

## Evidence to Decision Frameworks: Biophysical agents

**Clinical question** Is electrical stimulation an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

**Recommendation 17.1** **Administer pulsed current electrical stimulation to facilitate wound healing in recalcitrant Category/Stage II pressure injuries and Category/Stage III or IV pressure injuries.**

**Option:** Electrical stimulation

**Comparison:** Sham therapy or conventional wound therapy or another biophysical agent

**Background:** The electromagnetic spectrum (EMS) is an energy source that affects living systems. Electrical stimulation, delivered to the individual using a medical device, appears to induce physiological responses that are important for wound healing.<sup>1,2</sup>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	<b>What is the overall certainty of the evidence of effectiveness?</b>	<p>No included studies</p> <p>Very low      Low      Moderate      High</p> <p><input type="checkbox"/>      <input type="checkbox"/>      <input type="checkbox"/>      <input type="checkbox"/>      <input checked="" type="checkbox"/></p>	<p><b>Evidence for complete wound healing</b></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II to IV pressure injuries (n=77), statistically significantly more pressure injuries healed after six weeks of high voltage, monophasic ES compared with standard wound care (51.7% vs 22.6%, p=0.031).<sup>3</sup> (<i>Level 1, high quality</i>)</li> <li>In older adults with Category/Stage II or III pressure injuries (n=63), pressure injuries receiving placebo ES were significantly less likely to reach closure (0%) than those receiving either high voltage monophasic cathode-only ES (47.83%, p=0.013) or those receiving high voltage monophasic cathode-anode ES (45%, p=0.045).<sup>4</sup> (<i>Level 1, high quality</i>)</li> <li>In individuals with Category/Stage IV pressure injuries (n=16), 100% reached complete closure with treatment with high voltage, monophasic ES after a mean 7.3 weeks, compared with no healing in a sham treatment group (p=not reported).<sup>5</sup> (<i>Level 1, Low quality</i>)</li> <li>In individuals with SCI and Category/Stage II to IV pressure injuries (n=17), 100% of Category II pressure injuries treated with high voltage pulsed current ES reached complete healing within 20 days (rate for sham treatment not reported).<sup>6</sup> (<i>Level 1, low quality</i>)</li> <li>In individuals with SCI and Category/Stage II to IV pressure injuries (n=21), treatment with monophasic ES was associated with 23% pressure injuries reaching complete healing after 2 to 4 weeks of treatment.<sup>7</sup> (<i>Level 3, Low quality</i>)</li> </ul> <p><b>Evidence for reduction in wound surface area</b></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II to IV pressure injuries (n=77), mean percent reduction in wound surface area was 76.19 ± 32.83% with electrical stimulation compared with 48.87 ± 53.42% with standard wound care (p=0.03).<sup>3</sup> (<i>Level 1, high quality</i>)</li> <li>In older adults with Category/Stage II or III pressure injuries (n=63), cumulative surface area reduction over 6 weeks was 82.34% (95% CI 70.06 to 94.63) with high voltage monophasic</li> </ul>	<p><b>Cathode administration versus cathode-anode administration ES</b></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II or III pressure injuries (n=63), cumulative wound surface area reduction over 6 weeks was 82.34% (95% CI 70.06 to 94.63) in high voltage monophasic electrical stimulation (ES) via cathode-only compared with 70.77% (95% CI 53.51 to 88.04) for ES via cathode-anode (p=0.99).<sup>4</sup> (<i>Level 1, high quality</i>)</li> </ul> <p><b>Monophasic versus biphasic ES</b></p> <ul style="list-style-type: none"> <li>In outpatients with Category/Stage III or IV</li> </ul>
	<b>Is there important uncertainty about how much people value the main outcomes?</b>	<p>Important uncertainty or variability      Possibly important uncertainty or variability      Probably no important uncertainty or variability      No important uncertainty or variability      No known undesirable outcomes</p> <p><input type="checkbox"/>      <input type="checkbox"/>      <input type="checkbox"/>      <input checked="" type="checkbox"/>      <input type="checkbox"/></p>		
	<b>How substantial are the desirable anticipated effects?</b>	<p>Unclear      Not substantial      Probably not substantial      Probably substantial      Substantial</p> <p><input type="checkbox"/>      <input type="checkbox"/>      <input type="checkbox"/>      <input checked="" type="checkbox"/>      <input type="checkbox"/></p>		
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CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<p>Do the desirable effects outweigh the undesirable effects?</p>	<p>No <input type="checkbox"/>    Probably No <input type="checkbox"/>    Uncertain <input type="checkbox"/>    Probably Yes <input type="checkbox"/>    Yes <input checked="" type="checkbox"/>    Varies <input type="checkbox"/></p>	<p>electrical stimulation (ES) delivered via cathode-only compared with 70.77% (95% CI 53.51 to 88.04) for ES via cathode-anode and compared with 40.53% (95% CI 23.60 to 57.46) for sham therapy (p=0.0004 between all three groups).<sup>4</sup> (Level 1, high quality)</p> <ul style="list-style-type: none"> <li>• In older adults with Category/Stage II or III pressure injuries (n=49), surface area reduction was 45% after 6 weeks when treated with high voltage monophasic ES, compared with 20.32% for sham therapy (p&lt;0.032).<sup>8</sup> (Level 1, high quality)</li> <li>• In individuals with Category/Stage I, II or III pressure injuries (n=57) mean surface area reduction at 6 weeks was 88.9%±14% when treated with high voltage ES compared with 44.9%±63.1% for treatment with standard wound care (p=0.00003).<sup>9</sup> (Level 1, moderate quality)</li> <li>• In community-based individuals with SCI and Category/Stage II to IV pressure injuries (n=34), mean decrease in wound surface area at 3 months was 70% ± 25% for treatment with monophasic electrical stimulation plus a silver dressing compared with standard wound care (36% ± 61%, p=0.048).<sup>10</sup> (Level 1, moderate quality)</li> <li>• In individuals with Category/Stage I, II or III pressure injuries (n=58) mean surface area reduction at 6 weeks was 85.38% when treated with high voltage, monophasic ES compared with 40.08% for treatment with standard wound care (p&lt;0.0001 versus baseline).<sup>11</sup> (Level 1, moderate quality)</li> <li>• In individuals with Category/Stage II to IV pressure injuries (n=25), there was a significant 43% decrease in wound surface area at 12 weeks for pressure injuries treated with high voltage monophasic ES (p&lt;0.001).<sup>12</sup> (Level 1, low quality)</li> <li>• In individuals with SCI and Category/Stage II to IV pressure injuries (n=17), mean reduction in wound surface area at 20 days was 80% with high voltage ES compared with 53% for sham treatment (p=not reported).<sup>6</sup> (Level 1, low quality)</li> </ul> <p><b>Evidence for wound healing rate</b></p> <ul style="list-style-type: none"> <li>• In individuals with Category/Stage II and III pressure injuries (n=74), wound healing rate was 11.04% per week with low intensity direct current ES compared with 4.10% with sham treatment (p&lt;0.0001).<sup>13</sup> (Level 1, moderate quality)</li> <li>• In individuals with spinal cord injury (SCI) and pressure injuries of unreported Category/Stage (n=73), mean healing per day with low frequency biphasic ES was 5.7%±7.1 compared with 2.7%±3.6 for standard wound care (exponential fitting method, p=not reported).<sup>14</sup> (Level 1, low quality)</li> <li>• In individuals with Category/Stage IV pressure injuries (n=16), wound healing rate was 44.80% per week with high voltage, monophasic ES compared with -11.59% with sham treatment (p=not reported).<sup>5</sup> (Level 1, Low quality)</li> <li>• In individuals with SCI and pressure injuries of unreported Category/Stage (n=150), the mean healing rate was significantly faster with alternating current, low voltage biphasic ES compared with standard wound care (p=0.003).<sup>15</sup> (Level 2, low quality)</li> </ul> <p><b>Potential adverse effects</b></p> <p>None of the studies above reported any adverse events related to ES.<sup>16</sup> (Level 1 high quality)</p>	<p>pressure injuries (n=20), there was no significant difference between those receiving biphasic waveform ES compared with those receiving monophasic ES for wound surface area reduction at 4 weeks.<sup>17</sup> (Level 2, moderate quality)</p> <p><b>Pulsed current ES versus direct current ES</b></p> <ul style="list-style-type: none"> <li>• In individuals with SCI and pressure injuries of unreported Category/Stage (n=150), the mean healing rate was significantly faster compared with standard wound care when alternating current, low frequency biphasic ES was applied (p=0.003); however, direct current ES was not statistically significantly different from standard wound care (p=not reported).<sup>15</sup> (Level 2, low quality)</li> </ul> <p><b>Asymmetrical versus symmetrical ES</b></p> <ul style="list-style-type: none"> <li>• In individuals with SCI and pressure injuries of unreported Category/Stage, percent healing per week was higher in the asymmetric ES group compared with a symmetric ES group</li> </ul>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
			<p><i>and lower evidence)</i></p> <ul style="list-style-type: none"> <li>• <b>Strength of Evidence: A - More than one high quality Level I study providing direct evidence</b></li> </ul>	<p>(63.7%±7.2 versus 50.6%±5.6, p=not reported).<sup>18</sup> (<i>Level 1, low quality</i>)</p>

	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"> <li>There is no evidence on cost effectiveness of delivering ES to pressure injuries.</li> <li>In the reported studies, ES was delivered by a physical therapist/physiotherapist, with regimens that ranged from 30 minutes daily to two hours daily (generally one hour daily), generally five days per week for up to eight weeks.<sup>16</sup> (<i>Level 1 high quality and lower evidence</i>)</li> </ul>
<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"/>										
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 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"/>	The reported studies had low withdrawal rates (generally for reasons unrelated to the US treatment) suggesting that the intervention could be acceptable to individuals with pressure injuries. <sup>3-15,17</sup> ( <i>Level 1, high quality and lower 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"/>										
	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 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"/>	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 type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" 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"/>	<ul style="list-style-type: none"> <li>In all of the reported studies,<sup>3-15,17,18</sup> electrical stimulation was delivered by a trained health professional or a trained researcher. Access to appropriately qualified health professionals will vary based on clinical setting and geographic location. (<i>Expert opinion</i>)</li> <li>Electrical stimulation was delivered in a range of settings including medical centers, hospitals and wound clinics to inpatients and individuals living in the community, suggesting the intervention is appropriate for a range of clinical settings. Access to the intervention will vary. (<i>Expert opinion</i>)</li> </ul>
<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"/>										

