TITLE: Antiseptics versus Potable Water for Wound Cleansing: A Review of the Clinical Effectiveness and Guidelines

DATE: 07 December 2012

CONTEXT AND POLICY ISSUES

A wound is a disruption of the skin, and alters the normal structure and function of the skin.\(^1\) Approximately 1.5% of the population may have a wound of some kind at any one point and time.\(^2\) There are numerous types of wounds, the types of wounds include simple laceration, complicated lacerations, large tissue defects, burns, pressure ulcers, diabetic foot ulcers and venous ulcers.\(^1\)

The process of wound cleansing involves the application of a fluid to remove debris, wound discharge and metabolic wastes, to generate the ideal conditions for wound healing.\(^3\) Wounds are cleansed to remove foreign bodies such as debris and excess exudate, necrotic tissues, which could become a focus for infection.\(^4\) Wound cleansing is a vital component of wound bed preparation, however, how a wound should be cleansed and what types of fluid should be used to clean a wound remain a topic of debate. Currently, healthcare professionals primarily depend on ritualistic practice rather than research evidence.\(^4,5\)

Normal saline (0.9%) has been viewed by some as the favoured wound cleansing solution; this is because it is an isotonic solution and does not interfere with the normal healing process, damage tissue, cause sensitization or allergies or alter the normal bacterial flora of the skin.\(^3\) Tap water has also been recommended as it has advantages of being efficient, cost-effective and accessible.\(^3\) However, clinicians have been warned against using tap water to clean wounds that have bone or tendon is exposed, in those cases normal saline is preferred.\(^9\) However, the reason for this recommendation is unclear.

As the debate over which solution to use for wound cleansing continues, it remains unclear which solutions are appropriate to use. As a result, the purpose of this review is to examine the comparative clinical effectiveness of potable water compared to saline or antiseptic agents such as triclosan, chlorhexidine, hexachlorophene, povidone iodine, hydrogen peroxide, or alcohol and to examine the evidence-based guidelines for wound cleansing.
RESEARCH QUESTIONS

1. What is the comparative clinical effectiveness of potable water versus antiseptic agents for wound cleansing?

2. What are the evidence-based guidelines for wound cleansing?

KEY FINDINGS

There is limited evidence concerning the comparative clinical effectiveness of potable water to saline. There is some evidence to suggest potable water may be associated with lower infection rates for adults who have acute wounds when compared to saline. There is no evidence on the comparative clinical effectiveness of potable water versus triclosan, chlorhexidine, hexachlorophene, povidone iodine, hydrogen peroxide, or alcohol. Evidence-based guidelines suggest using water (tap or sterile) or saline for wound cleansing.

METHODS

Literature Search Strategy

A limited literature search was conducted on key resources including PubMed, Medline, The Cochrane Library (November 2012), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 01 2007 and November 2 2012.

Selection Criteria and Methods

One reviewer screened the titles and abstracts of the retrieved publications and evaluated the full-text publications for final article selection (Table 1).

Table 1: Selection Criteria

<table>
<thead>
<tr>
<th>Population</th>
<th>Patients with wounds (e.g. diabetic foot ulcers) in any setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>Potable water</td>
</tr>
<tr>
<td>Comparator</td>
<td>Triclosan, Chlorhexidine, Hexachlorophene, Povidone Iodine,</td>
</tr>
<tr>
<td></td>
<td>Hydrogen Peroxide, Alcohol, Saline</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Wound healing, infection rate</td>
</tr>
<tr>
<td></td>
<td>Guidelines, flow rate, pressure</td>
</tr>
<tr>
<td>Study Designs</td>
<td>Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials (RCTs), non-randomized studies and guidelines</td>
</tr>
</tbody>
</table>

Exclusion Criteria

Studies were excluded if they did not meet the selection criteria, were duplicate publications or included in a selected systematic review, or were published prior to 2007.
Critical Appraisal of Individual Studies

Systematic Reviews were appraised using the Assessment of Multiple Systematic Reviews (AMSTAR) tool. Evidence-Based Guidelines were assessed using the Appraisal of Guidelines for Research and Evaluation II (AGREE II). A numeric score for each study was not calculated, instead a narrative summary of study strengths and limitations was provided.

