For health care institutions, intraoperative prep agents are a critical link in combating surgical site infections and the associated economic burden. The question remains, is there an intraoperative prep agent that is truly superior to the others? We conducted a literature review to examine available empirical evidence related to intraoperative prep agents used in our health system for open abdominal, general surgery procedures: povidone-iodine, chlorhexidine gluconate, parachoroxylenol, and iodine povacrylex in 74% isopropyl alcohol. Intraoperative surgical skin prep studies were limited in providing empirical evidence to support one superior prep agent. Each prep agent has a specific mechanism of action along with specific advantages and disadvantages. We concluded that no one perioperative skin prep agent is superior in all clinical situations. Factors to consider when choosing an appropriate intraoperative skin prep agent include contraindications, environmental risks, the patient’s allergies and skin condition, the surgical site, the manufacturer recommendations for the prep agent, and surgeon preference. AORN J 92 (December 2010) 662-671. © AORN, Inc, 2010. doi: 10.1016/j.aorn.2010.07.016

Key words: surgical site infection, infection prevention, intraoperative prep agents, antiseptic skin prep, chlorhexidine gluconate, povidone-iodine, parachoroxylenol, isopropyl alcohol.

Surgical-site infections (SSIs) are the most common of all health care-associated infections in the surgical population, accounting for more than 6 million (38%) of all health care adverse events and 14% to 16% of all health care-associated infections.1-3 According to the American College of Surgeons, SSIs annually result in 3.7 million additional hospital days with $845 million spent nationally,4 which equates to 7.0 to 8.2 extra hospital days per case and a potential cost of more than $25,000 per event.4-6

Postoperative wound infections have fiscal ramifications for both the patient and the health
care facility. An SSI can more than double the patient’s health care-related expenses as well as adversely affect the patient’s quality of life, functional status, and satisfaction. An SSI can increase the hospital costs for major surgery five-fold; hospitals spend millions of dollars each year related to treatment costs and increased length of stay.7

As of October 2008, the revised Medicare reimbursement policy for health care facilities no longer includes the costs associated with treatment of specific SSIs.1,8,9 This change in policy has challenged health care administrators and providers to thoroughly examine current internal SSI prevention measures.1,8

It is critical that health care providers acknowledge the effects of SSIs on patient outcomes and the associated economic burden. Intraoperative prep agents are a vital link in combating SSIs, but questions remain:

- Is there empirical research available that clearly identifies a superior prep agent?
- What is the best intraoperative prep agent to reduce the risk of SSI?

The purpose of this literature review was to examine the specific empirical evidence related to the intraoperative skin prep agents used for general surgical procedures. The information from this review expands the body of clinical nursing knowledge and evidence-based practice, particularly for perioperative nurses. Health care institutions may use these findings as a foundation for formulating recommendations focused on patient-centered care topics, such as quality of care, safe patient outcomes, length of stay, and reimbursement.

BACKGROUND

The patient’s own floras are the most common source of an SSI.3,5,8,10,11 Intact patient skin inherently provides resistance to infection by creating a protective barrier.8 A surgical incision intentionally compromises intact patient skin, unavoidably allowing a portal of entry for endogenous and exogenous contaminating sources.3,8,10 Resident bacteria on the skin are considered very difficult to remove, further highlighting the significance of effective skin asepsis.12 An increase in wound infection risk occurs when the microbial counts on the surface of the skin are more than 10⁵ microorganisms per gram of tissue.3,8 Therefore, strict adherence to the basic principles of aseptic technique is a crucial responsibility of perioperative nurses that directly affects the potential for a postoperative SSI.8 Intraoperative skin preparation is critical in reducing microbial counts and killing microorganisms.5,8,11,13

AORN publishes recommendations annually for standards of practice for perioperative nurses. According to AORN, the purpose of intraoperative skin preparation is to provide antiseptic of the surgical site.10 Skin preparation limits the risk for SSI by

- removing bioburden (ie, soil and transient microorganisms) from the patient’s skin,
- decreasing resident microorganism counts quickly while not irritating tissue, and
- preventing regrowth and rebound of microorganisms.10

Perioperative nurses play an integral role in decreasing the risk of SSI by using rigorous adherence to aseptic technique and by using impeccable skin preparation technique.10