<b>Balance of consequences</b>	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"/>
<b>Strength of recommendation</b>	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"/>
<b>Justification</b>	<p>There was consistent evidence from eight Level 1 studies of high quality,<sup>3,4,8</sup> moderate quality<sup>9-11</sup> and low quality<sup>6,12</sup> that application of electrical stimulation to Category/Stage II to IV pressure injuries for between two weeks and eight weeks is associated with a greater reduction in wound surface area than either sham therapy<sup>4,6,8</sup> or standard wound care.<sup>3,9-11</sup> Studies reported relative wound surface area reduction of 25% to 82%<sup>3,4,6,8-11</sup> greater with electrical stimulation regimens than with comparator treatments. One high quality Level 1 study<sup>3</sup> showed that statistically significantly more pressure injuries healed after six weeks of electrical stimulation compared with standard wound care. Two small, low quality Level 1 studies<sup>5,6</sup> provided evidence that 100% of Category/Stage II to IV pressure injuries treated with high voltage electrical stimulation were able to completely heal in 20 days<sup>6</sup> and in seven weeks.<sup>5</sup> A low quality Level 3 study<sup>7</sup> reported a 23% complete healing rate for Category/Stage II to IV pressure injuries treated for between two and four weeks. Three moderate<sup>13</sup> and low quality<sup>5,14</sup> Level 1 studies reported statistically significantly faster wound healing rates associated with electrical stimulation compared with sham treatment<sup>5,13</sup> or standard wound care.<sup>14</sup> No adverse events were reported in the studies. The reported regimens varied with respect to characteristics of the electrical stimulation, but generally administered using high voltage monophasic electrical current,<sup>3-12</sup> for between 30 minutes to two hours daily (generally one hour daily), generally for five days per week for up to eight weeks.<sup>3-14,17</sup> The treatment was usually administered by physical therapists, physiotherapists or trained researchers in a range of inpatient and outpatient settings.</p>				

**Clinical question** Is non-contact low frequency ultrasound therapy an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

**Recommendation 17.2** Consider using non-contact low frequency ultrasound therapy as an adjunct therapy to facilitate healing in Category/Stage III and IV pressure injuries and suspected deep tissue injuries.

**Option:** Non-contact low frequency ultrasound (NCLFUS)  
**Comparison:** Sham therapy or conventional wound therapy

**Background:** Non-contact low frequency ultrasound refers to therapy that uses acoustic waveforms at low frequencies to transmit energy into the skin and tissues through atomized saline. The device is not in contact with the wound or tissues. The transmitted energy is reported to create bubbles in cell fluids, thereby promoting interstitial movement through the cell membrane that is thought to promote healing activities at a cellular level.<sup>19</sup>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence of effectiveness?	<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 checked="" 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 type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p><b>Evidence for complete wound healing</b></p> <ul style="list-style-type: none"> <li>In individuals with deep tissue injuries (n=60), those receiving NCLFUS within five days of development achieved a higher rate of complete resolution than deep tissue injuries not receiving NCLFUS (18% vs 2%, p = not reported).<sup>20</sup> (Level 3, low quality)</li> <li>In individuals with deep tissue injuries that were treated with NCLFUS (n=44), only 23% of the deep tissue injuries completely healed with treatment three times weekly.<sup>19</sup> (Level 4, low quality)</li> </ul> <p><b>Evidence for reduction in wound surface area</b></p> <ul style="list-style-type: none"> <li>In individuals with deep tissue injuries that were treated with NCLFUS (n=30), a statistically significantly greater reduction in surface area compared with deep tissue injuries not receiving NCLFUS (n=30) was noted (mean decrease 8.8cm<sup>2</sup> versus 0.3cm<sup>2</sup>, p=0.014).<sup>21</sup> (Level 3, high quality)</li> <li>In individuals with deep tissue injuries that were treated with NCLFUS (n=44), there was a statistically significant decrease in surface area over time with treatment three times weekly (24.6cm<sup>2</sup> vs 14.4 cm<sup>2</sup>, p=0.02).<sup>19</sup> (Level 4, low quality)</li> <li>In individuals with Category III pressure injuries with bioburden but no clinical signs of infection (n=11), there was a 26% reduction in wound area (from 13.8cm<sup>2</sup> to 10.8cm<sup>2</sup>, p=not reported) after two weeks of treatment with NCLFUS.<sup>22</sup> (Level 4, low quality)</li> </ul> <p><b>Potential adverse effects</b> No adverse events were reported in the studies.</p> <p><b>Strength of Evidence: B2 - Level 3 or 4 studies (regardless of quality) providing direct evidence</b></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 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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<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.	
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	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"/>	No evidence available.	
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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"/>	In the studies, NCLFUS therapy was delivered by trained health professionals. Access to the intervention will vary across clinical and geographic settings. (Expert opinion)	
<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>											
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<b>Balance of consequences</b>	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"/>
<b>Strength of recommendation</b>	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 checked="" type="checkbox"/>	Weak positive recommendation: Probably do it <input type="checkbox"/>	Strong positive recommendation: Definitely do it <input type="checkbox"/>
<b>Justification</b>	The available evidence is from small studies at high risk of bias. One low quality Level 3 study <sup>20</sup> and one low quality Level 4 study <sup>19</sup> provided evidence that treatment with NCLFUS therapy is associated with complete resolution of 18% <sup>20</sup> to 23% <sup>19</sup> of deep tissue injuries. Three low quality Level 3 and Level 4 studies provided evidence for an association between NCLFUS therapy and reduction in wound surface area. Two low quality Level 4 studies <sup>19,22</sup> reported that two weeks of treatment with NCLFUS therapy was between 26% reduction <sup>22</sup> and 41.4% reduction <sup>19</sup> in the mean deep tissue injury or Category III pressure injury surface. A high quality Level 3 study <sup>21</sup> also demonstrated a significantly greater reduction in deep tissue surface area associated with NCLFUS therapy compared with standard treatment. No adverse events were reported, and no studies reported comparisons of different NCLFUS therapy regimens.				



**Clinical question** Is ultrasound therapy an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

**Recommendation 17.3 Consider using high frequency ultrasound therapy at 1MHz as an adjunct therapy to facilitate healing in Category/Stage III and IV pressure injuries.**

**Option:** High frequency ultrasound (HFUS) therapy  
**Comparison:** Sham therapy or standard wound therapy

**Background:** High frequency ultrasound refers to ultrasound delivered at 1–3 MHz frequency. Ultrasound is reported to play a role in stimulating cell conductivity and promoting the wound healing roles of fibroblasts and macrophages, as well as promoting collagen synthesis and activating growth factors.<sup>3</sup>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND 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 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><b>Evidence for complete wound healing for 1mHz ultrasound</b></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II to IV pressure injuries (n=77), there was no statistically significant difference in number of pressure injuries completely healed after six weeks of HFUS therapy (1MHz) compared with standard wound care (46.4% versus 22.6%, p=0.097).<sup>3</sup> (Level 1, high quality)</li> <li>In older adults with Category II or III pressure injuries (n=42) there was no statistically significant difference between HFUS therapy (1MHz) and standard wound care for wound healing rate at six weeks (38.1% versus 11.04%, p=0.083).<sup>23</sup> (Level 1, high quality)</li> </ul> <p><b>Evidence for reduction in wound surface area for 1mHz ultrasound</b></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II to IV pressure injuries (n=77), mean percent reduction in wound surface area was 77.48±11.59% with HFUS therapy (1MHz) compared with 48.87 ± 53.42% with standard wound care (p=0.024).<sup>3</sup> (Level 1, high quality)</li> <li>In older adults with Category II or III pressure injuries (n=42), mean percent reduction in wound surface area was 68.8±37.23% with HFUS therapy (1MHz) compared with 37.24±57.04% with standard wound care (p=0.047).<sup>3</sup> (Level 1, high quality)<sup>23</sup> (Level 1, high quality)</li> </ul> <p><b>Evidence for complete wound healing for 3MHz ultrasound</b></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II to IV pressure injuries (n=88), HFUS therapy (3MHz) for 12 weeks was associated with no difference in complete healing rates compared to sham ultrasound (40% versus 44%, p=0.61).<sup>24</sup> (Level 1, high quality)</li> <li>In hospitalized individuals with Category/Stage I and II pressure injuries (n=40), HFUS therapy (3MHz) was not associated with significant differences in complete healing compared with sham US (48% vs 42%, p&gt;0.05).<sup>25</sup> (Level 1, moderate quality)</li> </ul> <p><b>Evidence for reduction in wound surface area for 3mHz ultrasound</b></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II to IV pressure injuries (n=88), HFUS therapy (3MHz) for 12 weeks was associated with no difference in wound surface area reduction compared with sham ultrasound (22.91% vs 13.82%, p=0.10, adjusted difference 8.27%, 95% CI -2.31% to 18.85%).<sup>24</sup> (Level 1, high quality)</li> <li>In individuals with Category/Stage II to IV pressure injuries (n=22), there was a significant 63% decrease in wound surface area at 12 weeks for pressure injuries treated with HFUS therapy (3MHz) (p&lt;0.001).<sup>12</sup> (Level 1, low quality)</li> <li>In hospitalized individuals with Category II and III pressure injuries, HFUS therapy (3MHz) was associated with a</li> </ul>
	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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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 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"/>
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	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE AND ADDITIONAL CONSIDERATIONS
			<p>statistically significantly better absolute improvement in wound surface area compared to standard wound care (9.97±5.83cm<sup>2</sup> vs 4.05±5.34cm<sup>2</sup>, p=0.0071).<sup>26</sup> (Level 1, low quality)</p> <ul style="list-style-type: none"> <li>• In individuals with SCIs and pressure injuries of unreported Category/Stage (n=22), HFUS therapy (3MHz) with ultraviolet C light was associated with a greater mean reduction in wound size (53.5% reduction) compared to laser therapy (23.7%) and standard wound care (32.4%, p=0.032).<sup>27</sup> (Level 1, low quality)</li> </ul> <p><b>Evidence for wound healing rate for 3MHz ultrasound</b></p> <ul style="list-style-type: none"> <li>• In hospitalized individuals with Category I and II pressure injuries (n=40), HFUS therapy (3MHz) was not associated with statistically significant differences in time to complete healing compared with sham US (32 days vs 36 days, p=0.80).<sup>25</sup> (Level 1, moderate quality)</li> </ul> <p><b>Undesired effects</b> No adverse events were reported in the studies.</p> <p><b>Strength of Evidence: B1 - Level 1 studies of moderate or low quality providing direct evidence; Level 2 studies of high or moderate quality providing direct evidence</b></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 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"/>	<ul style="list-style-type: none"> <li>There is no evidence on cost effectiveness of delivering HFUS therapy to deep tissue and pressure injuries.</li> <li>In the reported studies, HFUS therapy was delivered by trained health professionals in 2 to 10-minute sessions (length determined by the wound size), for alternating days or up to five days per week, for six to twelve weeks.<sup>3,12,23-25,27</sup> (Level 1)</li> </ul>
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"/>										
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 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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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"/>	<ul style="list-style-type: none"> <li>In all of the reported studies,<sup>3,12,23-27</sup> HFUS was delivered by a trained health professional. Access to appropriately qualified health professionals will vary based on clinical setting and geographic location. (Expert opinion)</li> <li>Longer courses of HFUS may not be feasible in short term stay clinical settings. Some studies experienced higher attrition due to discharges and transfers.<sup>25,27</sup> (Level 1)</li> </ul>
No	Probably No	Uncertain	Probably Yes	Yes	Varies										
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<b>Balance of consequences</b>	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"/>
<b>Strength of recommendation</b>	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 checked="" type="checkbox"/>	Weak positive recommendation: Probably do it <input type="checkbox"/>	Strong positive recommendation: Definitely do it <input type="checkbox"/>
<b>Justification</b>	<p>Two high quality Level 1 studies<sup>3,23</sup> provided evidence supporting the use of high frequency ultrasound (HFUS) therapy at 1 MHz frequency reducing wound surface area. In both studies,<sup>3,23</sup> mean wound surface area reduction was approximately 30% greater with the use of HFUS therapy (1 MHz), compared with standard therapy alone, which was a statistically significant improvement in both studies. In one study,<sup>3</sup> approximately 46% of Category/Stage II to IV pressure injuries completely healed with HFUS therapy (1MHz) for six weeks and in the second high quality Level 1 study<sup>23</sup> approximately 38% of Category/Stage II or III pressure injuries completely healed; however, neither of these results was statistically significant compared to standard therapy.</p> <p>Evidence from three quality low Level 1 studies<sup>12,26,27</sup> showed that HFUS therapy at 3MHz is associated with statistically significant reductions in wound surface area but other studies showed no statistically significant improvements in wound healing rates<sup>25</sup> or complete wound healing.<sup>24,25</sup> Ultrasound waves at 3MHz have shallower tissue penetration compared to ultrasound waves at 1MHz, and may not treat a pressure injury at sufficient tissue depth to achieve clinically significant outcomes.<sup>28,29</sup></p>				

