertainty or variability	Possibly important uncertainty or variability	Probably no important uncertainty or variability	No important uncertainty or variability	No known undesirable outcomes	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
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How substantial are the desirable anticipated effects?	<table border="0"> <tr> <td>Unclear</td> <td>Not substantial</td> <td>Probably not substantial</td> <td>Probably substantial</td> <td>Substantial</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
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Do the desirable effects outweigh the undesirable effects?	<table border="0"> <tr> <td>No</td> <td>Probably No</td> <td>Uncertain</td> <td>Probably Yes</td> <td>Yes</td> <td>Varies</td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
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	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS												
RESOURCE USE	How substantial are the resource requirements?	<table border="0"> <tr> <td><i>Not clear</i></td> <td><i>Not substantial</i></td> <td><i>Probably not substantial</i></td> <td><i>Probably substantial</i></td> <td><i>Substantial</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<i>Not clear</i>	<i>Not substantial</i>	<i>Probably not substantial</i>	<i>Probably substantial</i>	<i>Substantial</i>	<i>Varies</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Although artificial nutrition is associated with an increase in the intensity of care, there is no evidence available on cost effectiveness of providing enteral or parenteral nutritional support.
<i>Not clear</i>	<i>Not substantial</i>	<i>Probably not substantial</i>	<i>Probably substantial</i>	<i>Substantial</i>	<i>Varies</i>										
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PRIORITY AND ACCEPTABILITY	Is the option acceptable to key stakeholders?	<table border="0"> <tr> <td><i>No</i></td> <td><i>Probably No</i></td> <td><i>Uncertain</i></td> <td><i>Probably Yes</i></td> <td><i>Yes</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	No evidence available
	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>									
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<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>										
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										
FEASIBILITY	Is the option feasible to implement?	<table border="0"> <tr> <td><i>No</i></td> <td><i>Probably No</i></td> <td><i>Uncertain</i></td> <td><i>Probably Yes</i></td> <td><i>Yes</i></td> <td><i>Varies</i></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> </tr> </table>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	There is large variability in accessibility to appropriate dietary interventions that may be limited by the clinical and geographic setting. Access to dietary expertise is important to providing an appropriate, individualized diet. (<i>Expert opinion</i>)
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>										

Balance of consequences	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input type="checkbox"/>	Undesirable consequences <i>probably outweigh</i> desirable consequences in most settings <input type="checkbox"/>	The balance between desirable and undesirable consequences <i>is closely balanced or uncertain</i> <input checked="" type="checkbox"/>	Desirable consequences <i>probably outweigh</i> undesirable consequences in most settings <input type="checkbox"/>	Desirable consequences <i>clearly outweigh</i> undesirable consequences in most settings <input type="checkbox"/>
Strength of recommendation	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input checked="" type="checkbox"/>	Strong positive recommendation: Definitely do it <input type="checkbox"/>
Justification	<p>Due to obvious ethical reasons, there are no randomized trials comparing provision of artificial nutrition (enteral or parenteral) to no intervention in individuals unable to satisfy requirements by oral feeding. In these clinical situations, administering nutrition via other routes (e.g. naso-enteric tube, PEG or parenteral nutrition) may be discussed with the individual and informal caregivers. Consideration should be given to the individual's care goals and clinical needs beyond pressure injury prevention and treatment.</p> <p>Two moderate quality level 1 studies showed that high calorie, high protein enteral or parenteral supplements lead to improvements in some measures of pressure injury healing compared to standard formulas.^{35,36} A moderate quality level 3 study had conflicting findings; however, these findings could be because pressure injuries were often more severe in individuals who received enteral feeding in the clinical studies.⁶² For example, Breslow et al. (1991)⁶⁴ found a significant positive correlation between amount of enteral formula received and pressure injury surface area (r=0.59, p<0.04).</p>				

Clinical question What nutritional interventions are effective in supporting pressure injury healing?
Is there an ideal nutritional regimen to promote healing of pressure injuries, and if so, what should it include?

Good practice statement 4.13 **Provide and encourage adequate water/fluid intake for hydration for an individual with or at risk of a pressure injury, when compatible with goals of care and clinical conditions.**

Background: Water is a key nutrient for life. Dehydration is an often-occurring complication in PU patients. Appropriate hydration can support the maintenance of good tissue perfusion, which plays a pivotal role in tissue regeneration.

SUPPORTING EVIDENCE, WHEN AVAILABLE

Evidence to support the opinion (when available)

- Evidence-based guidelines recommend that water requirements for people with, or at risk of, pressure injuries be calculated as 1 mL/kcalorie consumed daily.^{65,66}

Justification Water is a key nutrient for life. Appropriate hydration can support the maintenance of good tissue perfusion, which plays a pivotal role in tissue regeneration. Nonetheless, fluids management should be part of regular care for all individuals.

Clinical question What are the unique pressure injury prevention strategies for neonates and children?

Good practice statement 4.14 **Conduct age appropriate nutritional screening and assessment for neonates and children at risk of pressure injuries.**

Background: Nutritional assessment, selection of the appropriate mode of feeding, frequent monitoring, strategies to promote adequate intake in an appealing manner, and, when required, nutritional supplements or nutritional support, are all important considerations in the promotion of wound healing in children.^{67,68}

SUPPORTING EVIDENCE, WHEN AVAILABLE

Evidence to support the opinion (when available) None

Justification A pediatrician, dietitian or other qualified health professional should conduct an age appropriate nutritional screening and assessment to identify nutritional requirements for neonates and children with, or at risk of pressure injuries. Early identification of neonates and children who have or at risk of malnutrition is important to enable prompt intervention.⁶⁸

Clinical question

What are the unique pressure injury prevention strategies for neonates and children?

**Good practice statement
4.15**

For neonates and children with or at risk of pressure injuries who have inadequate oral intake, consider fortified foods, age appropriate nutritional supplements, or enteral or parenteral nutritional support.

Background: Critically ill children should have their energy expenditure assessed regularly in order to determine appropriate energy needs.

SUPPORTING EVIDENCE, WHEN AVAILABLE

**Evidence to support the
opinion (when available)**

None

Justification

A pediatrician, pediatric dietitian or other qualified health professional should be involved in planning an appropriate, individualized nutrition plan, and providing caregivers with strategies to promote nutritional intake.⁶⁷ Energy needs should be individualized and determined with consideration to energy expenditure in order to avoid overfeeding or underfeeding.

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