METHODS

We searched the PubMed® and the Cumulative Index of Nursing and Allied Health Literature (CINAHL®) Plus databases and limited our results to articles published in English. Key words searched included intraoperative, perioperative, skin, prep, prepping, preparation, skin preparation, surgical, Techni-Care®, DuraPrep™, chlorhexidine, povidone-iodine, and surgical wound infection/prevention and control. To yield a greater number of articles related to intraoperative prep agents, we expanded the inclusive dates from five years to 15 years. In addition,
we reviewed the reference lists of the selected articles to identify primary literature of interest dating back to 1978. The articles yielded information on a variety of available intraoperative surgical prep agents, each agent having a different mechanism of action and specific advantages and disadvantages.

ANALYSIS
At the time of this literature review, the prep agents in our health system included povidone-iodine, chlorhexidine gluconate (CHG), para-chloroxylenol (PCMX), and iodine povacrylex (0.7% available iodine) in 74% isopropyl alcohol (DuraPrep). Relevant articles from the literature searches were distributed among the research team members for review, analysis, and synthesis. Each team member used a literature review grid to facilitate consistency in data collection and article review. Two examples of use of the review grid are shown in Table 1. Research team members met biweekly to discuss the articles and to identify gaps in the literature related to SSIs and skin prep agents.

RESULTS
The literature review resulted in 89 “hits,” and we chose and analyzed 29 of the articles based on relevance to the topic. The excluded articles involved animal studies and nonpertinent patient populations. All the studies reviewed clearly demonstrated a link between appropriate surgical skin preparation and the incidence of SSI. Only a limited number of research reports focused on the four skin prep agents used at our facility; therefore, we also included surgical hand scrub studies in this literature review. Surgical hand scrubs have the same goal of removing microorganisms and inhibiting rebound and regrowth. We found studies that compared two or three of the prep agents but not a direct comparison of all four intraoperative prep agents. The studies were all published between 1978 and 2010.

Povidone-iodine (Betadine®)
Povidone-iodine, commonly referred to as scrub and paint, was discovered in 1812 by a French chemist and is documented to have been first used on wounds in 1839. Povidone-iodine was quickly recognized for its antimicrobial activity and was introduced as an antiseptic agent in 1953. Although it is one of the longest established and widely used antiseptic agents in the surgical domain, povidone-iodine has the potential to cause local pain and skin irritation.

Povidone-iodine has been studied both as a surgical hand scrub and as a surgical skin prep. The mechanism of action of povidone-iodine is the release of free iodine that binds to bacteria. This agent has excellent activity against gram-positive bacteria and good activity against gram-negative bacteria. Povidone-iodine’s free iodine attracts and binds with organic substances, thus modifying or decreasing its antiseptic effectiveness in the presence of blood. Povidone-iodine is classified as moderate in relation to the rapidity of action and provides minimal persistent and residual activity.

Povidone-iodine has been shown to decrease the incidence of wound infection and is considered a highly effective skin preparation for surgery. Povidone-iodine is a broad-spectrum agent, which is a key component of an effective skin preparation. Removing organic substances such as blood, pus, or fat from the surgical site yields optimal results with use of a povidone-iodine agent.

