

Evidence for Successful Implementation and Protocols of Chlorhexidine Gluconate (CHG): A Review of the Literature

Clinical Question: *In adults undergoing elective surgery, what is the quantity, quality, and consistency of the evidence for successful implementation and protocols of chlorhexidine gluconate (CHG) bathing or wipes for prevention of surgical site infections (SSIs) versus non-CHG bathing or wipes?*

Conclusions: This literature review was requested to offer guidance for nursing on the implementation of standardized best practices on the use of CHG bathing or wipes for the prevention of SSIs. There is consistent evidence on the use of pre-operative CHG showers or bathing as part of a bundle approach for the prevention of SSIs.^{1,2,5,6,12,13,16,17-20,22,24-27} Evidence from this review reveals clinical or statistical significance that the use of CHG products decreased SSIs.^{12,13,14,16,19,28} Additionally, there were components of a CHG bundle approach or multi-modal interventions that decreased SSIs which include other items such as antibiotic prophylaxis,^{1,2,6,16,18,19,26} nasal screening for Methicillin-Resistant Staphylococcus Aureus (MRSA) and decolonization,^{1,5,12,13} patient warming and temperature checks,^{1,16,26} surgical checklists,^{1,16,17,25,26,27} patient education,^{12,17,18,22,24,27} and evaluation/preparation of the surgical environment.^{5,6}

There were several themes related to CHG implementation repeatedly found within the literature, which include standardized protocols and policies^{3,4,9,15,18,22,24,26,27}, education,^{13,22,25,27} preparation for specific surgeries such as colorectal and total hip/arthroplasties,^{13,26} which were cited to be the largest contributors of SSIs.^{1,26} Furthermore, the use of CHG is often implemented with multi-modal interventions during the surgical periods i.e. preoperative,^{1,3,10,12,13,17,21,24} intraoperative,^{1,5,16,20,27} and postoperative interventions.^{20,26} However, there are some conflicting results on CHG outcomes which report the use of bundles and multi-modal interventions to prevent SSIs do not guarantee success or may not improve outcomes consistently,⁶ there is insufficient evidence to recommend use of CHG as universal preoperative use²⁶ of CHG²⁶ and at home may not offer additional benefits over standard preoperative surgical scrub.²¹ Additionally, SSI rates decreased, but not considered statistically significant.^{4,12,21,25} Other authors stated varying compliance of patients with the preoperative protocols,⁴ and inadequate control for possible confounding variable variations in methods of applying antiseptics and insufficient sample size.⁴ **In conclusion, the overall quality of the evidence related to CHG implementation was moderate.** This review provides the best available evidence to date for informed decision making on standardized practices on the use of CHG bathing or wipes as described under structures, processes, and outcomes found in Table 1.

Key Summary of the Evidence:

- The need for an interdisciplinary team^{5,19,27} (i.e., ambulatory surgery nurse manager, administration, environmental services, surgeon and nurse champions, and patient) provides structures for implementation and evaluation of preventive interventions.
- Successful CHG implementation is often implemented simultaneously with other initiatives (i.e., administration commitment,¹⁷ standardized protocols and policies,^{3,4,9,15,18,22,24,26,27} and preoperative checklists),^{1,16,17,25,26,27} thus influencing SSI prevention and other outcomes.
- The evidence highlights the essential need to provide standardized education on the use of CHG to patients,^{13,22,27} nursing staff,^{22,25,27} and floor/ward personnel.^{25,27}
- Consistent evidence on CHG utilization times include the night before^{4,6,10,26} and/or morning of surgery^{9,10,14,18,24} and identification of CHG formulations i.e., 2% cloth wipes,^{2,4,7,9,10,16} 4% solution,^{2,19,18} and antimicrobial soap.^{4,6,10}
- Important to consider that there are specified preparations utilizing CHG along with simultaneous interventions used in colorectal^{1,13,26} and total hip arthroplasty surgeries.^{3,8,15}
- Evidence additionally displays, that implementation of CHG use is often successful with evaluation of the bundled interventions through adherence^{12,14,16} and compliance established by tracking and/ or a surveillance system.^{20,26,27}