**Clinical question** Is subatmospheric therapy (e.g negative pressure wound therapy, suction, tension) an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

**Recommendation 17.4** Consider negative pressure wound therapy as an early adjunct therapy for reducing the size and depth of Category/Stage III and IV pressure injuries.

**Option:** Negative pressure wound therapy (NPWT)

**Comparison:** Sham therapy or conventional wound therapy

**Background:** Negative pressure wound therapy (NPWT) is a vacuum-assisted method of applying negative (subatmospheric) pressure to the wound bed.<sup>30</sup> The therapy promotes wound healing through removal of third space edema,<sup>31</sup> thus enhancing nutrient and oxygen delivery,<sup>32</sup> removal of wound exudate,<sup>30,33-35</sup> promotion of granulation tissue,<sup>30,33,34</sup> promotion of angiogenesis,<sup>30</sup> and removal of wound inhibitory factors.<sup>33</sup>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence of effectiveness?	<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><b>Evidence for complete wound healing</b></p> <ul style="list-style-type: none"> <li>In individuals with SCI and Category/Stage III or IV pressure injuries (n=86), there was no significant difference between NPWT and standard wound care for percent reaching complete healing after 28 days (70% versus 67%, p&gt;0.05).<sup>36</sup> (Level 4, low quality)</li> </ul> <p><b>Evidence for reduction in wound surface area</b></p> <ul style="list-style-type: none"> <li>In individuals with SCI and Category/Stage III or IV pressure injuries (n=86), there was no significant difference between NPWT and standard wound care for reduction in wound surface area in those pressure injuries classified as healing (NPWT -43% ± 22% vs standard care -50% ± 26%, p&gt;0.05).<sup>36</sup> (Level 4, low quality)</li> <li>In immobilized individuals with pressure injuries of unreported Category/Stage (n=10), NPWT was associated with a reduction in surface area that became significant after one week of treatment (mean reduction 55.1% by seven weeks, p&lt;0.05).<sup>37</sup> (Level 4, low quality)</li> </ul> <p><b>Evidence for reduction in wound dimensions</b></p> <ul style="list-style-type: none"> <li>In individuals with pressure injuries of unreported Category/Stage (n=36 pressure injuries), treatment with NPWT for six weeks was associated with significantly greater reduction in wound depth (68% versus 20%, p=0.00001), wound width (62% versus 35%, p=0.02) and wound volume (48% versus 39%, p=0.038), but not in wound length (46% vs 38%, p=0.38), compared with three times daily saline dressings.<sup>34</sup> (Level 1, high quality)</li> <li>In individuals with Category/Stage III or IV pressure injuries (n=41), treatment with bellows enhanced vacuum NPWT for nine weeks was associated with statistically significant greater reduction in wound width (81.7% reduction vs 59.5% reduction, p=0.006), wound length (p=0.01) and wound depth (89.4% reduction vs 78.1% reduction, p=0.01) compared with twice daily wet-to-moist wound dressings.<sup>33,38</sup> Level 1, low quality)</li> <li>In trauma patients with Category/Stage III or IV pressure injuries (n=48), treatment with NPWT for three weeks was associated with significant reduction in pressure injury size and depth from baseline at weeks three, six and nine (p=0.001 for all), while the twice daily saline gauze dressings group showed no change (p&gt;0.05).<sup>39</sup> (Level 2, high quality)</li> </ul>	<p><b>Comparison between NPWT systems</b></p> <p>In an aged care setting, use of a commercial NPWT system with adjustable pressure level was associated with fewer dressing changes (3 times daily versus 0.5 times daily, p&lt;0.05) and improvements in granulation tissue (54% versus -7.1%, p=0.01) compared to a surgical drain system without adjustable pressure. Change in necrotic tissue or fibrin were not significantly different.<sup>42</sup> (Level 1, low quality)</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 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 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 type="checkbox"/></td> <td><input checked="" 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 type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial										
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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 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"/>	
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	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
			<ul style="list-style-type: none"> <li>In immobilized individuals with pressure injuries of unreported Category/Stage (n=10), NPWT was associated with a reduction in wound depth that became significant after two weeks of treatment (mean reduction 61.2% by seven weeks, p&lt;0.05).<sup>37</sup> (Level 4, low quality)</li> </ul> <p><b>Evidence for wound characteristics and/or PUSH scores</b></p> <ul style="list-style-type: none"> <li>In trauma patients with Category/Stage III or IV pressure injuries (n=48), treatment with NPWT for three weeks was associated with significantly more pressure injuries having slough converted to epithelialisation compared with twice daily saline gauze dressings (33.3% vs 0%, p=0.0001), with the difference still present after six weeks (73.8% vs 37.5%, p=0.0001).<sup>39</sup> (Level 2, high quality)</li> <li>In individuals with spinal cord injury and Category/Stage III or IV pressure injuries (n=44), treatment with NPWT was associated with a significant reduction in exudate levels by week three (p=0.01) and statistically significant improvement in tissue type by week four (p=0.001) compared to saline gauze dressings (as measured on PUSH tool).<sup>33,38</sup> (Level 1, low quality)</li> </ul> <p><b>Evidence for time to wound healing</b></p> <ul style="list-style-type: none"> <li>In individuals with SCI and Category/Stage IV pressure injuries (n=16 pressure injuries), NPWT was associated with a significantly faster rate of complete wound healing compared with sodium hypochlorite dressings three times daily (2.0 weeks [interquartile range, IQR=1 to 2] versus 3.0 weeks [IQR = 3 to 4], p=0.001).<sup>40</sup> (Level 1, moderate quality)</li> <li>In individuals with Category/Stage III pressure injuries, mean time to healing with NPWT was 35 days (range 8 to 14).<sup>41</sup> (Level 4, low quality)</li> </ul> <p><b>Evidence for reduction in inflammatory markers</b></p> <ul style="list-style-type: none"> <li>In individuals with Category/Stage III or IV pressure injuries (n=41), treatment with bellows enhanced vacuum NPWT for at least six weeks was associated with statistically significantly lower MMP-8 levels (p=0.006) compared with twice daily wet-to-moist wound dressings.<sup>33</sup> (Level 1, low quality)</li> </ul> <p><b>Adverse effects</b></p> <ul style="list-style-type: none"> <li>In individuals with pressure injuries of unreported Category/Stage (n=36 pressure injuries), NPWT was associated with fewer adverse events than standard wound care (44% vs 17%). (Level 1, high quality)</li> <li>In individuals with SCI and Category/Stage IV pressure injuries (n=16 pressure injuries), NPWT was associated with two clinically infected pressure injuries, and one small arterial bleed requiring suturing (adverse event rate of 18.75%), while a control wound group experienced two wound abscesses and one pressure injury required surgical debridement.<sup>40</sup> (Level 1, moderate quality)</li> </ul> <p><b>Strength of Evidence: B1 - Level 1 studies of moderate or low quality providing direct evidence, and lower</b></p>	