SUMMARY OF EVIDENCE

The literature search yielded 469 citations. From these, 25 articles were selected for further examination. Six additional guidelines were identified from grey literature searching. Of the 31 articles, one systematic review and two evidence-based guidelines were identified. No relevant health technology assessments, meta-analyses, randomized controlled trials, and non-randomized studies were identified. The study selection process is outlined in a PRISMA flowchart (Appendix 1).

Additional references of potential interest which did not meet the selection criteria are provided in the Appendix 7.

Summary of Study Characteristics

A detailed summary of study characteristics for the included systematic review, can be found in Appendix 2.

Study Design

Three articles are included in this report. There is one Cochrane systematic review. The systematic review included five RCTs and six quasi-RCTs. The two evidence-based guidelines were based on evidence from a systematic search of the literature. The National Institute for Health and Clinical Excellence (NICE) Clinical Guideline for Surgical Site Infection did not specify exclusion criteria based on study type. However, a systematic search of the grey literature was not conducted. The summary of the Association for the Advancement for Wound Care (AAWC) guideline was based on systematic search of the literature for guidelines. The AAWC guideline development group used the Appraisal of Guidelines Research and Evaluation (AGREE) principles, however, more strict criteria were used for acceptance of opinion-based care including only recommendations with a content validity index of ≥ 0.75.

Country of Origin

The Cochrane systematic review was conducted by authors from Australia. One of the evidence-based guidelines was generated in the United Kingdom, and one summary of evidence-based guidelines as created in Australia.

Population

The Cochrane systematic review included 11 randomized controlled trials (RCTs) and quasi-RCTs (N=3,449) involving patients ages 2 to 95. Two of the included studies were conducted with children. Five trials included patients with lacerations; one trial involved people with open fractures; one trial involved participants with chronic wounds; and four trials examined people with surgical wounds. Ten of the 11 trials were conducted in hospital emergency departments.
and ward settings and one study was conducted in a community setting. The duration of follow-up in the included trials for the systematic review varied from one to six weeks.

One guideline was designed for the treatment of patients with surgical site infection of without a specified age.\(^9\) The other guideline was developed for patients with or at risk of developing pressure ulcers.\(^8\)

**Intervention and Comparators**

Tap water was used as a cleaning solution in ten of the trials included in the systematic review. Normal saline was used as the comparator in six of these trials and no cleansing in three. One study compared tap water with tap water and procaine spirit. One study compared distilled or cooled boiled water to isotonic saline.

Both guidelines provided recommendations on the use of water and/or saline.

**Outcomes**

The primary outcome of the systematic review was infection. Secondary outcomes included wound healing and patient satisfaction.

Both guidelines provided recommendations around wound cleansing. One guideline\(^8\) included recommendations concerning water pressure. A summary of levels of evidence and recommendation grading used in the included guidelines is provided in Appendix 5.

**Summary of Critical Appraisal**

A detailed summary of the critical appraisal of individual included reports can be found in Appendix 3.

One systematic review\(^5\) was included in this review. Overall, this was a well-designed study. Strengths of the systematic review include the clear inclusion and exclusion criteria for studies, a comprehensive and systematic literature search along with a detailed search strategy, and duplicate, independent formal evaluation of risk of bias. However, the included systematic review lacked operational definitions of acute wounds and chronic wounds, there was no reporting on publication bias, and some comparisons may have been underpowered as infections were a rare event (3 to 47 events),\(^3\) and there was no reporting on publication bias.

A NICE guideline for Surgical Site Infection was included as an evidence-based guideline.\(^9\) The strengths of this evidence-based guideline include the formal assessment of the strength of the evidence for a recommendation, a clear systematic search of the literature, comprehensive clinical questions for the guidelines developed a priori with consultation from a diverse group of stakeholders, and recommendations that were clearly linked and targeted to answer the clinical questions. Limitations of the guideline include no information provided on the strengths and limitations of the included evidence that was the basis of the recommendations, limited information provided on the barriers and aides to implementing the recommendations, and few (three) recommendations on wound cleansing. In addition, it appears that no relevant studies were identified to provide the basis for the NICE recommendations on wound cleansing.
The second included evidence-based guideline was a summary of a guideline from the Association for the Advancement of Wound Care (AAWC) on pressure ulcers from the National Guideline Clearinghouse. The summary of the evidence-based guidelines was included because the full-text guideline was not readily available. This guideline was based on a systematic review of guidelines, the guidelines are comprehensive with over 100 graded recommendations, and the potential benefits and harms of implementing the recommendations have been identified. Limitations of this guideline include a lack of clarity of the clinical questions that led to the creation of the guideline, lack of clarity around patient input in the creation of the guidelines, lack of reporting of the strengths and limitations of the included guidelines, and lack of clarity whether the recommendations of this guideline reflect the source guidelines.

