**Clinical question.**

Does the use of irrigation (I) compared with no irrigation (C) improve healing (O) in patients with superficial wounds (P)?

**Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention**

**State if this is a proposed new topic or revision of existing worksheet: New Topic**

**Conflict of interest specific to this question: Yes**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? **I have conducted several studies on wound irrigation.**

**Search strategy (including electronic databases searched).**

PubMed "Wounds"[Mesh] AND "Irrigation"[Mesh].
EMBASE search using text words (all fields) wounds AND (irrigation OR lavage)
AHA EndNote Master library, Cochrane database for systematic reviews, Central Register of Controlled Trials, Review of references from articles.
Search using text words “wounds” and “irrigation” OR “lavage”

Hand searching of retrieved article was also performed.

**State inclusion and exclusion criteria**

Studies comparing no irrigation to irrigation and studies comparing different methods of irrigation of lacerations or acute wounds were included. A search identified 673 potential articles.

Studies limited to pre-operative or intra-operative irrigation of wounds, and soaking or scrubbing of wounds in the ED were excluded. Also excluded were studies of open fractures, chronic wounds and surgical wounds created in the operating room. Data presented in abstract form alone were not included. Studies of antibiotic solutions not readily available to the lay person were also excluded.

**Number of articles/sources meeting criteria for further review:**

17 articles were chosen for review including seven animal studies, nine original human studies, and one meta-analysis.
# Summary of evidence

## Evidence Supporting Clinical Question

In patients with thermal burns, treatment with wet dressings results in faster healing than treatment with a dry dressing.

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Dire 1990 (E1), Moscati 1998 (E1), Bansal 2002 (E1), Valente 2003 (E1), Ernst 2003 (E1), Moscati 2007 (E1), Fernandez 2008 (E1)</td>
<td>Longmire 1987 (E1), Angeras 1992 (E1)</td>
<td></td>
</tr>
<tr>
<td>Green 1971 (E1), Grower 1972 (E1), Gross 1972 (E1), Rodeheaver 1975 (E1), Hamer 1975 (E1), Stevenson 1976 (E1)</td>
<td>Anglen 1996 (E1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Level of evidence**

A = Return of spontaneous circulation  
B = Survival of event  
E1 = Infection  
C = Survival to hospital discharge  
D = Intact neurological survival  

*Italicics = Animal studies*
### Evidence Neutral to Clinical question

<table>
<thead>
<tr>
<th>Good</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair</td>
<td>Hollander 1998 (E1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Level of evidence**

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E1 = Infection  
*Italics = Animal studies*

### Evidence Opposing Clinical Question

<table>
<thead>
<tr>
<th>Good</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Level of evidence**

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E1 = Infection  
*Italics = Animal studies*
Discussion:
There are three fundamental questions regarding wound irrigation. 1) Is irrigation better than no irrigation? 2) What is the optimal irrigation pressure and volume? 3) What is the best irrigation solution to be used?

There are no randomized clinical trials comparing irrigation to no irrigation or various methods of irrigation and irrigation solutions for acute superficial wounds in the home, work, or prehospital settings. Data were extrapolated from clinical trials conducted in the emergency department or from high quality animal experiments.

Regarding whether irrigation is better than no irrigation, no such clinical trial has been reported for acute superficial wounds or lacerations. Several high quality experiments in animal (LOE 5) models of contaminated wounds demonstrated that high pressure irrigation (usually defined as greater than 7 PSI) is more effective than low pressure irrigation or no irrigation at all (Green 1971; Grower 1972; Gross 1972; Hammer 1975; Stevenson 1976). A rat study compared bacterial wound counts of contaminated lacerations treated with no irrigation, gravity flow irrigation, bulb syringe irrigation, and pulsating jet lavage (Hammer, 1975). The only effective method of irrigation was the pulsating jet lavage. Another study compared high pressure (8 PSI) low pressure irrigation with an asepto syringe and no irrigation in a contaminated animal wound model and found that only high pressure irrigation reduce bacterial counts and wound infection rates (Stevenson, 1976). A randomized study (LOE 2) of 335 ED patients with lacerations compared wound infection rates in patients whose wounds were irrigated high (Syringe/Needle) and low (Bulb lavage) pressure irrigation (Longmire, 1987). Infection rates were lower in patients whose wound were irrigated with high pressure than low pressure (1.3% vs. 6.9%; P=0.017). A retrospective study (LOE 4) of approximately 2000 lacerations of the face and scalp found that high pressure irrigation did not reduce infection rates (Hollander, 1998). However, this study was non randomized introducing significant selection bias. Furthermore, no data is given whether the patients had already cleaned their wounds at home prior to ED presentation limiting the results.

Several clinical trials (LOE 1 and 2) have compared irrigation of lacerations with saline and tap water (Longmire 1987, Angeras 1992, Godinez 2001, Bansal 2002, Valente 2003, Moscati 1998 and 2007). Angeras et al. randomized 705 patients ages 16 and over with acute traumatic soft tissue injuries to irrigation with either tap water or saline (Angeras 1992). Infection rates were significantly lower after irrigation with tap water (5.4% vs. 10.3%; OR 0.5, 95% CI 0.25-0.96). Another RCT compared infection rates between 271 children irrigated with normal saline and 259 irrigated with tap water (Valente, 2003). The wound infection rates were 2.8% in the saline group and 2.9% in the tap water group. A recent multicenter randomized clinical trial including 715 ED subjects with acute simple lacerations found similar infection rates after irrigation with tap water and saline (4% vs. 3.3%; RR 1.21, 95% CI 0.5 to 2.7). These data are supported by a systematic review conducted by the Cochrane Collaboration (Fernandez, 2009). This review included 11 trials of which 7 compared tap water with saline, 3 compared cleansing with no cleansing, and one compared procaine spirit with water. For acute wounds in adults, tap water was more effective than saline in reducing infection rates (RR 0.63; 95% CI 0.40 to 0.99). The difference in infection rates between children with acute wound irrigated with tap water and saline was not significant (RR1.07; 95% CI 0.43 to 2.64). Of note, in all studies of tap water the source was a reliable source of water. In one study the tap water was tested for bacteria and found to have very low counts.