There are several limitations to this review in that studies were conducted in single centers²⁴ with small sample sizes.^{12,21} Other articles stated that researchers nor patients were blinded¹⁸ and one author states only 4 RCTs²⁸ which could potentially bias the results.^{18,28} Additionally, that only the bathing protocol and no other strategies were addressed for reducing SSI in the studies done.²⁵

Recommendations/Future Research: The use of CHG show a wide range of growing evidence that is promising to combat future SSIs.^{3,4} The following recommendations are offered to clinicians to consider when evaluating CHG use for adult patients:

- Integrate future research with well-designed and powered comparative studies of prep containing povidone-iodine plus alcohol and CHG plus alcohol.²
- Monitor for adverse reactions and evidence of resistance/susceptibility of CHG.⁷
- Identify horizontal versus targeted bathing, measuring compliance, and staff attitudes and knowledge.⁷
- Incorporate use of 2% CHG polyester cloth for patients who are limited in their physical activity or unable to shower.⁹

- Utilize future research results into practice on time and number of preoperative washes to be carried out with CHG impregnated clothes.¹⁰
- Promote using a learning platform that consists of surgical debriefs-to help change culture and produce positive SSI outcomes with CHG use, which include questions, What went well? What can we improve?¹⁹
- Opportunities for additional high-quality trials to identify effects of CHG on reducing incidence of infection after total knee arthroplasties.²⁸

Search Results: The population examined in this review consisted of adults having elective surgery in the hospital setting. This review was a complimentary review to the efficacy of CHG done by another team; however, this review focuses on the implementation and its workflows that are described in the structures and processes to get the desired outcomes. A total of **29** articles which include regulatory and professional organizations were found to answer the clinical inquiry. The final evidence consisted of **one high quality** level (meta-analysis²⁷), **sixteen moderate quality** level of evidence consisting of (two systematic reviews,^{7,10} five prospective studies,^{14,15,16,21,23} three retrospective observational studies,^{8,24,18} one integrative review,²⁰ one synthesis review,³ one literature review,⁴ and four descriptive reviews^{6,12,19}), **eight low quality level** of evidence consisting of (two literature reviews,^{1,9} five opinion evidence reviews,^{2,5,13,22} and two case reports^{17,25}), and **four guidelines** from professional organizations and regulatory agencies^{11,26,28,29}). Each citation was ranked using the Johns Hopkins Evidenced-Based Appraisal Tools, the **final appraisal grade for the quality of this evidence was deemed moderate.**

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Table 1
Structures, Processes, and Outcomes of CHG use

