

**CADTH RAPID RESPONSE REPORT:
SUMMARY WITH CRITICAL APPRAISAL**

Preoperative Interventions for the Prevention of Surgical Site Infections: A Review of Guidelines

Service Line: Rapid Response Service
Version: 1.0
Publication Date: June 18, 2020
Report Length: 32 Pages

Authors: Yan Li, Melissa Severn

Cite As: Preoperative interventions for the prevention of surgical site infections: a review of guidelines. Ottawa: CADTH; 2020 Jun. (CADTH rapid response report: summary with critical appraisal).

ISSN: 1922-8147 (online)

Disclaimer: The information in this document is intended to help Canadian health care decision-makers, health care professionals, health systems leaders, and policy-makers make well-informed decisions and thereby improve the quality of health care services. While patients and others may access this document, the document is made available for informational purposes only and no representations or warranties are made with respect to its fitness for any particular purpose. The information in this document should not be used as a substitute for professional medical advice or as a substitute for the application of clinical judgment in respect of the care of a particular patient or other professional judgment in any decision-making process. The Canadian Agency for Drugs and Technologies in Health (CADTH) does not endorse any information, drugs, therapies, treatments, products, processes, or services.

While care has been taken to ensure that the information prepared by CADTH in this document is accurate, complete, and up-to-date as at the applicable date the material was first published by CADTH, CADTH does not make any guarantees to that effect. CADTH does not guarantee and is not responsible for the quality, currency, propriety, accuracy, or reasonableness of any statements, information, or conclusions contained in any third-party materials used in preparing this document. The views and opinions of third parties published in this document do not necessarily state or reflect those of CADTH.

CADTH is not responsible for any errors, omissions, injury, loss, or damage arising from or relating to the use (or misuse) of any information, statements, or conclusions contained in or implied by the contents of this document or any of the source materials.

This document may contain links to third-party websites. CADTH does not have control over the content of such sites. Use of third-party sites is governed by the third-party website owners' own terms and conditions set out for such sites. CADTH does not make any guarantee with respect to any information contained on such third-party sites and CADTH is not responsible for any injury, loss, or damage suffered as a result of using such third-party sites. CADTH has no responsibility for the collection, use, and disclosure of personal information by third-party sites.

Subject to the aforementioned limitations, the views expressed herein are those of CADTH and do not necessarily represent the views of Canada's federal, provincial, or territorial governments or any third party supplier of information.

This document is prepared and intended for use in the context of the Canadian health care system. The use of this document outside of Canada is done so at the user's own risk.

This disclaimer and any questions or matters of any nature arising from or relating to the content or use (or misuse) of this document will be governed by and interpreted in accordance with the laws of the Province of Ontario and the laws of Canada applicable therein, and all proceedings shall be subject to the exclusive jurisdiction of the courts of the Province of Ontario, Canada.

The copyright and other intellectual property rights in this document are owned by CADTH and its licensors. These rights are protected by the Canadian *Copyright Act* and other national and international laws and agreements. Users are permitted to make copies of this document for non-commercial purposes only, provided it is not modified when reproduced and appropriate credit is given to CADTH and its licensors.

About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

Funding: CADTH receives funding from Canada's federal, provincial, and territorial governments, with the exception of Quebec.

Questions or requests for information about this report can be directed to Requests@CADTH.ca

Abbreviations

AGREE II	Appraisal of Guidelines for Research & Evaluation 2
CDC	Centers for Disease Control and Prevention
CHG	Chlorhexidine gluconate
GRADE	Grading of Recommendations, Assessment, Development, and Evaluation
MRSA	methicillin-resistant <i>Staphylococcus aureus</i>
NICE	National Institute for Health and Care Excellence
RCT	Randomized controlled trial
<i>S. aureus</i>	<i>Staphylococcus aureus</i>
SR	Systematic Review
SSI	Surgical site infection

Context and Policy Issues

Defined as postoperative infections of an incision, organ, or space,¹ surgical site infections (SSIs) are the most common health care-related infections.² Occurring in up to 5% of all surgeries, SSIs affect approximately 26,000 to 65,000 Canadian patients annually.² Due to increased hospital stays and readmission rates, SSIs cost the health care system between \$350,000 to \$1 million each year.² To help reduce morbidity, extended hospitalization, and death, infection control measures have been implemented in surgical settings.²

Surgical infection control measures include staff precautions such as practicing hand hygiene and using barrier devices, and patient-specific perioperative infection control interventions that may include nasal decolonization for *Staphylococcus aureus* (*S. aureus*), preoperative washing, skin antisepsis, hair removal, glucose control, bowel preparation, and antibiotic prophylaxis.³ It has been shown that almost half of SSIs may be prevented by applying evidence-based strategies.⁴ SSI prevention measures can be bundled to promote staff and patient adherence, but there is a lack of consensus regarding the appropriate components of an infection control bundle.³

This report is an upgrade from a previous CADTH Reference List report published in 2020, and includes one of the research questions from that report.⁵ The aim of the current report is to summarize and critically appraise the relevant evidence-based guidelines identified in the previous report⁵ regarding preoperative interventions for the prevention of SSIs.