The disadvantages of povidone-iodine as an intraoperative prep agent are difficult to determine because of the longevity of this agent, which has resulted in a lack of recent empirical studies. Povidone-iodine is a US Food and Drug Administration (FDA) approved, fast-acting, broad-spectrum agent that has beneficial and desirable characteristics as an intraoperative prep agent. Without conclusive evidence to demonstrate otherwise, povidone-iodine will remain a viable
<table>
<thead>
<tr>
<th>Article</th>
<th>Participants</th>
<th>Design</th>
<th>Results</th>
<th>Strengths and weaknesses</th>
<th>Evidence and/or implications for a practice change?</th>
<th>Level of evidence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorhexidine-alcohol versus povidone-iodine for surgical-site antisepsis27</td>
<td>Adult surgical patients 18 years or older undergoing clean-contaminated surgery</td>
<td>Randomly assigned skin prep of chlorhexidine-alcohol or povidone-iodine</td>
<td>N = 849 with 409 in the chlorhexidine-alcohol group, 440 in the povidone-iodine group</td>
<td>Significantly fewer SSIs in the chlorhexidine-alcohol group (9.5% v 16.1%; P = .004)</td>
<td>This article suggests that chlorhexidine-alcohol is a superior product to povidone-iodine for wound class 2 procedures</td>
<td>A = Prospective, randomized clinical trial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Setting: 6 hospital sites</td>
<td></td>
<td>Chlorhexidine-alcohol group had fewer superficial incisional infections (4.2 v 8.6; P = .008), povidone-iodine group had fewer deep incision infections (1% v 3%; P = .05)</td>
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<tr>
<td></td>
<td>Followed patients for 30 days after surgery for development of surgical site infection (SSI)</td>
<td></td>
<td>Chlorhexidine-alcohol and povidone-iodine group had similar results related to organ/space infections (4.4% v 4.5%)</td>
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*Level of evidence: A = Prospective, randomized clinical trial
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<tr>
<th>Article</th>
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<th>Evidence and/or implications for a practice change?</th>
<th>Level of evidence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effects of preoperative skin preparation on postoperative wound infections rates: a prospective study of 3 skin preparation protocols&lt;sup&gt;28&lt;/sup&gt;</td>
<td>Adult surgical patients 18 years or older undergoing general surgery</td>
<td>Placed in one of the 3 prep agent groups being studied based on the date of surgery: 01/01/06 to 06/30/06: povidone-iodine 07/01/06 to 12/31/06: 2% chlorhexidine and 70% isopropyl alcohol 01/01/07 to 06/30/07: iodine povacrylex in isopropyl alcohol</td>
<td>N = 3,209 with 987 in the povidone-iodine group 994 in the chlorhexidine and 70% isopropyl alcohol group 1,228 in the povacrylex in isopropyl alcohol group</td>
<td>SSI lowest in the povacrylex in isopropyl alcohol group (3.9%) compared to povidone-iodine group (6.4%); the highest rates were observed in the 2% chlorhexidine and 70% isopropyl alcohol group (7.1%) (P = .002)</td>
<td>Greatest difference in SSI observed in the incidence of superficial SSIs</td>
<td>Strengths: Compared commonly used prep agents for surgical patients Scientific rationale for non-randomization (to analyze the effects of a widespread implementation of a protocol commonly seen in hospital practice; maximize consistency of prep application; shorten time frame to control for other variables) Adequate sample size Statistically significant results</td>
</tr>
<tr>
<td>Setting: single large academic medical center</td>
<td>Followed patients for 30 days after surgery for development of SSI</td>
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<tr>
<td></td>
<td></td>
<td>Evidence and/or implications for a practice change?</td>
<td>Level of evidence*</td>
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<td></td>
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<td>A = Single center, prospective, phase 4, unblinded protocol implementation comparison study</td>
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</table>

* A = strong randomized clinical trial (RCT); B = strong case control, cohort studies, weak RCT; C = case control, cohort; D = expert opinion, case study.
intraoperative prep agent and remains a common agent used in intraoperative prep.

**Chlorhexidine Gluconate**

Chlorhexidine gluconate with and without alcohol has been studied extensively as a surgical hand scrub and surgical skin preparation. The mechanism of action for this broad-spectrum agent is disruption of the cell membranes by cytologic and physiologic changes that lead to cell death, specifically targeting vegetative gram-positive and gram-negative bacteria. This agent has excellent activity against gram-positive bacteria and good activity against gram-negative bacteria.\(^3\,8\,10\,11\) Chlorhexidine gluconate has been shown to remain effective in the presence of serum and protein-rich biomaterial, such as blood.\(^5\,11\) Chlorhexidine gluconate is classified as moderate in relation to the rapidity of action and has excellent persistent and residual activity.\(^3\,8\,10\,11\,20\)