Structures	Processes	Outcomes
<p>Interdisciplinary Team^{5,19,27} is needed for the implementation and evaluation of preventive interventions.</p> <ul style="list-style-type: none"> • Ambulatory surgery nurse manager¹⁷ • Administration^{17,27} • Quality Improvement manager^{17,27} • Environmental services¹³ • Surgeon champions^{1,14,17,27} • Perioperative personnel/nurse champions^{1,13,17,27} • Nursing staff^{3,11} • Patient¹ <p>Administration Commitment¹⁷ was key with an organizational readiness assessment^{17,27} and a mechanism for front-line staff feedback for successful roll-out.¹⁹</p> <p>CHG utilized night before^{4,6,10,26} and/or morning of surgery^{9,10,14,18,24} before entering the surgical arena. CHG is instituted in a variety of formulations:</p> <ul style="list-style-type: none"> • 2% cloth wipes^{2,4,7,9,10,16} • 4% solution^{2,9,18} • Antimicrobial soap^{4,6,10} <p>Standardized Protocols and Policies^{3,4,9,15,18,22,24,26,27}</p> <ul style="list-style-type: none"> • Pre-operative bathing²² • Pre-operative patient education on application of CHG,^{4,12} CHG bathing, and signs of SSI¹³ • Preventive Bundles^{4,16,17}/multi-modal interventions/approach²⁷ 	<p>Implementation of Standardized Education on the use of CHG¹³ to patients,^{13,22,27} nursing staff,^{22,25,27} and floor/ward personnel^{25,27} include:</p> <ul style="list-style-type: none"> • Pre-surgical hand hygiene¹³ • CHG bathing and signs of SSIs¹³ • Updates, kick off to orientation events¹⁷ and in-services²⁵ • Pre-operative class education is reviewed verbally, handouts, demonstration, and correct use^{12,22,24,27} • Online education platform to share communication and materials and videos for patients to watch pre-operative bathing^{19,27} • Providing instructions on how to apply CHG^{4,6,12,24,27} and what areas of the body¹² (See reference 12 for Figure 2) <p>Evaluation: Tracking and Surveillance system</p> <ul style="list-style-type: none"> • Implementation of surveillance system^{20,26,27} which included staff tracking, daily auditing, education and providing real time feedback to staff.^{12,13,14,17,18,19,26,27} • Team consistency/compliance adherence⁶ • Transparent reporting of either surgeon or unit SSI⁶ • Compliance with preoperative protocols⁴ <p>Tracking of the completion of checklists forms, collection of pre-operative class attendance to be evaluated and determine staff adherence to CHG bundle.^{12,14,16}</p> <p>Specified preparation utilizing CHG in a bundle approach for specific surgeries such as colorectal and total knee or orthopedic cases.^{13,26}</p> <p>Colorectal surgeries</p>	<p>SSI related Outcomes:</p> <ul style="list-style-type: none"> • Clinical or statistical significance demonstrated that the use of CHG products decreased SSIs.^{12,13,14,16,19, 28} • SSI rates decreased, but not considered statistically significant.^{4,12,21,25} • Full-body preparation was initiated as part of an institutional Enhanced Recovery After Surgery (ERAS) showed reduction in SSI.²⁴ • Combined povidone iodine-alcohol or chlorhexidine-alcohol preparations appear to work better than formulations without alcohol.⁸ <p>Product related Outcomes:</p> <ul style="list-style-type: none"> • Lower SSI rates were associated with: <ul style="list-style-type: none"> ○ Preoperative CHG shower⁶ ○ Combination of CHG/alcohol pre-operatively skin preparation⁶ ○ CHG impregnated wipes¹⁷ <p>Potential Outcomes:</p> <ul style="list-style-type: none"> • Variability in MRSA/methicillin sensitive staph aureus nasal swab for at risk patients.⁶ <p>Evaluation of Outcomes: CHG was evaluated in various ways that include patient compliance and adherence.^{7,10,14,16}</p> <ul style="list-style-type: none"> • Compliance was verified by patients sticking the packaging sticker on the instructions sheet^{10,12} and proper use of cloths,¹⁰ assessed skin swabs to measure concentration of CHG on

- Alcohol based CHG Contraindications to special populations and when not to use²³

Preoperative Surgical Checklists^{1,16,17,25,26,27} include antecedents for SSI and the ability to track if patients prepped the night before and morning of surgery¹⁶ and aspects of the bundled approach.

- CHG bathing¹⁶
- Antibiotic use¹⁶
- Hair clipping¹⁶
- Temperature check¹⁶

- Utilized a 9-component bundle and shown to have improvement in outcomes for prevention of SSIs specifically to colorectal surgeries.²⁶
- Mechanical bowel preparation and use of preoperative oral antibiotics.^{1,26}
- Re-gowning, re-gloving, re-draping, and a new sterile table and instruments were utilized at surgical closure.¹³
- Operating room established scheduled auditing for cleaning.¹³