Research Question

What are the evidence-based guidelines regarding preoperative interventions for the prevention of surgical site infections?

Key Findings

Six evidence-based guidelines regarding the use of preoperative interventions for the prevention of surgical site infections were included in this report. Four included guidelines were of high quality, while two guidelines were of moderate quality due to unclear reporting of methodological details.

Of these guidelines, for the purpose of infection prevention, four recommend nasal decolonization with mupirocin, body washing with chlorhexidine gluconate, and bathing with antimicrobial or non-antimicrobial soap prior to surgery. Furthermore, four guidelines recommend the use of alcohol-based solutions for skin antiseptic preparation but

recommend against hair removal unless absolutely required. Three guidelines recommend mechanical bowel preparation with oral antibiotics for elective colorectal surgery, while one guideline recommends against its use with no mention of specific indications or concurrent antibiotic use. Two guidelines made recommendations on perioperative blood glucose control with different target levels. Four guidelines made recommendations on the optimal time for administering antibiotic prophylaxis (i.e., at one or two hours before incision, or at the time of anesthesia). Overall, these recommendations ranged from conditional to strong and were based on evidence that ranged in quality from very low to high (when reported).

Methods

Literature Search Methods

The literature search that was conducted for a previous CADTH report⁵ was used for this report. A limited literature search was conducted by an information specialist on key resources including Medline via Ovid, the Cochrane Library, the University of York Centre for Reviews and Dissemination (CRD) databases, the websites of Canadian and major international health technology agencies, as well as a focused internet search. The search strategy was comprised of both controlled vocabulary, such as the National Library of Medicine’s MeSH (Medical Subject Headings), and keywords. The main search concepts in the previous CADTH report⁵ were surgical site infections in the preoperative setting. Methodological filters were applied to limit the retrieval to guidelines only. The search was also limited to English language documents published between January 1, 2015 and February 27, 2020.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Surgical patients, any age
Intervention	Preoperative bundle components for the prevention of surgical site infections (e.g., nasal decolonization interventions, chlorhexidine gluconate washes/wipes/bathing, preoperative washing with other methods or agents, oral antibiotics)
Comparator	Not applicable
Outcomes	Recommendations regarding preoperative interventions for the prevention of surgical site infections
Study Designs	Evidence-based guidelines

Exclusion Criteria

Articles were excluded if they did not meet the selection criteria outlined in Table 1, they were duplicate publications, or were published prior to 2015. Guidelines with unclear methodology were excluded.

Critical Appraisal of Individual Studies

The included guidelines were critically appraised by one reviewer using the Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument⁶ as a guide. Summary scores were not calculated for the included studies; rather, a review of the strengths and limitations of each included guideline were described narratively.

Summary of Evidence

Quantity of Research Available

A total of 354 citations were identified in the literature search. Following screening of titles and abstracts, 350 citations were excluded and 4 potentially relevant reports from the electronic search were retrieved for full-text review. Eight potentially relevant publications were retrieved from the grey literature search for full-text review. Of these potentially relevant articles, six publications were excluded for various reasons, and six evidence-based guidelines met the inclusion criteria and were included in this report. Appendix 1 presents the PRISMA⁷ flowchart of the study selection.

Additional publications of potential interest are provided in Appendix 5.

Summary of Study Characteristics

Six evidence-based guidelines were identified and included in this report.^{1,8-12} Detailed characteristics of the guidelines are available in Appendix 2.

Study Design

Six evidence-based guidelines were identified regarding preoperative interventions for the prevention of SSIs.^{1,8-12} Two of these guidelines were published in 2019 and were developed by the Asia Pacific Society of Infection Control (APSIC)¹¹ and the National Institute for Health and Care Excellence (NICE).⁹ Two guidelines were published in 2017 and were developed by the American College of Surgeons (ACS) & Surgical Infection Society¹² and the US Centers for Disease Control and Prevention (CDC).¹ The guidelines developed by the WHO⁸ and the Ministry of Health Malaysia¹⁰ were published in 2016 and 2015, respectively.

The CDC guidelines were informed by a SR which included systematic searches from 1998 through April 2014 for relevant randomized controlled trials (RCTs) and SRs.¹ The WHO guidelines were informed by a SR which included systematic searches between December 2013 and October 2015 for RCTs and non-randomized studies.⁸ The NICE guidelines were informed by systematic searches on March 15, 2018 and screened for RCTs and SRs of RCTs.⁹ The Ministry of Health Malaysia guidelines were informed by systematic searches from 2003 onwards and screened for SRs, RCTs, and non-randomized studies.¹⁰ The APSIC guidelines¹¹ were informed by computerized literature searches on PubMed and a review of other published guidelines (e.g., CDC, WHO), while the ACS guidelines¹² were informed by literature searches on PubMed.