Summary of Findings

The results of the included systematic review are reported in detail in Appendix 4.

The comparisons of tap water to normal saline were categorized into acute and chronic wounds. The findings from the acute wound studies are summarized below. A meta-analysis including three trials, which included adults who had acute wounds that compared tap water to normal saline, demonstrated a statistically significant reduction in infection rate with tap water. The risk of infection was a 37% lower with tap water compared to normal saline (relative risk [RR] = 0.63; 95% CI 0.40 to 0.99; P= 0.05). A meta-analysis of two trials, which measured infection rate in children who had acute wounds, found no statistically significant difference between wounds cleaned with tap water or saline (RR= 1.07; 95% CI 0.43 to 2.64; P=0.88). One study included in the systematic review compared the infection rates for chronic non-sutured wounds. A comparison of wounds cleaned with tap water or normal saline demonstrated no statistically significant differences for infection rate (RR= 0.16, 95% CI 0.01 to 2.96; P=0.22).

A summary of guideline recommendations is provided in Appendix 6.

The NICE guideline offered two recommendations relating to wound cleansing during the postoperative phase out of three recommendations related to postoperative cleansing. According to the guideline authors, first, sterile saline should be used for wound cleansing up to 48 hours post-surgery. Second, tap water may be used for wound cleaning at least 48 hours after surgery if the surgical wound has separated or has been opened surgically to drain pus. Evidence ratings were not provided for these recommendations.

The systematic review of guidelines to form the AAWC guideline offered three relevant recommendations related to wound cleansing out of seven recommendations related to wound cleansing. The guidelines state that the optimal irrigation pressure of four to fifteen pounds per square inch (psi) can be achieved using a 35 cc syringe with 19 gauge angiocath or a single-use 100 ml squeezable saline bottle. The guidelines further suggest wound cleansing solutions permitted include normal saline, sterile water, Finger’s lactate, or tap water. Finally, the guidelines recommend that the ulcer and perimeter should be cleansed with enough irrigant for the wound size, depth and condition (usually 100 to 150 ml) at room temperature.
Limitations

There were numerous limitations to the included systematic reviews and guidelines. The included Cochrane systematic review was limited due to the small number of patients in the trials who experienced infections. As a result, the authors state that findings are underpowered, which may make it difficult to interpret the study findings. The NICE guideline on surgical site infection may have been limited by the apparent lack of included literature on wound cleansing to form the basis of the recommendations on wound cleansing. The summary of the AAWC guidelines provided by the Agency for Health Research and Quality (AHRQ) may be limited by the lack of the clarity around the clinical questions, which led to the creation of the guideline and methodological criteria for the included guidelines. Although there are numerous recommendations, it is unknown whether the recommendations were targeted to respond to prespecified clinical questions.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

There is limited evidence concerning the comparative clinical effectiveness of potable water to saline. There was no evidence of the comparative efficacy of potable water to triclosan, chlorhexidine, hexachlorophene, povidone iodine, hydrogen peroxide, and alcohol. The available evidence suggests for adults water may be better for wound cleansing than saline as there was a lower risk of infection when cleansing with water. Evidence-based guidelines recommend the use of normal saline or sterile saline and tap water or sterile water with some variation in the suggested time frame after the wound developed. Guidelines present some evidence to suggest the ideal irrigation pressure is between four to fifteen psi.

Wound cleansing and management remains a complex and multifactorial process. In the process of wound cleansing and management, the literature advises the consideration of multiple factors in the selection of wound cleansing agents including whether the wound has exposed bone or tendon, type of wound, location of wound, age of wound and size of wound. Additional factors related to the patient may be considered such as age and comorbidities.

At this stage, more research is needed to determine if the efficacy of potable water is comparable to the numerous antiseptic agents listed above. The evidence-based guidelines provide brief recommendations on the use of tap water or sterile water and sterile saline or normal saline. However, the recommendations lack information on monitoring and the appropriate use of saline and water to cleanse wounds.