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	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 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"/>	<ul style="list-style-type: none"> <li>• Treatment with NPWT delivered in an intensive care unit in India over nine weeks was approximately 46% lower than the cost of treatment with twice daily saline dressings, with consideration to all wound dressing equipment, but not labor or sterilization costs.<sup>39</sup> (<i>Level 2, high quality</i>)</li> <li>• Treatment with NPWT delivered in a SCI unit in India over nine weeks cost USD \$105 compared with USD \$200 for moist saline dressings.<sup>33,38</sup> (<i>Level 1, low quality</i>)</li> </ul>	
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"/>											
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"/>	<ul style="list-style-type: none"> <li>• There was no evidence available</li> </ul>	
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<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 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"/>	<ul style="list-style-type: none"> <li>• There was no evidence available</li> </ul>	
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"/>											
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"/>	<p>Negative pressure at the wound bed can be created using drainage bottles or using a commercially available closed suction system. Application of NPWT should be by trained health professionals. Access to the required resources may be limited in some clinical or geographic settings (<i>Expert opinion</i>)</p> <p>Some systems (especially non-commercial systems) can limit the individual's mobility. In one study, calcaneal fractures occurred in two individuals who ambulated with a NPWT against medical advice.<sup>34</sup> (<i>Level 1, high quality</i>)</p>	
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"/>											

<b>Balance of consequences</b>	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"/>
<b>Strength of recommendation</b>	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"/>
<b>Justification</b>	<p>Most evidence on NPWT focuses on its effectiveness in reducing the wound size, as this is the primary purpose for applying NPWT. Only a low quality Level 4 study<sup>43</sup> provided evidence on complete wound healing, reporting no difference to standard wound care. Two low quality Level 4 studies had conflicting findings on the association between NPWT and reduction in wound surface area.<sup>37,43</sup> However, high<sup>34</sup> and low<sup>33,38</sup> quality Level 1 studies provided evidence suggesting NPWT is associated with reduction in pressure injury dimensions, including depth and volume, which was supported lower level studies.<sup>37,39</sup> Relative reduction in wound depth compared with standard wound care ranged from 22% to 48% after six to nine weeks of treatment.<sup>33,34,38</sup> Additional evidence<sup>33,38,39</sup> suggested NPWT has a role in promoting reduction in slough and increase in epithelialisation. Significant reductions in wound dimensions and improvements in wound characteristics (e.g., tissue type and exudate level) were evident early in treatment, with studies reporting significant effects observable within two to three weeks.<sup>33,37-39</sup> One moderate quality Level 1 study<sup>40</sup> reported significantly faster healing of Category/Stage IV pressure injuries when NPWT was implemented, and a low quality Level 1 study suggested NPWT was associated with a significant reduction in inflammatory markers.<sup>33</sup> Adverse events were reported in the literature, including retention of a foam dressing (Level 5), osteomyelitis, calcaneal fractures, arterial bleeding and clinical infection. Some adverse events may be due to improper use of NPWT devices. However, when compared to the rate of adverse events occurring with standard wound care in high<sup>34</sup> and moderate<sup>40</sup> quality Level 1 studies, NPWT was not associated with an increased risk of adverse events. Most studies reported use of a commercially available NPWT system; some studies reported custom-made systems. In most comparison studies, comparator groups received saline soaked gauze dressings (in one study,<sup>40</sup> sodium hypochlorite dressing was the comparison) attended twice or three times daily rather than comparison to contemporary wound dressings. In two limited cost evaluations,<sup>33,38,39</sup> NPWT was cheaper to deliver than moist gauze dressings. However, use of NPWT requires application by a trained health professional, along with specialized medical equipment that may not be accessible in all clinical or geographic settings.</p>				



**Clinical question** Is electromagnetic therapy an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

*Pulsed electromagnetic field therapy*

**Option:** Pulsed electromagnetic field (PEMF) therapy  
**Comparison:** Sham therapy or conventional wound therapy

**Background:** Pulsed electromagnetic field (PEMF) nonthermal, low frequency (usually < 100 Hz) therapy is the delivery of magnetic field to the wound bed with a goal of delivering therapeutic effect. Although precise mechanism of the physiological effect of PEMF therapy is unclear, increase in keratinocyte growth, reduction in inflammation, increased collagen and fibrin deposits in the wound bed are all proposed outcomes.<sup>44,45</sup>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence of effectiveness?	<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><b>Evidence for complete wound healing</b></p> <ul style="list-style-type: none"> <li>In individuals with SCI and Category/Stage II or III pressure injuries (n=30), complete wound healing was achieved in more Category/Stage II pressure injuries with PEMF therapy for up to 12 weeks compared with sham therapy (84% vs 40%, p=0.01) and complete wound healing was achieved in more Category/Stage III pressure injuries with PEMF therapy compared with sham therapy (60% vs 0%, p=not reported).<sup>46</sup> (Level 1, low quality)</li> </ul> <p><b>Evidence for reduction in wound surface area</b></p> <ul style="list-style-type: none"> <li>In immobile individuals with pressure injuries of unreported Category/Stage (n=20), reduction in mean wound surface area compared to baseline were statistically significantly greater at weeks 4 and 5 compared to baseline (p&lt;0.001) for four groups receiving different PEMF regimens.<sup>47</sup> (Level 1, moderate quality)</li> <li>In individuals with SCI and Category/Stage II or III pressure injuries (n=30), PEMF for one week was associated with statistically significantly greater reduction in mean wound surface area compared with sham treatment for Category/Stage II pressure injuries (16.5 cm<sup>2</sup> versus 2.7cm<sup>2</sup>, p=0.015).<sup>46</sup> (Level 1, low quality)</li> </ul> <p><b>Evidence for evaluations of wound condition</b></p> <ul style="list-style-type: none"> <li>In older adults with pressure injuries of unreported Category/Stage, treatment with PEMF therapy for up to 4 weeks was associated with 85% of pressure injuries being ranked as 'excellent' and 15% ranked as 'very good' condition compared to those treated with sham therapy ranked as no improvement (80%) or poor improvement (20%).<sup>48</sup> (Level 1, low quality)</li> </ul>	<p><b>Comparison of PEMF regimens</b></p> <p>In immobile individuals with pressure injuries of unreported Category/Stage (n=20), there were no significant differences in reductions in mean wound surface area between four PEMF therapy regimens that varied in magnetic vs electrical field and power density.<sup>47</sup> (Level 1, moderate quality)</p>
	No included studies	Very low	Low	Moderate	High									
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" 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 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"/>		
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"/>										
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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Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial										
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CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
<p>Do the desirable effects outweigh the undesirable effects?</p>	<p> <input type="checkbox"/> No    <input type="checkbox"/> Probably No    <input type="checkbox"/> Uncertain    <input type="checkbox"/> Probably Yes    <input checked="" type="checkbox"/> Yes    <input type="checkbox"/> Varies </p>	<ul style="list-style-type: none"> <li>In individuals with neurological disorders and Category/Stage III or IV pressure injuries, pressure injuries treated with PEMF therapy significantly improved in ratings on the Bates-Jensen Wound Assessment Tool compared with baseline (<math>p=0.01</math>) but the difference in improvement was not significantly greater than a sham therapy group (<math>p=0.361</math>)<sup>49</sup> (Level 1, low quality)</li> </ul> <p><b>Potential adverse effects</b> No adverse events occurred in the reported studies.<sup>46-49</sup> (Level 1, moderate and low quality)</p> <p><b>Strength of Evidence: C - A body of evidence with inconsistencies that cannot be explained, reflecting genuine uncertainty surrounding the topic</b></p>	

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	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 checked="" 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 type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> <li>There is no evidence on cost effectiveness of delivering PEMF therapy to pressure injuries.</li> <li>In the reported studies, PEMF therapy was delivered in sessions of between 20 and 45 minutes' duration, once or twice daily, five days per week for 1 to 12 weeks.<sup>46-49</sup> (<i>Level 1, low quality</i>)</li> </ul>	
<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 checked="" 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 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"/>	In none of the reported studies was there a large withdrawal rate (generally no withdrawals), suggesting that the intervention is acceptable to individuals with pressure injuries. <sup>46-49</sup> ( <i>Level 1, low quality</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"/>											
	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"/>	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"/>											
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"/>	Access to PEMF therapy will vary across clinical and geographic settings. ( <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"/>											

<b>Balance of consequences</b>	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"/>
<b>Strength of recommendation</b>	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 type="checkbox"/>

<b>Recommendation (text)</b>	<b>No recommendation</b>
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**Justification** The evidence on PEMF therapy for treating pressure injuries is at high risk of bias, mode of operation has not been clearly established and there is a lack of recent research in this field, therefore, no recommendation could be made on its use. One small, low quality Level 1 study<sup>46</sup> provided evidence that Category/Stage II and III pressure injuries have better rates of complete healing with PEMF therapy compared with sham therapy after up to 12 weeks of treatment. The study indicated that over 40% more Category/Stage II pressure injuries could achieve complete healing with PEMF therapy as compared to sham therapy.<sup>46</sup> One small, moderate quality Level 1 study<sup>46</sup> indicated that PEMF therapy is associated with larger reduction in Category/Stage II pressure injury surface area than sham treatment after one week of treatment. Another moderate quality Level 1 study<sup>47</sup> indicated that four different PEMF therapy regimens were associated with statistically significant reductions in Category/Stage II and III pressure injury surface area compared to baseline after four weeks of treatment, with no differences in outcomes associated with any specific PEMF therapy regimen. Evidence for PEMF therapy being associated with greater improvements in wound characteristics compared with sham therapy was provided by two Low quality Level 1 studies<sup>48,49</sup> In these studies, no adverse events were associated with PEMF therapy, although individuals with potential contraindications, including medical device implants, fever and seizures were excluded from participating.<sup>46-49</sup>

**Clinical question** Is pulsed radio frequency energy (PRFE) therapy an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