The NICE,⁹ CDC,¹ and WHO⁸ guidelines used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to evaluate the quality of the evidence. The NICE guideline graded the quality of evidence from very low to high, and reflected the strength of recommendations in the wording (i.e., “offer/advise” was used for strong recommendations with clear evidence of benefit, while “consider” was used if the

evidence was less certain).⁹ The CDC guideline graded the quality of evidence from C (i.e., required by state/federal regulation) to A (i.e., high to moderate-quality evidence), and classified the strength of recommendation from no recommendation to strong recommendation.¹ The WHO guideline graded the quality of evidence from very low to high, and classified the strength of recommendation as conditional or strong.⁸

The authors of the APSIC guideline assessed the quality of evidence as category III (i.e., evidence from opinions or expert committee reports) to category I (i.e., evidence from \geq one RCT), and rated the strength of recommendation from E (i.e., good evidence to recommend against use) to A (i.e., good evidence to recommend use).¹¹ The guideline development group for the Ministry of Health Malaysia guideline used the US/Canadian Preventive Services Task Force guide to classify the quality of evidence from category III (i.e., evidence from opinions or expert committee reports) to category I (i.e., evidence from \geq one RCT), and rated the strength of recommendation using the Scottish Intercollegiate Guidelines Network system from C (i.e., evidence from opinions or expert committee reports) to A (i.e., evidence from \geq one meta-analysis, SR, or RCT).¹⁰ The authors of the ACS guideline did not report assessment of the quality of the evidence or grade the strength of the recommendations.¹²

The rating systems for quality of evidence and strength of recommendations, if available, are reported in Appendix 4. Decisions on the recommendations were reached through consensus in five guidelines,^{1,8-10,12} while the methodology for formulating the recommendations was not reported in the APSIC guideline.¹¹

Country of Origin

The WHO guideline⁸ is meant to apply globally, while the ACS¹² and CDC¹ guidelines are meant to apply to the United States. The other three guidelines are meant to apply to the Asia Pacific region,¹¹ the United Kingdom,⁹ and Malaysia.¹⁰

Patient Population

The target population covered by the six guidelines was patients undergoing surgical procedures.^{1,8-12} The Ministry of Health Malaysia guideline specifically focused on patients undergoing oral and maxillofacial surgical procedures.¹⁰ The intended users of four guidelines are surgical staff who provide care for surgical patients.^{1,8-12} In two guidelines, the intended users were not explicitly stated, but they appear to be intended for surgical staff.^{11,12} The CDC,¹ WHO,⁸ and Ministry of Health Malaysia¹⁰ guidelines are also intended for professional societies and organizations, anesthesiologists and pharmacists, and dental practitioners and educators, respectively.

Interventions and Comparators

The six guidelines considered a variety of preoperative interventions that can be used to help prevent SSIs.^{1,8-12} These included preoperative body washing, mechanical bowel preparation, antibiotic prophylaxis, hair removal, skin antiseptic, glucose control, and nasal decolonization.

Outcomes

All six guidelines considered the incidence of SSIs.^{1,8-12} Three guidelines also considered SSI-related deaths,^{1,8,9} and two guidelines^{1,9} considered duration of hospital stay, hospital readmission, antimicrobial resistance, and adverse events. Additionally, the NICE guideline

considered postoperative antibiotic use, infection complications, and other nosocomial infections as outcomes.⁹

Summary of Critical Appraisal

Additional details regarding the AGREE II evaluation of the included guidelines are provided in Appendix 3.

The guideline development groups for all six guidelines were comprised of experts from multidisciplinary areas. All guidelines provided a clear description of their objectives, specified the target populations, and provided unambiguous and easily identifiable recommendations.^{1,8-12} The views of the funding sources did not appear to have influenced the guidelines' contents.^{1,8-12} However, the views and preferences of the target population were not sought and the target users of the guidelines were not explicitly defined in two guidelines.^{11,12}

With respect to rigour of guideline development, the APSIC¹¹ and the ACS¹² guideline provided brief details of their methodology without search timeframes. Additionally, the authors of these two guidelines conducted literature searches in one database (i.e., PubMed), which may have resulted in omission of relevant information. The methodology for formulating the recommendations was not reported in the APSIC guideline.¹¹ The authors of the ACS guideline did not assess the quality of the evidence or grade the strength of the recommendations.¹² In the NICE guideline, the supporting evidence used to inform the recommendations on preoperative bathing, hair removal, mechanical bowel preparation, and antibiotic prophylaxis was not updated since the original 2008 guideline publication.¹³ Furthermore, the quality of the aforementioned supporting evidence was not available online. The recommendations on preoperative washing, nasal decolonization, and skin antisepsis were updated in the current NICE guideline.⁹ All six guidelines were externally reviewed prior to publication.^{1,8-12} However, three guidelines did not explicitly describe procedures for guideline updates.¹⁰⁻¹²