A study in a contaminated animal wound model found that irrigation of lacerations with tap water resulted in a larger degree of bacterial decontamination than saline, possibly due to a higher pressure and volume when wounds were irrigated with a faucet (Moscati, 1998). Another study compared the ability of various solutions delivered by jet lavage to remove surface bacteria from three different inanimate surfaces. Of all solutions studied (saline, bacitracin, neomycin, soap) soap was most effective at removing bacteria (Anglen, 1996).

A quasi randomized (LOE 2) trial of 531 ED patients with simple lacerations randomized wounds to irrigation with saline, 1% povidine iodine, or a surfactant (Pluronic F-68) found no statistically significant differences in the rates of wound infection (6.9% vs. 4.3% vs. 5.6% respectively, P=0.571).

A single RCT (LOE 2) compared irrigation with warm (90°-100° F) versus room temperature saline in 38 ED patients with lacerations . Significantly more patients preferred warm to room temperature saline (Ernst, 2003).

Concerns that high pressure irrigation would disseminate bacteria deeper into the wound have not been supported by the evidence (Wheeler, 1976). However, with very high pressures fluid can disseminate laterally into the tissues which can increase the susceptibility to a bacterial challenge in an experimental contaminated animal wound model (Wheeler, 1976).

Acknowledgements:
Citation List


(LOE 5, fair, support).

Summary: In this study inanimate material were contaminated with bacteria and the ability of various irrigation solutions to reduce bacterial counts was determined. Irrigation with a soap solution was most effective.


(LOE 1, good, supports).

Summary: This was a small clinical trial comparing irrigation of simple lacerations with saline or tap water. The authors concluded that tap water was as good as saline in reducing wound infections.


(LOE 1, good, supports).

Summary: This was a large clinical trial comparing saline, iodine and a surfactant for irrigating lacerations in the ED. Saline was as effective as the other solutions in reducing wound infection rates.


(LOE 1, fair, supports).

Summary: This was a small study of ED patients with lacerations whose wound were irrigated with room temperature or warm saline. The warm saline was preferred by patients.


(LOE 1, good, supports).

Summary: This is the most recent meta-analysis conducted by the Cochrane group concluding that tap water reduced infection in adults with acute wounds compared with saline, and that tap water and saline are comparable in children with acute wounds.


(LOE 5, good, supports).
Summary: This was an animal experiment in dogs with punch wounds that were contaminated with metal debris. More debris was removed from the wounds with higher irrigation pressure, regardless of whether a pulsed or constant irrigation stream was used.


(LOE 5, good, supports).

Summary: This was an animal experiment in which skin incisions were created on rats and contaminated with soil and bacteria. High pressure irrigation was more effective than low pressure bulb irrigation in reducing abscess formation and debris.


(LOE 5, good, supports).

Summary: This was an animal experiment in which crushed incisional wounds were made in rats. High pressure irrigation was more effective than low pressure irrigation in debriding the wound of devitalized tissue.


(LOE 5, good, supports).

Summary: This was an animal experiment in which incisions were created in rats and contaminated with bacteria. High pressure irrigation was more effective than low pressure irrigation in reducing bacterial counts.


(LOE 3, fair, neutral).

Summary: This was a retrospective study of approximately 2000 ED scalp and facial lacerations half of which were irrigated. Wound irrigation did not reduce infection rates.


(LOE 1, fair, support).

Summary: This was a clinical trial of 335 ED patients with lacerations whose wounds were irrigated with high (syringe/needle) or low (bulb syringe) pressure irrigation. High pressure irrigation reduce inflammation and wound infections compared with low pressure irrigation.

(LOE 5, good, supports).

**Summary:** In this study wounds were created in rats and contaminated with bacteria. Irrigation with tap water was as effective as saline in reducing bacterial counts.


(LOE 5, good, supports).

**Summary:** This was a multicenter RCT of 715 ED patients with simple lacerations. Wound infection rates were similar after wound irrigation with tap water or saline.


(LOE 5, good, supports).

**Summary:** This was an animal study in which wounds were created in rats and contaminated bacteria. Wound irrigated with tap water had lower bacterial counts than those irrigated with saline.


(LOE 5, good, supports).

**Summary:** This was an animal experiment in which the ability of irrigation to remove soil from experimental wounds was tested. High pressure irrigation was effective in removing most of the soil.


(LOE 5, good, supports).

**Summary:** This was an animal experiment of incisions in rabbits contaminated with bacteria. High pressure irrigation effectively removed bacteria and reduced infection compared with low pressure irrigation and no irrigation.


(LOE 1, good, supports).

**Summary:** This was a single center RCT of 530 pediatric ED patients with simple lacerations randomized to irrigation with tap water or saline. Infection rates were similar in both groups.