Total hip and/or arthroplasty surgeries

- Utilized whole body antimicrobial bathing on the day prior to undergoing arthroplasty.³
- Specific preoperative skin agents were used to specific orthopedic cases: CHG, povidone iodine, and isopropyl alcohol.⁸
- Recommended use of chloraprep for shoulder and elbow, foot, ankle, and spine.⁸
- Application of 2% CHG cloth the night before and morning of surgery and either Duraprep or iodine-alcohol skin prep.⁸
- Hip arthroplasty operations were conducted in a positive-pressure operating room without laminar flow and utilizing occlusive and adhesive drapes.¹⁵

Interventions in the **preoperative**,^{1,3,10,12,13,17,21,24}

intraoperative,^{1,5,16,20,27} and **postoperative**^{20,26} **periods** were implemented on the use of CHG.

Preoperative period consisted of preparing the patient prior to surgery, which included:

- Sending text messages and phone calls as reminders for preoperative baths to patients.¹
- Timeliness of when to use CHG prior to surgery varied from the night before and morning of surgery,^{10,13,26} 3 days prior to procedure, 2 days before and morning of surgery,¹² CHG wipes to start one-month before¹⁷
- Application of CHG varied from washing all over their bodies^{10,13,26} to waiting to dry between applications^{12,21,27}

patients' skin, 1 hour prior to 1 hour after, and 24 hours after CHG treatment.¹⁷

- Infection surveillance programs and feedback of SSI rates to surgeons decrease overall SSI.²⁶

Conflicting Outcomes:

- Bundles and multi-modal interventions to prevent SSI do not guarantee success or may not improve outcomes consistently.⁶
- Use of CHG at home may not offer any additional benefit over the current standard preoperative surgical scrub and protocol has no difference in bacterial counts.²¹
- SSIs were significantly higher for the CHG group.²³
- Insufficient evidence exists to recommend universal preoperative use of CHG.²⁶

Study Limitations:

- Varying compliance of patients with recommended preoperative protocols for skin antisepsis.⁴
- Inadequate control for possible confounding variables variation in methods of applying antiseptics.⁴
- Insufficient sample size in some early studies.⁴

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	<ul style="list-style-type: none">• Supplies given to patient during preoperative visit²⁴• Hair removal be left in place as part of the SSI bundle^{5,6,26} and suggests that if hair must be removed, remove hair outside of operative room, and recommended to do hair clipping versus shaving.⁶• Antibiotic prophylaxis as part of SSI bundle^{2,19, 20}• Differing evidence on full body wash using antimicrobial soap night before planned surgery.^{2,14,20,27} <p><u>Intraoperative period</u> utilized CHG along with other initiatives within the surgical environment included:</p> <ul style="list-style-type: none">• Hand antisepsis, operative wound, intraoperative temperature control as part of a preventive SSI bundle.^{1,16,20,27}• Use of a checklist to ensure items initiated such as antibiotics given shortly after surgical incision,^{16,26} hair clipping,^{6,16} and maintenance of body temperature of at least 36.0c with the use of warming devices.^{1,16,20}• Operating Room (OR) traffic control,^{5,26} and OR maintenance, care, and disinfection practices.² <p><u>Postoperative period</u> after surgery care included:</p> <ul style="list-style-type: none">• Surgical wound care and drains²⁰• Patient education specific to discharge²⁰• Patients were seen in an outpatient clinic and evaluated for signs and symptoms of infection^{20, 26}	
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Additional Regulatory/Professional Organizations References

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Evidence Search Strategies: A review of the literature on the clinical inquiry was conducted from May 2022 to July 2022. This review examined the quantity, quality, and consistency of the evidence for successful implementation and protocols of CHG bathing or wipes for prevention of surgical site infections. In addition, cited structures, processes, outcomes related to CHG use and related outcomes were drawn from the literature.