Extensive studies have demonstrated that CHG lowers bacteria counts compared with povidone-iodine and parachoroxylenol as a surgical hand scrub.\(^12\,14\,21\,22\) Because of CHG’s persistent and residual activity, it is considered a highly effective surgical hand scrub,\(^11\,14\,21\,22\) consistently demonstrating log reductions below baseline criteria as defined by the FDA.\(^1\,2\,21\) Hibiclens\(^\text{®}\), a brand of CHG, was the first surgical hand scrub approved as safe and effective by the Topical Antimicrobials Committee of the FDA and continues to be commonly used throughout health care settings. Results of numerous studies have supported CHG as effective in decreasing bacteria on the skin,\(^1\,5\,23\) which correlates with decreased bloodstream and central line infections. These findings support the use of CHG as beneficial with repeated applications over an extended period of time.\(^1\,21\,23\)

Research results also support bathing or showering twice before surgery with a 4% CHG agent as an effective measure to decrease the potential for postoperative infections.\(^1\,8\,10\,11\) Given the reported findings of the effectiveness of the 2% CHG cloth in decreasing bloodstream and central line infections, two interesting questions arise:

- Is a 2% CHG cloth as effective as the established 4% CHG bath/shower application to decrease the potential for SSIs?
- If yes, would one application of the 2% CHG cloth be adequate to achieve the same results as the twice bathing or showering with the 4% CHG agent?

These questions highlight an additional gap in evidence and warrant further exploration.

The disadvantages of CHG are specific contraindications for use. Chlorhexidine gluconate contact may cause corneal damage, ototoxicity, and neurotoxicity.\(^10\,11\,15\) Furthermore, because of potential toxicities, CHG is not recommended for use on eyes, ears, brain and spinal tissues, mucus membranes, or genitalia, or for individuals with a known sensitivity.\(^10\,11\,15\) Chlorhexidine gluconate has been reported to be inactivated by saline solution\(^24\) and may have a drying effect on the skin.\(^15\)

**Parachoroxylenol**

Parachoroxylenol, also known as PCMX, is considered to be a broad-spectrum agent with a mechanism of action that disrupts cell membranes by preventing the uptake of essential amino acids. This agent demonstrates good activity against vegetative gram-positive bacteria and fair activity against gram-negative bacteria.\(^3\,8\,10\,15\) Results of previous studies of parachoroxylenol have suggested it is 99.9% effective against methicillin-resistant *Staphylococcus aureus* and other common organisms.\(^15\) Parachoroxylenol is classified as moderate with regard to the rapidity of action and persistent and residual activities.\(^3\,8\,10\) Parachoroxylenol immediately bonds with the dermis and is not denatured by organic material, thus parachoroxylenol has a tolerance for organic material, such as blood, and remains active in saline solution.\(^15\) Parachoroxylenol is considered nontoxic, with no tissue contraindications.\(^8\,10,15\)

Although this review yielded limited evidence to support parachoroxylenol as a first choice for intraoperative skin prep, further research is warranted to address the questions raised regarding its effectiveness and appropriate use.
antimicrobial agent, it has been introduced as a safe intraoperative skin prep alternative for surgical sites that involve mucus membranes.

The disadvantages of parachoroxylenol are not well documented in the literature. Among the studies available that evaluated parachoroxylenol as a surgical hand scrub, the agent has demonstrated less effective results than other agents included in this review. As an intraoperative skin prep agent, parachoroxylenol also demonstrates less effective results than other skin prep agents. Currently, there is not an abundance of data regarding this prep agent and thus, additional investigation is needed.

Iodine-base With Alcohol (DuraPrep)
Alcohol alone is considered to have excellent gram-positive and gram-negative activity with a mechanism of action to denature proteins. Alcohol is considered immediately germicidal, classified excellent with regard to rapidity of action but does not demonstrate persistent residual activity. However, the combination of alcohol and iodine (DuraPrep) has demonstrated greater effectiveness than each of these agents used independently in combating SSIs. This increased effectiveness may be a result of the immediate germicidal action of alcohol and the residual activity of iodine.

The majority of DuraPrep research focuses on orthopedic procedures. The purpose of this literature review was to explore prep agents specifically used in open abdominal, general surgery procedures, therefore we did not include research articles that focused on DuraPrep in orthopedic procedures. We found limited research that addressed the use of DuraPrep in open abdominal, general surgery procedures, thus demonstrating a gap in the knowledge and evidence specific to this prep agent and population.