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REFERENCES


APPENDIX 1: Selection of Included Studies

469 citations identified from electronic literature search and screened

444 citations excluded

25 potentially relevant articles retrieved for scrutiny (full text, if available)

6 potentially relevant reports retrieved from other sources (grey literature, hand search)

31 potentially relevant reports

28 reports excluded:
- other (review articles, commentary, case studies) (11)
- Non evidence-based guidelines (6)
- Guidelines included in a systematic review of guidelines (2)
- already included in at least one of the selected systematic reviews (5)
- irrelevant intervention (4)

3 reports included in review
APPENDIX 2: Characteristics of Included Clinical Studies

<table>
<thead>
<tr>
<th>First Author, Publication Year, Country</th>
<th>Study Design and Length</th>
<th>Patient Characteristics</th>
<th>Intervention</th>
<th>Comparator</th>
<th>Clinical Outcomes Measured</th>
</tr>
</thead>
</table>
| Fernandez (2012)³ Australia             | Systematic Review       | • Patients ages 2 to 95,  
• Hospital emergency departments, ward setting and community followed up for one to six weeks | Tap water     | Cooled boiled water, normal saline | Infection, wound healing, patient satisfaction |
APPENDIX 3: Summary of Critical Appraisal

<table>
<thead>
<tr>
<th>First Author, Publication Year</th>
<th>Strengths</th>
<th>Limitations</th>
</tr>
</thead>
</table>
| **Systematic Review**         | • Clear inclusion and exclusion criteria  
• Comprehensive literature search  
• Independent formal assessment of risk of bias conducted by both systematic review authors | • Acute vs. chronic wounds are not clearly defined  
• All comparisons were severely underpowered as infections were a rare event  
• No reporting on publication bias | |
| Fernandez (2012)³  
Australia | | |
| **Evidence-Based Guidelines** | • Benefits and harms of implementing the guidelines have been explicitly outlined  
• Individual recommendations are clear and concise  
• The intended audience for the guidelines has been clearly identified | • It is unclear if patient input was considered in the creation of the guidelines  
• It is unclear what health questions the guideline was designed to address  
• The strengths and limitations of the included guidelines was addressed  
• It is unclear if the recommendations reflect the source guidelines | |
| AHRQ Guideline Summary of Association for the Advancement of Wound Care guideline of pressure ulcer guidelines (2010)⁴ | | |
| National Institute for Health and Clinical Excellence (NICE) (2008)⁵ | • Formal assessment of the included studies  
• Systematic search of the literature for evidence  
• Clear comprehensive health questions for the guidelines specified a priori  
• Clear methods for formulating recommendations and specific targeted recommendations | • No information provided on the strengths and limitations of the included evidence  
• Limited information provided on the barriers and aides to implement the recommendations  
• Few recommendations on wound cleansing  
• The audience of these recommendations is health professionals and patients in the United Kingdom. As a result, it is unclear if these recommendations can be generalized to a Canadian setting  
• None of the included literature addressed wound cleansing interventions directly | |
| | | |
### APPENDIX 4: Summary of Findings

<table>
<thead>
<tr>
<th>First Author, Publication Year</th>
<th>Main Study Findings</th>
<th>Authors’ Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fernandez (2012)³ Australia</td>
<td><strong>TAP WATER VS. NORMAL SALINE</strong>&lt;br&gt;<strong>Acute wounds</strong>&lt;br&gt;• A meta-analysis including three trials (Angeras, 1992; Godinez, 2002; Moscati, 2007), which compared the infection rate for tap water with normal saline reported a significant reduction in infections with tap water (RR 0.63, 95% 0.40 to 0.99; P=0.05)&lt;br&gt;• Two trials (Bansal, 2002; Valente, 2003) that included measurements of infection rates in children and the pooled results demonstrated no statistically significant difference in the infection rates for children whose wounds were cleansed with saline or tap water (RR 1.07, 95% CI 0.43 to 2.64; P= 0.88).&lt;br&gt;&lt;br&gt;<strong>Chronic wounds</strong>&lt;br&gt;• Griffiths (2001) observed no statistically significant difference in infection rates in non-sutured wounds that were cleansed with either tap water or normal saline (RR= 0.16, 95% CI 0.01 to 2.96; P= 0.22)&lt;br&gt;&lt;br&gt;<strong>Wound healing</strong>&lt;br&gt;• Griffiths (2001) was the only included study that reported on wound healing that healed after cleansing with either tap water or saline (RR=0.57, 95% 0.30 to 1.07). There were no significant differences in wound healing between tap water and saline.</td>
<td>• “Based on randomized trials undertaken to date, evidence suggests that tap water is unlikely to be harmful if used for wound cleansing. The decision to use tap water to cleanse wounds should take into account the quality of water, nature of wounds and the patients’ general condition, including the presence of comorbid conditions.” (p.9)&lt;br&gt;&lt;br&gt;<strong>DISTILLED/BOILED WATER VS. SALINE</strong>&lt;br&gt;• One study compared distilled water to isotonic saline, cooled boiled water to isotonic saline and water (distilled and/or cooled boiled water) to normal saline (Museru 1989)&lt;br&gt;• There were no statistically significant differences between isotonic saline and distilled water (RR=0.49; 95% CI 0.19 to 1.26) (7/20 vs. 6/35)&lt;br&gt;• Cooled boiled water vs. isotonic saline. (RR=0.83, 95% CI 0.37 to 1.87) (9/31 vs. 7/20)&lt;br&gt;• Distilled and cooled boiled water pooled and compared to isotonic saline, no statistically significant difference in infection rate (RR 0.65, 95% 0.31 to 1.37)</td>
</tr>
</tbody>
</table>
APPENDIX 5: Summary of Level of Recommendations and Evidence