*Pulsed radio frequency energy therapy*

**Option:** Pulsed radio frequency energy (PRFE) therapy  
**Comparison:** Sham therapy or conventional wound therapy

**Background:** Pulsed radio frequency energy (PRFE) therapy is a nonthermal, non-invasive method of delivering electromagnetic energy in in pulsed athermal doses to a wound bed to promote healing.<sup>50,51</sup> Invitro cell studies have demonstrated that waveform energy is associated with optimized fibroblast and epithelial cell proliferation.<sup>50</sup>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence of effectiveness?	<p>No included studies <input type="checkbox"/></p> <p>Very low <input checked="" type="checkbox"/></p> <p>Low <input type="checkbox"/></p> <p>Moderate <input type="checkbox"/></p> <p>High <input type="checkbox"/></p>	<p><b>Evidence for reduction in wound surface area</b></p> <ul style="list-style-type: none"> <li>In older adults with a recalcitrant pressure injury of unknown Category/Stage registered in the manufacturer’s database (n=28), PRFE therapy was associated with a mean wound surface area reduction of 49% ± 6% (range 100% to -386%, p&lt;0.0001) after 4 weeks of treatment.<sup>50</sup> (Level 4, low quality)</li> <li>In individuals with a recalcitrant Category/Stage II to IV pressure injuries registered in the manufacturer’s database (n=89), PREF therapy was associated with a median surface area reduction of 44% ± 54% (range 100% to -386%) after 4 weeks of treatment.<sup>51</sup> (Level 4, low quality)</li> </ul> <p><b>Potential adverse effects</b></p> <p>Some pressure injuries increased in size while being treated with PRFE therapy.<sup>50,51</sup> (Level 4, low quality)</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 checked="" 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 type="checkbox"/></p>		
	How substantial are the undesirable anticipated effects?	<p>Unclear <input type="checkbox"/></p> <p>Not substantial <input type="checkbox"/></p> <p>Probably not substantial <input checked="" 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 checked="" type="checkbox"/></p> <p>Probably Yes <input type="checkbox"/></p> <p>Yes <input type="checkbox"/></p> <p>Varies <input type="checkbox"/></p>		<p><b>Strength of Evidence: B2 - Level 3 or 4 studies (regardless of quality) providing direct evidence</b></p>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	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"/>	<ul style="list-style-type: none"> <li>There is no evidence on cost effectiveness of delivering PRFE therapy to pressure injuries.</li> <li>In the reported studies, PRFE therapy was delivered by individuals with pressure injuries or health professionals in 30-minute sessions, twice daily for up to four weeks.<sup>50,51</sup> (<i>Level 4, low quality</i>)</li> </ul>	
<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"/>	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"/>											
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"/>	<ul style="list-style-type: none"> <li>Pulsed radio frequency energy therapy was delivered in community and inpatient settings, suggesting the intervention is feasible for a range of clinical settings.<sup>51</sup> (<i>Level 4, low quality</i>)</li> <li>In the studies, PRFE therapy was delivered by individuals in community settings or by health professionals.<sup>50</sup> (<i>Level 4, low quality</i>)</li> <li>Access to the intervention will vary. (<i>Expert opinion</i>)</li> </ul>	
<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"/>											

<b>Balance of consequences</b>	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"/>
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<b>Strength of recommendation</b>	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 type="checkbox"/>
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**Recommendation (text)** **No recommendation**

**Justification** Evidence on PRFE therapy is limited to retrospective analyses of wound registries maintained by the product manufacturer that are at high risk of bias, therefore no recommendation can be made on its use. Two low quality Level 4 studies<sup>50,51</sup> reported a mean/median decrease in wound surface area of around 45 to 50% after four weeks of treatment with pulsed radio frequency energy therapy. The pressure injuries reported in both analyses ranged from 100% healing to increase in area by almost four times.<sup>50,51</sup> Neither study reported adverse events. Pulsed radio frequency energy therapy was administered either by an individual with a pressure injury or a health professional for two 30-minute sessions each day, with therapy administered through the wound dressing.<sup>50,51</sup>

**Clinical question** Is phototherapy an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

*Phototherapy*

**Option:** Phototherapy (any type)

**Comparison:** Sham therapy or conventional wound therapy

**Background:** Phototherapy is therapy that involves exposure of the wound to a source of light, including daylight, low level laser therapy (LLLT), other laser therapies, light emitting diodes and ultraviolet light. Although the mechanism are unclear, phototherapy is thought to reduce inflammation, increase lymphatic circulation and increase tissue regeneration.<sup>52</sup>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence of effectiveness?	<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><b>Evidence for complete wound healing</b></p> <p><i>Phototherapy with laser</i></p> <ul style="list-style-type: none"> <li>In individuals with lower limb Category/Stage II and III pressure injuries (n=72), treatment with laser therapy applied with a gallium-aluminum-arsenide diode laser at a dose of 658 nm was associated with significantly more pressure injuries compared with a placebo laser achieving complete healing after one month of treatment (47.05% vs 11.11%, p&lt;0.001) and aby three month follow-up 58.82% vs 16.16%, p&lt;0.001).<sup>53</sup> (<i>Level 1, high quality</i>)</li> <li>In individuals with spinal cord injury (SCI) and Category/Stage I or II pressure injuries (primarily Category/Stage I), phototherapy with a gallium-aluminum-arsenide diode laser plus a gallium-aluminum-indium-phosphate diode laser at 980nm was associated with a larger proportion of completely healed pressure injuries than standard wound care (p=0.001).<sup>54</sup> (<i>Level 1, low quality</i>)</li> </ul> <p><i>Phototherapy with infrared (IR) light</i></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II or III pressure injuries, infrared light treatment for 12 weeks was associated with a greater proportion of completely healed pressure injuries compared to placebo light therapy (43.6% versus 39.5%, p=not reported).<sup>55</sup> (<i>Level 1, low quality</i>)</li> </ul> <p><i>Phototherapy with ultraviolet (UV) light</i></p> <ul style="list-style-type: none"> <li>In individuals with SCI and Category II to IV pressure injuries (n=58 pressure injuries), there was no significant difference in complete healing rates between ultraviolet C light therapy (43.3%) and placebo light therapy (42.8%, p&gt;0.05).<sup>56</sup> (<i>Level 1, high quality</i>)</li> </ul> <p><b>Evidence for percent reduction in wound surface area</b></p> <p><i>Phototherapy with laser</i></p> <ul style="list-style-type: none"> <li>In individuals with SCI and pressure injuries of unreported Category/Stage (n=20), laser therapy was associated with lower reductions in wound surface area (23.7%) compared to ultraviolet C light (53.5%) and compared with standard wound care (32.4%, p=0.032).<sup>27</sup> (<i>Level 1, low quality</i>)</li> </ul> <p><i>Phototherapy with ultraviolet (UV) light</i></p> <ul style="list-style-type: none"> <li>In individuals with SCI and pressure injuries of unreported Category/Stage (n=20), ultraviolet C light was associated with larger mean reductions in wound surface area compared with standard wound care (53.5% versus 32.4%, p=0.032).<sup>27</sup> (<i>Level 1, low quality</i>)</li> <li>In bedridden individuals with pressure injuries of unreported Category/Stage (n=10), ultraviolet B light treatment for six weeks was associated with greater reduction in mean wound surface</li> </ul>	<p><b>Comparison of different laser therapy doses</b></p> <ul style="list-style-type: none"> <li>In individuals with lower limb Category/Stage II and III pressure injuries, treatment with laser therapy applied with a gallium-aluminum-arsenide diode laser at a dose of 658 nm was associated with significantly more pressure injuries achieving complete healing (47.05%) compared with two other doses of laser (940nm, 11.11% and 808nm, 11.11%, p&lt;0.001).<sup>53</sup> (<i>Level 1, high quality</i>)</li> </ul>
	No included studies	Very low	Low	Moderate	High									
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									
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No	Probably No	Uncertain	Probably Yes	Yes	Varies									
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	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
			<p>area compared with standard care (78.9% versus 37.4%, p=not reported).<sup>57</sup> (Level 2, low quality)</p> <p><i>Phototherapy with polarized light</i></p> <ul style="list-style-type: none"> <li>In individuals with Category I to III pressure injuries (n=40), mean wound surface area was significantly lower after four weeks of polarized light therapy (10.80 ±19.18 cm<sup>2</sup>) compared with standard wound care (22.97±15.69 cm<sup>2</sup>), p=0.00005. Both groups had significantly healing when compared to baseline.<sup>58</sup> (Level 1, low quality)</li> </ul> <p><b>Evidence for wound healing rates</b></p> <p><i>Phototherapy with laser</i></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage III pressure injuries (n=86), there was no statistically significant difference in rate of change in wound surface area between a group receiving LLLT at 904nm and a group receiving standard wound treatment only (p=0.23).<sup>59</sup> (Level 1, low quality)</li> <li>In individuals with SCI and Category/Stage I or II pressure injuries (primarily Category/Stage I), phototherapy with a gallium-aluminum-arsenide diode laser plus a gallium-aluminum-indium-phosphate diode laser at 980nm was associated with no significant difference in healing rates compared to standard wound care (p=0.236).<sup>54</sup> (Level 1, low quality)</li> </ul> <p><i>Phototherapy with ultraviolet (UV) light</i></p> <ul style="list-style-type: none"> <li>In older adults with superficial pressure injuries (n=16), treatment with ultraviolet light for 10 weeks was associated with statistically significantly faster wound healing with time to healing of 6.26±1.6688 weeks versus 8.37±1.4142 with sham light therapy (p&lt;0.02; mean difference -2.11, 95% CI -3.63 to -0.59).<sup>60</sup> (Level 1, low quality)</li> </ul> <p><i>Phototherapy with infrared (IR) light</i></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage II and III pressure injuries (n=72), healing rate was 49% greater with infrared and red light treatment for 10 weeks compared with standard wound care only (0.298/week versus 0.200 per week).<sup>61</sup> (Level 1, moderate quality)</li> <li>In older adults with Category/Stage II or III pressure injuries, treatment with infrared light for 12 weeks was associated with no significant difference in wound healing rate compared with a placebo light therapy (p=0.18).<sup>55</sup> (Level 1, low quality)</li> </ul> <p><b>Potential adverse effects</b></p> <p><i>Phototherapy with laser</i></p> <ul style="list-style-type: none"> <li>In older adults with Category/Stage III pressure injuries (n=86), 8% of individuals receiving LLLT experienced an adverse event, one of which was development of a Category/Stage IV pressure injury. However, this was not different to the standard wound care group (11%, p=0.72).<sup>59</sup> (Level 1, low quality)</li> </ul> <p><i>Phototherapy with infrared (IR) light</i></p> <ul style="list-style-type: none"> <li>In older adults receiving infrared light therapy (n=164), five adverse events were deemed to be related to the treatment and these cases involved tingling, pain, bleeding and/or skin redness.<sup>55</sup> (Level 1, low quality)</li> </ul> <p><b>Strength of Evidence: C - body of evidence with inconsistencies that cannot be explained, reflecting genuine uncertainty surrounding the topic</b></p>	<p><b>Comparison of ultraviolet C light to laser therapy</b></p> <p>In individuals with SCI and pressure injuries of unreported Category/Stage (n=20), ultraviolet C light was associated with larger mean reductions in wound surface area compared with laser therapy (53.5% versus 23.7%).<sup>27</sup> (Level 1, low quality)</p>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	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"/>	<ul style="list-style-type: none"> <li>• There is no evidence on cost effectiveness of delivering phototherapy to pressure injuries.</li> <li>• In the reported studies phototherapy was delivered by a trained health professional using a wide range of light types. Regimens ranged from once to twice daily, five to seven days per week for 4 to 12 weeks. Session duration was generally determined by the size of the pressure injury (generally 5 to 10 minutes).<sup>27,53-61</sup> (<i>Level 1, low quality</i>)</li> </ul>	
<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"/>	Some studies reported larger attrition (17% to 20% withdrawal). Although some withdrawals were due to transfers between centers or death, others were related to medical condition or poor tolerance of the treatment. <sup>27,55,56,61</sup> ( <i>Level 1, low quality</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"/>											
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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 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"/>	Phototherapy should be delivered by a trained health professional using appropriate light delivery devices. Access to treatment may be limited in some clinical or geographic settings. ( <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"/>											