A disadvantage of DuraPrep is the product’s potential for causing surgical fires because it has an alcohol base. The alcohol content in this skin prep agent is an undesirable catalyst in the OR because of its flammability. Along with specific SSIs, surgical fires are considered “never events” (ie, preventable events that may cause serious injury or death) by the Centers for Medicare and Medicaid Services and are considered 100% preventable. An overview of the advantages and disadvantages of the prep agents included in this literature review is provided in Table 2.

DISCUSSION
Several factors must be considered when choosing an appropriate intraoperative skin preparation, including a nursing assessment of contraindications. Advantages and disadvantages of the prep agents must be weighed carefully to facilitate positive patient outcomes, specifically, to decrease the incidence of SSIs. Given the current status of the economy, hospitals must consider the cost:benefit ratio for each prep agent and ask the question, “Are health care systems paying for a product whose performance is evidence based?”

Environmental risks are another factor to consider when choosing an appropriate intraoperative skin preparation. Although rare, surgical fires are a significant risk in any OR. Ignition sources (eg, electrosurgery, lasers) are used commonly in surgery; therefore, the potential of a surgical fire is increased any time alcohol-based or flammable skin prep agents are used. According to a 2009 ECRI Institute guidance report, 70% of surgical fires are caused by an electrosurgery unit and 10% are related to laser use, both of which are common ignition sources in any OR setting. Furthermore, surgical fires rank third on the ECRI Institute’s technology hazard alerts.

Health care providers are responsible for choosing an appropriate intraoperative prep agent for each patient. An ideal prep agent should

- decrease the microorganism count,
- be effective against a broad spectrum of microorganisms,
- be fast acting, and
- have a persistent effect against rebound and regrowth.
Before making a final decision on a surgical skin prep agent, health care providers should consider the patient’s allergies and skin condition, the surgical site, the manufacturer recommendations for the prep agent, and surgeon preference. Based on this literature review for intraoperative skin preparations specific to general surgical procedures, and considering all the advantages and disadvantages, we concluded that there is not one superior skin prep agent for use in abdominal procedures.

**LIMITATIONS**

Intraoperative surgical skin prep studies were limited in providing empirical evidence to support one superior prep agent. Each prep agent has a specific mechanism of action along with specific advantages and disadvantages to consider when selecting a prep agent to use for surgery. Many factors must be considered when choosing a prep agent, such as patient allergy, surgical site, and surgeon preference. All prep agents are FDA approved and meet requirements for efficacy. No prep agent is categorized as superior. The Centers for Disease Control and Prevention has not made formal recommendations for the use of intraoperative prep agents, citing a lack of well-controlled studies related to skin preparation and SSIs on specific surgical procedures. Rather, the Centers for Disease Control and Prevention focuses on the intent of the aseptic skin preparation, the

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**TABLE 2. Comparison of Prep Solutions**

<table>
<thead>
<tr>
<th>Prep Solution</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Povidone-iodine (Betadine®)</td>
<td>- Excellent gram-positive activity</td>
<td>- Minimal persistent and residual activity</td>
</tr>
<tr>
<td></td>
<td>- Good gram-negative activity</td>
<td>- Decreased effectiveness in the presence of blood and organic material</td>
</tr>
<tr>
<td></td>
<td>- Broad spectrum</td>
<td>- Lack of recent empirical evidence</td>
</tr>
<tr>
<td></td>
<td>- Moderate rapidity of action</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Long established as an effective agent</td>
<td></td>
</tr>
<tr>
<td>Chlorhexidine gluconate (Hibiclens®)</td>
<td>- Excellent gram-positive activity</td>
<td>- Contraindicated for use on eyes, ears, brain and spinal tissue, genitalia, mucus membranes</td>
</tr>
<tr>
<td></td>
<td>- Good gram-negative activity</td>
<td>- Inactivated in the presence of saline solution</td>
</tr>
<tr>
<td></td>
<td>- Broad spectrum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Moderate rapidity of action</td>
<td>- Drying effect on the skin</td>
</tr>
<tr>
<td></td>
<td>- Excellent persistent residual activity</td>
<td></td>
</tr>
<tr>
<td>Parachloroxylenol (PCMX)</td>
<td>- Good gram-positive activity</td>
<td>- Has demonstrated less effective results in studies for hand scrubs</td>
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<tr>
<td></td>
<td>- Good/fair gram-negative activity</td>
<td>- Not well documented in the literature as an intraoperative prep solution</td>
</tr>
<tr>
<td></td>
<td>- Broad spectrum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Moderate rapidity of action</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Moderate persistent/residual activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Considered nontoxic with no tissue contraindications</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Remains effective in the presence of blood and organic material and in the presence of saline solution</td>
<td></td>
</tr>
<tr>
<td>Iodine-base with alcohol (DuraPrep™)</td>
<td>- Excellent gram-positive activity</td>
<td>- Highly flammable</td>
</tr>
<tr>
<td></td>
<td>- Excellent gram-negative activity</td>
<td>- Limited research related to application in general surgery</td>
</tr>
<tr>
<td></td>
<td>- Broad spectrum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Moderate rapidity of action</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Long established as an effective agent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Alcohol provides immediately germicidal activity</td>
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</tbody>
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The information is from the AORN Journal. For more details, please refer to the original source.
environment in the OR, staff attire, drapes, and the technique used to prep the patient. In other words, there is no published gold standard related to a superior prep agent to decrease the incidence of SSIs. In addition, a variety of products must be available to meet the needs of the diverse patient populations encountered in the perioperative setting.