A review of the evidence was conducted via electronic database search from 2017-2022 which included PubMed, Cochrane Library, CINAHL, ClinicalKey, and Google Scholar. Search terms included CHG bathing wipes, adult elective surgery, chloraprep, first aid wound care, SAGE skin prep, perioperative prep cloths, midline baths, rinse free bath wipes, chlorhexidine broad spectrum antiseptic.

Inclusion criteria for this review were articles related to adults >18 years age, elective surgery (total joint arthroplasty, ob/gyn/non-pregnant related general surgeries, colorectal, vascular, acute care setting, use of CHG bath or wipes, description guideline, protocol for structures and processes, outcomes to include: prevention of SSI, types of SSIs, how to use, apply, before surgery, done by nurse or other healthcare worker, use of CHG in bundle versus separate.

Exclusion criteria for articles were not adults, not elective surgery (c-section, cardiac, head and neck, ophthalmology, minor skin incisions, catheter insertions, catheter venous surgeries, setting other than acute care, not use of CHG. We did however save articles in a separate folder found in our search but excluded as it did not meet the clinical focus which included topics on: CLABSI, C-Section, Decolonization, S. aureus, antibiotic use Mupirocin.

This review yielded 122 relevant hits after careful examination of the literature and multiple rounds of reviewing the full text, 29 articles were identified as the final articles that pertained to the clinical area of inquiry, which included regulatory and professional organizational references as it was cited in several of the articles. References were ranked using the Academy of Evidence-Based Practice Evidence Leveling System (Page 9) and graded using the Johns Hopkins Appraisal tools, 2017.

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Academy of Evidence Based Practice® (EBP) Evidence Leveling System (ELS)			
LEVEL	DESCRIPTION	RELEVANT ARTICLES	ARTICLE NUMBER
A	Meta-analysis of multiple large sample or small sample* randomized controlled studies, or meta-synthesis of qualitative studies with results that consistently support a specific action, intervention, or treatment	1	27
B	Well-designed controlled studies, both randomized and nonrandomized, prospective or retrospective studies, and integrative reviews with results that consistently support a specific action, intervention, or treatment	8	8,14,15,16,20,21,23,24,
C	Qualitative studies, descriptive or correlational studies, integrative reviews, systematic reviews, or randomized controlled trials with inconsistent results	8	3,4,6,7,10,12,18,19
D	Peer-reviewed professional organizational standards, with clinical studies to support recommendations		
E	Theory-based evidence from expert opinion or multiple case reports, case studies, consensus of experts, and literature reviews	12	1,2,5,9,11,13,17,22,25,26,28,29
MA	Manufacturer's recommendation; Anecdotes		
LR	Laws and Regulations (local, state, federal; licensing boards; accreditation bodies, etc.)		
Total		29	29

* A large sample has adequate power to detect the observed effect with confidence (as seen in significant Confidence Intervals). A small sample may lack confidence in the power of the desired effect (Polit & Beck, 2008)

Designed by Emma M. Cuenca and Cecelia L. Crawford, Academy of EBP; ©Kaiser Permanente SCAL Regional Nursing Research Program, May 2011. Adapted from AACN Evidence Leveling System (2009) and Canadian Medical Association & Centre for Evidence-Based Medicine, Levels of the Evidence (2001)

Johns Hopkins Evidence-Based Practice Appraisal Tools

High Quality: #27

(Consistent, generalizable results; sufficient sample size for study design; adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review including thorough reference to scientific evidence **OR** expertise clearly evident; draws definitive conclusions; provides scientific rationale; thought leader in the field.)

Moderate Quality: #3,4,6,7,8,10,12,14,15,16,18,19,20,21,23,24

(Reasonably consistent results; sufficient sample size for study design; some control, and fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review including references to scientific evidence **OR** expertise appears credible; draws definitive conclusions; provides logical argument for opinions.)

Low Quality: #1,2,5,9,13,17,22,25

(Little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn **OR** expertise is not discernable or is dubious; conclusions cannot be drawn.)