<b>Balance of consequences</b>	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"/>
<b>Strength of recommendation</b>	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 type="checkbox"/>
<b>Recommendation (text)</b>	<b>No recommendation</b>				

**Justification**

The evidence on effectiveness of phototherapy (laser, ultraviolet and infrared light therapies) is conflicting and no recommendations can be made on the use of any type of phototherapy. Differences may relate to the type of light therapy used or the regimen implemented. Only one study compared different types of phototherapy and the results from this low quality Level 1 study<sup>27</sup> suggested ultraviolet C light may be superior to laser therapy; however, there was a high risk of bias.

One high quality Level 1 study<sup>53</sup> provided evidence that laser therapy is associated with significantly better rates of complete healing for Category/Stage II and III pressure injuries compared to a placebo therapy. Approximately 30% more pressure injuries achieved complete healing with one month of treatment and approximately 50% more pressure injuries were completely healed at three-month follow-up. A low quality Level 1 study supported this finding.<sup>54</sup> However, three low quality Level 1 studies<sup>27,54,59</sup> reported that laser therapy was not associated with superior effects compared to standard wound care when the outcome measure was reduction in wound surface area or healing rates. The rate of undesirable outcomes did not significantly differ from standard wound care.<sup>59</sup>

One high quality Level 1 study<sup>56</sup> reported no statistically significant effect in achieving complete wound healing for ultraviolet C light compared to placebo therapy. A low quality Level 1 study<sup>55</sup> reported slightly a higher healing rate in a group receiving infrared light therapy compared to placebo therapy; however, the approximate 4% difference in complete healing rates did not appear to be clinically significant and statistical significance was not reported. Evidence from small, low quality Level 1<sup>27,60</sup> and Level 2<sup>57</sup> studies suggested that ultraviolet B or C light is associated with statistically significant superior effects for reduction in wound surface area and healing rates. Evidence from moderate<sup>61</sup> and low quality<sup>55</sup> Level 1 studies provided conflicting evidence on the effectiveness of infrared light for promoting faster wound healing. One study reported adverse events associated with infrared light including tingling, pain, bleeding and skin redness.<sup>55</sup>

No evidence on cost effectiveness was available. Phototherapy requires a trained health professional and is generally conducted once or twice daily for five days per week until the wound heals. This regimen may be inaccessible in many clinical or geographic settings. High attrition was noted in some studies, suggesting that some phototherapy interventions may not be acceptable to individuals or may lack feasibility in some settings.<sup>27,55,56,61</sup>

**Clinical question** Is kinetic therapy an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

**Whirlpool**

**Option:** Whirlpool  
**Comparison:** Conventional wound therapy

**Background:** Whirlpool is a form of hydrotherapy in which warm water circulation is used to promote wound cleansing, including removal of necrotic tissue and debris in the wound bed. Either the individual is submerged in a whirlpool bath, or the limb is submerged and the water may or may not be agitated.<sup>62</sup>

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence of effectiveness?	<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 checked="" 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 type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p><b>Evidence for wound healing rate</b> In individuals with Category/Stage III and IV pressure injuries, whirlpool therapy for two weeks was associated with a statistically significantly faster wound healing rate (<math>p=0.0435</math>).<sup>63</sup> (Level 1, low quality)</p> <p><b>Potential adverse effects</b> A review reported a large range of adverse events arising in clinical studies conducted in wounds of other etiologies. Adverse events included increased rates of wound infection (particularly <i>Pseudomonas aeruginosa</i>), venous hypertension and vascular congestion of limbs.<sup>62</sup> (Indirect evidence)</p> <p><b>Strength of Evidence: B1 - Level 1 studies of moderate or low quality providing direct evidence</b></p>	
	No included studies	Very low	Low	Moderate	High									
	<input type="checkbox"/>	<input checked="" 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 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"/>		
	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"/>										
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"/>			
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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Unclear	Not substantial	Probably not substantial	Probably substantial	Substantial										
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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 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>	No	Probably No	Uncertain	Probably Yes	Yes	Varies	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
No	Probably No	Uncertain	Probably Yes	Yes	Varies									
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	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 type="checkbox"/></td> <td><input checked="" 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 type="checkbox"/>	<input checked="" type="checkbox"/>	<ul style="list-style-type: none"> <li>No evidence on cost effectiveness was available.</li> <li>Whirlpool was delivered in a specially designed whirlpool bath and therapy was delivered for 20 minutes per day for two weeks.<sup>63</sup> (<i>Level 1, low quality</i>)</li> </ul>	
<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 type="checkbox"/>	<input checked="" 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"/>	<ul style="list-style-type: none"> <li>No evidence available.</li> </ul>	
	<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"/>	<ul style="list-style-type: none"> <li>No evidence available.</li> </ul>	
<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>											
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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 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>	<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>Evidence from other sources suggests that there is a high risk of cross-contamination when hydrotherapy pools are used between individuals. This reduces the feasibility of whirlpool therapy.<sup>62</sup> (<i>Indirect evidence</i>)</p>	
<i>No</i>	<i>Probably No</i>	<i>Uncertain</i>	<i>Probably Yes</i>	<i>Yes</i>	<i>Varies</i>											
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>											

<b>Balance of consequences</b>	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input checked="" 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 type="checkbox"/>
<b>Strength of recommendation</b>	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 type="checkbox"/>
<b>Recommendation (text)</b>	<b>No recommendation</b>				
<b>Justification</b>	Due to the high risk from adverse events and the low certainty of desired effects, no recommendation can be made regarding whirlpool therapy for the treatment of pressure injuries. One low quality Level 1 study <sup>63</sup> reported that whirlpool therapy for two weeks was associated with faster healing compared to a moist saline wound dressing. This study was at a high risk of bias. Indirect evidence from a review <sup>62</sup> that included outcomes for research conducted in other types of wounds highlighted the risks of whirlpool therapy including wound infection, cross contamination and increased vascular hypertension and vascular congestion.				

**Clinical question** Is atmospheric therapy (e.g. hyperbaric oxygen therapy, topical oxygen therapy) an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

*Topical oxygen therapy*

**Option:** Topical oxygen therapy  
**Comparison:** Conventional wound therapy

**Background:** Oxygen-based therapies are hypothesized to stimulate wound healing in hypoxic wounds by improving angiogenesis. Topical oxygen is a therapy in which 100% oxygen is applied directly to the wound, usually at pressures between 22 mm Hg and 50 mm Hg.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS										
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence of effectiveness?	<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><b>Evidence for complete wound healing</b> <i>Topical oxygen therapy</i></p> <ul style="list-style-type: none"> <li>In individuals in ICU with Category/Stage II to IV pressure injuries (n=100), high pressure humidified oxygen delivered to the wound bed was associated with a statistically significantly greater reduction in wound surface area compared to standard wound care (32% versus 1%, p&lt;0.01).<sup>64</sup> (<i>Level 1, moderate quality</i>)</li> </ul> <p><b>Evidence for reduction in wound surface area</b> <i>Topical oxygen therapy</i></p> <ul style="list-style-type: none"> <li>In individuals in ICU with Category/Stage II to IV pressure injuries (n=100), high pressure humidified oxygen delivered to the wound bed was associated with statistically significant reduction in baseline in wound surface area after 12 days (p=0.001).<sup>64</sup> (<i>Level 1, moderate quality</i>)</li> </ul> <p><b>Potential adverse effects</b> No adverse events were reported in the studies.</p> <p><b>Strength of Evidence: B1 - Level 1 studies of moderate or low quality providing direct evidence</b></p>	
	No included studies	Very low	Low	Moderate	High									
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>									
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No	Probably No	Uncertain	Probably Yes	Yes	Varies									
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<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"/>	<ul style="list-style-type: none"> <li>No evidence available</li> </ul>	
	<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 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 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"/>	<p>In one study, the intervention required a hyperbaric oxygen chamber and trained health professionals. Oxygen was delivered directly to the wound bed three times per day.<sup>64</sup> Access to equipment and trained health professionals may be limited in some clinical or geographic settings. (<i>Expert opinion</i>)</p>	
<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"/>											



<b>Balance of consequences</b>	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"/>
<b>Strength of recommendation</b>	Strong negative recommendation: Definitely don't it <input type="checkbox"/>	Weak negative recommendation: Probably don't do it <input checked="" type="checkbox"/>	No specific recommendation <input type="checkbox"/>	Weak positive recommendation: Probably do it <input type="checkbox"/>	Strong positive recommendation: Definitely do it <input type="checkbox"/>
<b>Recommendation (text)</b>	<b>No recommendation</b>				
<b>Justification</b>	There was insufficient evidence to make a recommendation on the use of topical oxygen therapy to treat pressure injuries. A moderate quality Level 1 study <sup>64</sup> indicated that topical oxygen therapy delivered directly to the wound bed with an oxygen catheter for a total of 60 minutes daily over three sessions is associated with significantly better reductions in wound surface area and higher rates of complete healing compared to saline-soaked gauze dressings. There was no comparison to contemporary wound dressings. No adverse events were reported. The intervention required trained health professionals delivering therapy for 60 minutes daily using specialized equipment, <sup>64</sup> which may reduce feasibility in some clinical and geographic settings.				