The team did not evaluate the literature exclusively pertaining to 2% CHG with 70% isopropyl alcohol (ChloraPrep®) because this product was not available in our hospital system at the time of our literature review. A recent study claimed superior results for patients who underwent intraoperative surgical preparation with ChloraPrep versus povidone-iodine. This study did not include all of the four prep agents used in our hospital system, which was one reason we did not use it in our literature review. In addition, more than half of the researchers in this study disclosed receiving monetary considerations from the manufacturer of ChloraPrep. In another recent study, ChloraPrep was not found to be a superior prep agent compared with povidone-iodine and iodine povacrylex in isopropyl alcohol (DuraPrep). The findings indicated that compared with ChloraPrep both iodophor-based compounds performed better and resulted in lower SSI rates.

**IMPLICATIONS FOR NURSING**

Nurses are participating in multidisciplinary collaboration in many hospitals to provide knowledge and recommendations for evidenced-based clinical practice issues. The findings of this literature review provide the foundation for future retrospective and prospective studies to empirically evaluate surgical skin agents. Information gained from future research may be used to help formulate surgical prep solution recommendations for perioperative nurses, surgeons, infection prevention practitioners, other health care providers, policy makers, administrators, third-party payers, and the general population interested in SSIs.

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Intraoperative Skin Prep Agents: Is There a Difference?

PURPOSE/GOAL
To educate perioperative nurses about the properties of different surgical skin prep solutions used to help prevent surgical site infections.

OBJECTIVES
1. Discuss the purpose of intraoperative skin preparation.
2. Explain how four common surgical skin prep agents work.
3. Identify the advantages associated with four common surgical skin prep agents.
4. Identify the disadvantages associated with four common surgical skin prep agents.
5. Discuss health care provider considerations for choosing a particular surgical skin prep agent.

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QUESTIONS
1. The patient’s floras are the most common source of a surgical site infection.
   a. true  b. false

2. The purpose of intraoperative skin preparation is to
   1. provide antisepsis of the surgical site.
   2. remove bioburden from the patient’s skin.
   3. decrease resident microorganisms counts quickly.
   4. prevent regrowth and rebound of microorganisms.
      a. 1 and 3  b. 2 and 4
      c. 1, 2, and 4  d. 1, 2, 3, and 4

3. The mechanism of action of povidone-iodine is the
   a. disruption of cell membranes by cytologic and physiological changes.
   b. release of free iodine that binds to bacteria.
   c. denaturation of proteins.
   d. disruption of cell membranes by preventing the uptake of amino acids.