Final Summary Evidence Grade = Moderate Quality

Search Date(s): May 2022 to July 2022

Clinical question: In adults undergoing elective surgery, what is the quantity, quality, and consistency of the evidence for successful implementation and protocols of CHG bathing or wipes for prevention of surgical site infections vs. non CHG bathing or wipes?

Database	Key Word(s) and/or Controlled Vocabulary Terms [#]	Total References Identified (hits)	Relevant References	Duplicate Articles	Selected for Review	Excluded	Final Total
PubMed Years: No limit	CHG wipes	26	5	0	5	5	0
PubMed Years: 5 years	CHG wipes	8	1	8	1	0	1
PubMed Years: 5 years	CHG wipes Adults	3	1	3	1	0	1
PubMed Years: 5 years	CHG wipes Elective Surgical Patients	0	0	0	0	0	0
PubMed Years: 5 years	CHG wipes Surgical Patients	2	1	1	1	0	1
PubMed Years: 2017-2022	CHG SSI	3	2	1	1	0	1
Clinical Key Years: all	CHG bath	110	27	0	0	0	0
Clinical Key Years: 2017-2022	CHG bath, Less than 5 years	57	26	11	6	0	6
CINAHL Years: 2017-2022	(Chlorhexidine OR CHG) AND Bathing & baths AND Surgical wound Infection Also: chlorhexidine AND bath AND surgical site infection	12	12	2	10	4	6

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Cochrane Library Years: 2017-2022	CHG baths Surgical site Chlorhexidine baths	2	0	2	0	0	0
Google Scholar Years: 2017-2022	CHG wipes, Surgical site infection	1140	36	0	36	27	9
Google Scholar Years: 2017-2022	CHG protocol AND nursing AND SSI	11,500 8 pages in hitting repeats	7	2	5	5	0
Regulatory/Professional Organizations	Surgical site infection prevention	4	4	0	4	0	4
TOTALS		12,867	122	30	70	41	<u>29</u>

Clinical Question				
Population and/or Patient(s)	Intervention/Interest Area	Comparison Intervention (Often current practice)	Outcome	Time Period (If Applicable; Optional)
P: Adults >18 years age (adult elective surgeries i.e., total joint arthroplasty, ob/gyn/non-pregnant related, general surgeries, colorectal, vascular)	I: CHG bathing or wipes use	C: non CHG bathing or wipes	O: prevention SSIs, types of SSIs, how to use, apply, before surgery, done by registered nurse or other healthcare worker; use of CHG in bundle versus separate	T: Hospital stay
Final Clinical Question: In adults undergoing elective surgery, what is the quantity, quality, and consistency of the evidence for successful implementation and protocols of CHG bathing or wipes for prevention of surgical site infections vs. non CHG bathing or wipes?				

Searchable Question
Key Search Terms: CHG bath wipes, adult elective surgery, chloraprep, first aid wound care, SAGE skin prep, perioperative prep cloths, midline baths, rinse free bath wipes, chlorhexidine broad spectrum antiseptic
Inclusion Criteria: adults >18 years age, elective surgery (total joint arthroplasty, ob/gyn/non-pregnant related, general surgeries colorectal, vascular), acute care setting, use of CHG bath or wipes, description guideline protocol, structures, processes, outcomes: prevention of SSI, types of SSIs, how to use, apply, before surgery, done by registered nurse or other healthcare worker; use of CHG in bundle versus separate
Exclusion Criteria: not adults, not elective surgery i.e. (c-section, cardiac, head and neck, ophthalmology, minor skin incisions, catheter insertions, catheter venous surgeries, setting other than acute care, not use of CHG.
Limiters (Open year or year ranges, age ranges, and language, etc.): nothing over 5 years- 2017-2022, okay to include international studies, English, adults >18 years older
Databases: PubMed; Clinical Key; CINAHL; Cochrane Library,
Web Browsers: Google Scholar

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Purpose/intended Audience

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