**Clinical question** Is atmospheric therapy (e.g. hyperbaric oxygen therapy, topical oxygen therapy) an effective intervention for treating pressure injuries?  
If effective, what is the most effective regimen for use?

1. Hyperbaric oxygen therapy

**Option:** Hyperbaric oxygen therapy  
**Comparison:** Conventional wound therapy

**Background:** Hyperbaric oxygen therapy (HBOT) is a therapy in which the individual breathes 100% oxygen at pressures greater than normal atmospheric (sea level) pressure or more than 1 atmosphere absolute (ATA). Pressures of up to three times normal atmospheric pressure may be utilized.

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	ADDITIONAL CONSIDERATIONS
BENEFITS & HARMS OF THE RECOMMENDED PRACTICE	What is the overall certainty of the evidence of effectiveness?	<p>No included studies <input type="checkbox"/></p> <p>Very low <input checked="" type="checkbox"/></p> <p>Low <input type="checkbox"/></p> <p>Moderate <input type="checkbox"/></p> <p>High <input type="checkbox"/></p>	<p><b>Evidence for complete wound healing</b></p> <ul style="list-style-type: none"> <li>In individuals with pressure injuries of unreported Category/Stage (n=38 pressure injuries), 58% (22/38) of pressure injuries treated with hyperbaric oxygen therapy completely healed after an average of 7 weeks of treatment.<sup>65</sup> (Level 3, low quality)</li> </ul> <p><b>Evidence for reduction in wound surface area</b></p> <ul style="list-style-type: none"> <li>In individuals with pressure injuries of unreported Category/Stage (n=38 pressure injuries), 13% (5/38) of pressure injuries had a reduction of at least 50% in wound surface area after treatment with hyperbaric oxygen therapy completely healed after an average of 7 weeks of treatment.<sup>65</sup> (Level 3, low quality)</li> </ul> <p><b>Potential adverse effects</b></p> <p>No adverse events were reported in the studies.</p> <p><b>Strength of Evidence: B2 - Level 3 or 4 studies (regardless of quality) providing direct evidence</b></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 checked="" 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 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 checked="" type="checkbox"/></p> <p>Probably Yes <input type="checkbox"/></p> <p>Yes <input type="checkbox"/></p> <p>Varies <input type="checkbox"/></p>		

	CRITERIA	JUDGEMENTS	RESEARCH EVIDENCE	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"/>	<ul style="list-style-type: none"> <li>No evidence on cost effectiveness was available.</li> <li>Oxygen was delivered using a hyperbaric chamber, which required trained health professionals and a regimen of two hours daily, five days per week for an average of 37 treatments.<sup>65</sup></li> </ul>	
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"/>											
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"/>	<ul style="list-style-type: none"> <li>No evidence available</li> </ul>	
	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 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"/>	<ul style="list-style-type: none"> <li>No evidence available</li> </ul>	
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"/>											
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 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"/>	<p>The intervention required a hyperbaric oxygen chamber and trained health professionals. This may not be feasible in many clinical and geographic settings.<sup>65</sup> Access to equipment and trained health professionals may be limited in some clinical or geographic settings. (<i>Expert opinion</i>)</p>	
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"/>											

<b>Balance of consequences</b>	Undesirable consequences <i>clearly outweigh</i> desirable consequences in most settings <input checked="" 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"/>
<b>Strength of recommendation</b>	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 type="checkbox"/>
<b>Recommendation (text)</b>	<b>No recommendation</b>				
<b>Justification</b>	There was insufficient evidence to make a recommendation on the use of hyperbaric oxygen therapy to treat pressure injuries. A low quality Level 3 study <sup>65</sup> indicated superior outcomes for complete wound healing and reduction in wound surface area associated with use of a hyperbaric oxygen chamber for two hours per day compared with frequent wound dressings. There was no comparison to contemporary wound dressings. No adverse events were reported. The intervention required trained health professionals delivering therapy for 120 minutes daily using specialized equipment, <sup>65</sup> which may reduce feasibility in some clinical and geographic settings.				

## References

1. Aaron RK, Boyan BD, Ciombor DM, Schwartz Z, Simon BJ. Stimulation of growth factor synthesis by electric and electromagnetic fields. *Clin Orthop Relat Res*, 2004(419): 30-37.
2. Bassett CA. Low energy pulsing electromagnetic fields modify biomedical processes. *Bioessays*, 1987; 6(1): 36-42.
3. Polak A, Taradaj J, Nawrat-Szoltysik A, Stania M, Dolibog P, Blaszcak E, Zarzeczny R, Juras G, Franek A, Kucio C. Reduction of pressure ulcer size with high-voltage pulsed current and high-frequency ultrasound: A randomised trial. *J Wound Care*, 2016; 25(12): 742-754.
4. Polak A, Kloth LC, Blaszcak E, Taradaj J, Nawrat-Szoltysik A, Ickowicz T, Hordynska E, Franek A, Kucio C. The efficacy of pressure ulcer treatment with cathodal and cathodal-anodal high-voltage monophasic pulsed current: A prospective, randomized, controlled clinical trial. *Phys Ther*, 2017; 97(8): 777-789.
5. Kloth LC, Feedar JA. Acceleration of wound healing with high voltage, monophasic, pulsed current. *Phys Ther*, 1988; 68(4): 503-8.
6. Griffin JW, Tooms RE, Mendius RA, Clifft JK, Vander Zwaag R, el Zeky F. Efficacy of high voltage pulsed current for healing of pressure ulcers in patients with spinal cord injury. *Phys Ther*, 1991; 71(6): 433-42.
7. Gentzkow GD, Alon G, Taler GA, Eltorai IM, Montroy RE. Healing of refractory Stage III & IV pressure ulcers by a new electrical stimulation device. *Wounds*, 1993; 5(3): 160-171.
8. Polak A, Kloth LC, Blaszcak E, Taradaj J, Nawrat-Szoltysik A, Walczak A, Bialek L, Paczula M, Franek A, Kucio C. Evaluation of the healing progress of pressure ulcers treated with cathodal high-voltage monophasic pulsed current: Results of a prospective, double-blind, randomized clinical trial. *Adv Skin Wound Care*, 2016; 29(10): 447-459.
9. Franek A, Kostur R, Polak A, Taradaj J, Szlachta Z, Blaszcak E, Dolibog P, Dolibog P, Koczy B, Kucio C. Using high-voltage electrical stimulation in the treatment of recalcitrant pressure ulcers: Results of a randomized, controlled clinical study. *Ostomy Wound Manage*, 2012; 58(3): 30-44.
10. Houghton PE, Campbell KE, Fraser CH, Harris C, Keast DH, Potter PJ, Hayes KC, Woodbury MG. Electrical stimulation therapy increases rate of healing of pressure ulcers in community-dwelling people with spinal cord injury. *Arch Phys Med Rehabil*, 2010; 91(5): 669-678.
11. Franek A, Kostur R, Taradaj J, Blaszcak E, Szlachta Z, Dolibog P, Dolibog P, Polak A. Effect of high voltage monophasic stimulation on pressure ulcer healing: Results from a randomized controlled trial. *Wounds*, 2011; 23(1): 15-23.
12. Karsli PB, Gurcay E, Karaahmet OZ, Cakci A. High-voltage electrical stimulation versus ultrasound in the treatment of pressure ulcers. *Adv Skin Wound Care*, 2017; 30(12): 565-570.
13. Wood JM, Evans PE, Schallreuter KU, Jacobson WE, Sufit R, Newman J, White C, Jacobson M. A multicenter study on the use of pulsed low-intensity direct current for healing chronic stage II and stage III decubitus ulcers. *Arch Dermatol*, 1993; 129(8): 999-1009.
14. Jercinovic A, Karba R, Vodovnik L, Stefanovska A, Kroselj P, Turk R, Dzidic I, Benko H, Savrin R. Low frequency pulsed current and pressure ulcer healing. *IEEE Trans Rehabil Eng*, 1994; 2(4): 225-233.
15. Stefanovska A, Vodovnik L, Benko H, Turk R. Treatment of chronic wounds by means of electric and electromagnetic fields. Part 2. Value of FES parameters for pressure sore treatment. *Med Biol Eng Comput*, 1993; 31(3): 213-20.
16. !!! INVALID CITATION !!! 3-17.
17. Lawson D, Petrofsky J. The Eeffect of monophasic vs. biphasic current on healing rate and blood flow in people with pressure and neuropathic ulcers. *J Acute Care Phys Ther*, 2013; 4(1): 26-33.
18. Baker LL, Rubayi S, Villar F, DeMuth SK. Effect of electrical stimulation waveform on healing of ulcers in human beings with spinal cord injury. *Wound Repair Reg*, 1996; 4(1): 21-8.