<table>
<thead>
<tr>
<th>Guideline Society or Institute, Year</th>
<th>Level of Recommendation</th>
<th>Level of Evidence</th>
</tr>
</thead>
</table>
| Guideline Summary of Association for the Advancement for Wound Care Guideline (2010)§ | No grading scheme for strength of recommendations was reported | “A. Results of a meta-analysis or two or more pressure (PU)-related randomized controlled trials (RCTs) on humans provide support (or for diagnostics or risk assessment: prospective cohort [CO] studies and/or controlled studies reporting recognized diagnostic or predictive validity measures).  
B. Results of one PU-related RCT in humans plus two or more similar historically controlled trials (HCTs) or convenience controlled trials (CCTs) or one HCT and one CCT provide support or when appropriate, results of two or more RCTs in animal model validated as clinically relevant to PU provide indirect support. For diagnostics or risk assessment one PU-related prospective CO study and/or a controlled study reporting recognized diagnostic or predictive validity measures.  
C. This rating requires one or more of the following:  
C1: Results of one controlled trial, e.g., RCT, CCT or HCT (or for diagnostics or risk prediction one prospective CO study may be substituted for a controlled trial)  
C2: Results of at least two case series (CS) or descriptive studies or a cohort study in humans  
C3: Expert opinion (EO).”(p.3) |
| National Institute for Health and Clinical Excellence (NICE) (2008)§ | No grading scheme for strength of recommendations was reported | “ 1++: High-quality meta-analyses, systematic reviews of randomized controlled trials (RCTs), or RCTs with a very low risk of bias  
1+ well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with low risk of bias  
1- Meta-analyses, systematic reviews  
2+ well-conducted case-control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal  
2- Case-control or cohort studies with a high risk of confounding, bias or chance and a significant risk that the relationship is not causal  
3 Non-analytical studies (for example case reports, case series)  
4 Expert opinion, formal consensus”(p. 5) |
# APPENDIX 6: Summary of Guidelines and Recommendations

<table>
<thead>
<tr>
<th>Guideline Society or Institute, Year</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| Guideline Summary of Association for the Advancement for Wound Care Guideline (2010) | - Wound cleansing solutions may include normal saline, sterile water, Ringer’s lactate or tap water (Evidence Level=B)  
- Optimal irrigation pressure of 4 to 15 pounds per square inch (psi) may be obtained using a 35 cc syringe with 19 gauge angiocath (Evidence Level=B) or a single-use 100 ml saline squeeze bottle (Evidence C)  
- Cleanse the ulcer and perimeter with enough irrigant for the wound size, depth, and condition (usually 100 to 150 ml) warmed to room temperature (Evidence Level=C) |
| National Institute for Health and Clinical Excellence (NICE) (2008) | - Sterile saline should be used for wound cleansing up to 48 hours post-surgery  
- Tap water may be used for wound cleaning at least 48 hours after surgery if the surgical wound has separated or has been opened surgically to drain pus.  

*The guideline states that no relevant evidence on wound cleansing was identified (p. 92), therefore no evidence levels are provided.*
APPENDIX 7: Additional Information

Potentially relevant Intervention (Water and Soap versus Saline)