4. Povidone-iodine
   1. attracts and binds to organic substances.
   2. has excellent activity against gram-positive bacteria.
   3. is a broad-spectrum agent.
   4. is inactivated by saline solution.
      a. 1 and 4  b. 2 and 4
      c. 1, 2, and 3  d. 1, 2, 3, and 4
5. Chlorhexidine gluconate has been shown to remain effective in the presence of serum and protein-rich biomaterial, such as blood.  
   a. true  
   b. false

6. Disadvantages of chlorhexidine gluconate include that it  
   1. is not effective against gram-positive bacteria.  
   2. is not recommended for use on brain and spinal tissues.  
   3. may cause corneal damage.  
   4. may be inactivated by saline solution.  
   a. 1 and 2  
   b. 1 and 4  
   c. 2, 3, and 4  
   d. 1, 2, 3, and 4

7. Some studies have suggested that _________ is 99.9% effective against methicillin-resistant Staphylococcus aureus and other common organisms.  
   a. chlorhexidine gluconate  
   b. iodine-base with alcohol  
   c. parachloroxylenol  
   d. povidone-iodine

8. The combination of alcohol and iodine has demonstrated greater effectiveness in combating surgical site infections than each of the agents used independently, which may be a result of the  
   1. immediate germicidal action of alcohol.  
   2. residual activity of iodine.  
   3. immediate bond of iodine with the dermis.  
   4. residual activity of alcohol.  
   a. 1 and 2  
   b. 3 and 4  
   c. 1, 2, 3, and 4  
   d. 1, 2, 3, and 4

9. Before making a final decision about which skin prep agent to use, health care providers should consider  
   1. the patient’s allergies and skin condition.  
   2. the surgical site.  
   3. manufacturer recommendations of the prep product.  
   4. surgeon preference.  
   a. 1 and 2  
   b. 3 and 4  
   c. 1, 2, and 3  
   d. 1, 2, 3, and 4

10. The Centers for Disease Control and Prevention has not made formal recommendations for the use of intraoperative prep agents.  
   a. true  
   b. false

The behavioral objectives and examination for this program were prepared by Rebecca Holm, MSN, RN, CNOR, clinical editor, with consultation from Susan Bakewell, MS, RN-BC, director, Center for Perioperative Education. Ms Holm and Ms Bakewell have no declared affiliations that could be perceived as potential conflicts of interest in publishing this article.
Intraoperative Patient Skin Prep Agents: Is There a Difference?

This evaluation is used to determine the extent to which this continuing education program met your learning needs. Rate the items as described below.

OBJECTIVES

To what extent were the following objectives of this continuing education program achieved?

1. Discuss the purpose of intraoperative skin preparation. Low 1. 2. 3. 4. 5. High

2. Explain how four common surgical skin prep agents work. Low 1. 2. 3. 4. 5. High

3. Identify the advantages associated with four common surgical skin prep agents. Low 1. 2. 3. 4. 5. High

4. Identify the disadvantages associated with four common surgical skin prep agents. Low 1. 2. 3. 4. 5. High

5. Discuss health care provider considerations for choosing a particular surgical skin prep agent. Low 1. 2. 3. 4. 5. High

CONTENT

6. To what extent did this article increase your knowledge of the subject matter? Low 1. 2. 3. 4. 5. High

7. To what extent were your individual objectives met? Low 1. 2. 3. 4. 5. High

8. Will you be able to use the information from this article in your work setting? Yes 2. No

9. Will you change your practice as a result of reading this article? (If yes, answer question #9A. If no, answer question #9B.)

9A. How will you change your practice? (Select all that apply)

1. I will provide education to my team regarding why change is needed.
2. I will work with management to change/implement a policy and procedure.
3. I will plan an informational meeting with physicians to seek their input and acceptance of the need for change.
4. I will implement change and evaluate the effect of the change at regular intervals until the change is incorporated as best practice.
5. Other: ____________________________

9B. If you will not change your practice as a result of reading this article, why? (Select all that apply)

1. The content of the article is not relevant to my practice.
2. I do not have enough time to teach others about the purpose of the needed change.
3. I do not have management support to make a change.
4. Other: ____________________________

10. Our accrediting body requires that we verify the time you needed to complete the 2.2 continuing education contact hour (132-minute) program: ____________

This program meets criteria for CNOR and CRNFA recertification, as well as other continuing education requirements.

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Event: #10505; Session: #4052 Fee: Members $11, Nonmembers $22

The deadline for this program is December 31, 2013.

A score of 70% correct on the examination is required for credit. Participants receive feedback on incorrect answers. Each applicant who successfully completes this program can immediately print a certificate of completion.