19. Wagner-Cox P, Duhamel HM, Jamison CR, Jackson RR, Fehr ST. Use of Noncontact Low-Frequency Ultrasound in Deep Tissue Pressure Injury: A Retrospective Analysis. *J Wound Ostomy Continence Nurs*, 2017; 44(4): 336-342.
20. Honaker JS, Forston MR, Davis EA, Wiesner MM, Morgan JA. Effects of non contact low-frequency ultrasound on healing of suspected deep tissue injury: A retrospective analysis. *Int Wound J*, 2013; 10(1): 65-72.
21. Honaker JS, Forston MR, Davis EA, Weisner MM, Morgan JA, & , Sacca E. The Effect of Adjunctive Non-Contact Low Frequency Ultrasound on Deep Tissue Pressure Injury. *Wound Repair Regen*, 2016.
22. Serena T, Lee SK, Lam K, Attar P, Meneses P, Ennis W. The impact of noncontact, nonthermal, low-frequency ultrasound on bacterial counts in experimental and chronic wounds. *Ostomy Wound Manage*, 2009; 55(1): 22-30.
23. Polak A, Franek A, Blaszczyk E, Nawrat-Szoltysik A, Taradaj J, Wiercigroch L, Dolibog P, Stania M, Juras G. A prospective, randomized, controlled, clinical study to evaluate the efficacy of high-frequency ultrasound in the treatment of Stage II and Stage III pressure ulcers in geriatric patients. *Ostomy Wound Manage*, 2014; 60(8): 16-28.
24. ter Riet G, Kessels AG, Knipschild P. A randomized clinical trial of ultrasound in the treatment of pressure ulcers. *Phys Ther*, 1996; 76(12): 1301-11.
25. McDiarmid T, Burns PN, Lewith GT, Machin D. Ultrasound and the treatment of pressure sores. *Physiotherapy*, 1985; 71(2): 66-70.
26. Shanmuga RP, Suryanaryana Reddy V, Venkat R, Sachin G, Bhagya SS. A study to evaluate the effectiveness of continuous ultrasound therapy in healing of pressure sores - A prospective randomized clinical trial. *Indian J Physiother Occup Ther*, 2017; 11(3): 136-140.
27. Nussbaum EL, Biemann I, Mustard B. Comparison of ultrasound/ultraviolet-C and laser for treatment of pressure ulcers in patients with spinal cord injury. *Phys Ther*, 1994; 74(9): 812-23.
28. Maeshige N, Fujiwara H, Honda H, Yoshikawa Y. Evaluation of the combined use of ultrasound irradiation and wound dressing on pressure ulcers. *J Wound Care*, 2010; 19: 63-8.
29. Aliano K, Low C, Stavrides S, Luchs J, Davenport T. The correlation between ultrasound findings and clinical assessment of pressure-related ulcers: is the extent of injury greater than what is predicted? *Surg Technol Int*, 2014; 24: 112-6.
30. Dwivedi MK, Srivastava RN, Bhagat AK, Agarwal R, Baghel K, Jain A, Raj S. Pressure ulcer management in paraplegic patients with a novel negative pressure device: a randomised controlled trial. *Journal of Wound Care*, 2016; 25(4): 199-207.
31. Timmers M, Le Cessie S, Banwell P. The effects of varying degrees of pressure delivered by negative-pressure wound therapy on skin perfusion. *Ann Plast Surg*, 2005; 55(6): 665-71; 1097-98.
32. Morykwas MJ, Argenta LC, Shelton-Brown EI, McGuirt W. Vacuum-assisted closure: a new method for wound control and treatment: Animal studies and basic foundation. *Ann Plast Surg*, 1997; 38(6): 553-562.
33. Dwivedi MK, Bhagat AK, Srivastava RN, Jain A, Baghel K, Raj S. Expression of MMP-8 in Pressure Injuries in Spinal Cord Injury Patients Managed by Negative Pressure Wound Therapy or Conventional Wound Care. *J Wound Ostomy Continence Nurs*, 2017; 44(4): 343-349.
34. Joseph E, Hamori CA, Bergman S, Roaf E, Swann NF, Anastasi GW. New therapeutic approaches in wound care. A prospective randomized trial of vacuum-assisted closure versus standard therapy of chronic nonhealing wounds. *Wounds*, 2000; 12(3): 60-67.
35. Fabian T, Kaufman H, Lett E. The evaluation of subatmospheric pressure and hyperbaric oxygen in ischemic full-thickness wound healing. *Am J Surg*, 2000; 66(12): 1136-43.
36. Ho CH, Powell HL, Collins JF, Bauman WA, Spungen AM. Poor nutrition is a relative contraindication to negative pressure wound therapy for pressure ulcers: preliminary observations in patients with spinal cord injury. *Advances in Skin & Wound Care*, 2010; 23(11): 508-516.
37. Isago T, Nozaki M, Kikuchi Y, Honda T, Nakazawa H. Negative-pressure dressings in the treatment of pressure ulcers. *J Dermatol*, 2003; 30(4): 299-305.

38. Dwivedi MK, Srivastava RN, Bhagat AK, Agarwal R, Baghel K, Jain A, Raj S. Pressure ulcer management in paraplegic patients with a novel negative pressure device: A randomised controlled trial. *J Wound Care*, 2016; 25(4): 199-207.
39. Srivastava RN, Dwivedi MK, Bhagat AK, Raj S, Agarwal R, Chandra A. A non-randomised, controlled clinical trial of an innovative device for negative pressure wound therapy of pressure ulcers in traumatic paraplegia patients. *Int Wound J*, 2014.
40. de Laat EHEW, van den Boogaard MHWA, Spauwen PHM, van Kuppevelt DHJM, van Goor H, Schoonhoven L. Faster wound healing with topical negative pressure therapy in difficult-to-heal wounds: A prospective randomized controlled trial. *Ann Plast Surg*, 2011; 67(6): 626-631.
41. Deva AK, Buckland GH, Fisher E, Liew SC, Merten S, McGlynn M, Gianoutsos MP, Baldwin MA, Lendvay PG. Topical negative pressure in wound management. *Med J Aust*, 2000; 173(3): 128-131.
42. Wild T, Stremitzer S, Budzanowski A, Hoelzenbein T, Ludwig C, Ohrenberger G. Definition of efficiency in vacuum therapy - A randomised controlled trial comparing with V.A.C. therapy. *Int Wound J*, 2008; 5(5): 641-647.
43. Ho CH, Powell HL, Collins JF, Bauman WA, Spungen AM. Poor nutrition is a relative contraindication to negative pressure wound therapy for pressure ulcers: preliminary observations in patients with spinal cord injury. *Adv Skin Wound Care*, 2010; 23(11): 508-516.
44. Mostafa J, Ali Y, Zohre R, Samaneh R. Electromagnetic fields and ultrasound waves in wound treatment: A comparative review of therapeutic outcomes. *Biosciences Biotechnology Research Asia*, 2015; 12: 185-195.
45. Aziz Z, Bell-Syer SEM. Electromagnetic therapy for treating pressure ulcers. *Cochrane Database of Systematic Reviews* 2015; 9(Art. No.: CD002930.).
46. Salzberg CA, Cooper Vastola SA, Perez F, Viehbeck MG, Byrne DW. The effects of non-thermal pulsed electromagnetic energy on wound healing of pressure ulcers in spinal cord-injured patients: a randomized, double-blind study. *Ostomy Wound Manage*, 1995; 41(3): 42-4, 46, 48
47. Seaborne D, Quirion-DeGirardi C, Rousseau M, Rivest M, Lambert J. The treatment of pressure sores using pulsed electromagnetic energy (PEME). *Physiother Can*, 1996; 48(2): 131-137.
48. Comorosan S, Vasilco R, Arghiropol M, Paslaru L, Jieanu V, S. S. The effect of Diapulse therapy on the healing of decubitus ulcer. *Rom J Physiol*, 1993; 30(1-2): 41-45.
49. Gupta A, Taly AB, Srivastava A, Kumar S, Thyloth M. Efficacy of pulsed electromagnetic field therapy in healing of pressure ulcers: A randomized control trial. *Neurol India*, 2009; 57(5): 622.
50. Frykberg RG, Driver VR, Lavery LA, Armstrong DG, Isenberg RA. The use of pulsed radio frequency energy therapy in treating lower extremity wounds: Results of a retrospective study of a wound registry. *Ostomy Wound Manage*, 2011; 57(3): 22-29.
51. Conner-Kerr T, Isenberg RA. Retrospective analysis of pulsed radiofrequency energy therapy use in the treatment of chronic pressure ulcers. *Adv Skin Wound Care*, 2012; 25(6): 253-60.
52. Chen C, Hou W-H, Chan Edwin SY, Yeh M-L, Lo Heng-Lien D. Phototherapy for treating pressure ulcers. *Cochrane Database of Systematic Reviews*, 2014(7).
53. Taradaj J, Halski T, Kucharzewski M, Urbanek T, Halska U, Kucio C. Effect of laser irradiation at different wavelengths (940, 808, and 658 nm) on pressure ulcer healing: Results from a clinical study. *Evid Based Complement Alternat Med*, 2013.
54. Shojaei H, Sokhangoei Y, Soroush MR. Low level laser therapy in the treatment of pressure ulcers in spinal cord handicapped veterans living in Tehran. *Janbazan Medical eac Engineering Research Centre* 2008; 33(1): 44-8.
55. Dehlin O, Elmstahl S, Gottrup F. Monochromatic phototherapy in elderly patients: a new way of treating chronic pressure ulcers? *Aging Clin Exp Res*, 2003; 15(3): 259-63.
56. Nussbaum E, Flett H, Hitzig S, McGillivray C, Leber D, Morris H, Jing F. Ultraviolet-C irradiation in the management of pressure ulcers in people with spinal cord injury: A randomized, placebo-controlled trial. *Arch Phys Med Rehabil*, 2013; 94(4): 650-9.

57. Onigbinde AT, Olafimihan KF, Ojoawo A, Adedoyin RA, Omiyale O, Mothabeng J. The effect of ultraviolet radiation (type B) on decubitus ulcers. *Internet J Allied Health Sci Pract*, 2010; 8(1): 1-6.
58. Durovic A, Maric D, Brdareski Z, Jevtic M, Durdevic S. The effects of polarized light therapy in pressure ulcer healing. *Vojnosanit Pregl*, 2008; 65(12): 906.
59. Lucas C, van Gemert MJ, de Haan RJ. Efficacy of lowlevel laser therapy in the management of stage III decubitus ulcers: A prospective, observer-blinded multicentre randomised clinical trial. *Lasers Med Sci*, 2003; 18 (2 ): 72–7.
60. Wills EE, Anderson TW, Beattie BL, Scott A. A randomized placebo-controlled trial of ultraviolet light in the treatment of superficial pressure sores. *J Am Geriatr Soc*, 1983; 31(3): 131-3.
61. Schubert V. Effects of phototherapy on pressure ulcer healing in elderly patients after a falling trauma. A prospective, randomized, controlled study. *Photodermatol Photoimmunol Photomed*, 2001; 17(1): 32-38.
62. Tao H, Butler JP, Luttrell T. The role of whirlpool in wound care. *J Am Coll Clin Wound Spec*, 2012; 4(1): 7–12.
63. Burke DT, Ho CH, Saucier MA, Stewart G. Effects of hydrotherapy on pressure ulcer healing. *Am J Phys Med Rehabil*, 1998; 77(5): 394-8.
64. Azimian J, Nayeri ND, Pourkhaleghi E, Ansari M. Transdermal wound oxygen therapy on pressure ulcer healing: A single-blind multi-center randomized controlled trial. *Iran Red Crescent Med J*, 2015; 17(11).
65. Rosenthal AM, Schurman A. Hyperbaric treatment of pressure sores. *Arch Phys Med Rehabil*, 1971; 52(9): 413-5.