In terms of guideline applicability, all six guidelines presented monitoring criteria for their recommendations. The NICE⁹ CDC,¹ and WHO⁸ guideline described facilitators or barriers to their application and provided tools for putting recommendations into practice. Four guidelines did not consider the potential resource implications of applying the recommendations.^{1,10-12} Finally, the six guidelines were developed for use in the Asia Pacific region,¹¹ Malaysia,¹⁰ United Kingdom,⁹ United States,^{1,12} or globally;⁸ therefore, the generalizability of the recommendations to the Canadian context is unclear.

Summary of Findings

The recommendations regarding the use of preoperative interventions for the prevention of SSIs from the six included evidence-based guidelines are highlighted below.^{1,8-12} Detailed summaries of the recommendations and the evidence on which the recommendations were based are presented in Appendix 4.

Guidelines

Recommendations Regarding *S. aureus* and/or Antimicrobial Resistance Screening

Two identified evidence-based guidelines provided recommendations regarding preoperative *S. aureus* and/or antimicrobial resistance screening.^{11,12} The APSIC and ACS guidelines recommend that hospitals evaluate their baseline *S. aureus*, *methicillin-resistant*

S. aureus (MRSA), and SSI rates to determine if the implementation of *S. aureus* screening and decolonization procedures is appropriate.^{11,12} Furthermore, the APSIC guideline recommends that surveillance on mupirocin resistance rates should be taken into consideration when implementing decolonization measures.¹¹ The APSIC recommendations¹¹ were rated B in strength and were based on level II evidence, while the ACS guideline¹² did not report the recommendation strength or evidence level.

Recommendations Regarding Nasal Decolonization and Preoperative Body Washing

Four identified evidence-based guidelines provided recommendations regarding nasal decolonization,^{8,9,11,12} and five provided recommendations on preoperative body washing.^{1,8,9,11,12}

Regarding nasal decolonization, the NICE guideline recommends considering using nasal decolonization with mupirocin along with preoperative body washing with chlorhexidine gluconate (CHG) if *S. aureus* is a likely cause of SSIs (recommendation strength: consider; evidence level: very low to high).^{9,14} The APSIC and WHO guidelines recommend nasal decolonization with mupirocin 2% ointment, with or without CHG body washing, for cardiothoracic and orthopedic surgical patients with known *S. aureus* nasal carriage (recommendation strength: A or strong; evidence level: I or moderate).^{8,11} The WHO guideline states that this recommendation can also be considered for other surgical procedures (recommendation strength: conditional; evidence level: moderate).⁸ The ACS guideline recommends clinicians consider using nasal mupirocin, with or without CHG body washing (strength of recommendation and level of evidence not reported).¹² For SSI bundles to be effective, interventions should be adhered to and performed close to surgery date (strength of recommendation and level of evidence not reported).¹² The CDC did not make recommendations regarding nasal decolonization.¹

Regarding preoperative body washing, four guidelines (APSID, NICE, CDC, and WHO) recommend surgical patients bathe with soap before their procedure.^{1,8,9,11} These recommendations ranged from conditional to strong and were based on evidence that ranged in quality from very low to moderate where reported (evidence level not reported in the NICE guideline).^{1,8,9,11} Three guidelines (APSID, CDC, and WHO) state that patients can use antimicrobial or non-antimicrobial soap for their preoperative bath (recommendation strength ranged from conditional to strong; evidence level ranged from very low to moderate).^{1,8,11} Due to uncertainty in the available evidence, the CDC and WHO were not able to make recommendations regarding the use of CHG washcloths.^{1,8} Furthermore, the ACS guideline highlighted that body washing with CHG, when not part of an SSI bundle, reduces skin pathogen levels but not SSI rates (strength of recommendation and level of evidence not reported).¹²

Recommendations Regarding Skin Antiseptic Preparation

Four identified evidence-based guidelines provided recommendations regarding preoperative skin antisepsis.^{8,9,11,12} Unless contraindicated, alcohol-based skin antiseptic solutions should be used to prepare the surgical site prior to incision as per APSIC, NICE, WHO, and ACS guidelines (recommendation strength was A or strong; evidence level ranged from very low to high where reported; recommendation strength and evidence level not reported in the ACS guideline).^{8,9,11,12} Contraindications to the use of alcohol-based solutions may include surgical sites close to or involving mucous membrane,^{9,12} cornea,¹² or ear.¹² Three guidelines made recommendations on the specific types of skin antiseptic solutions to use.^{8,9,12} As the first choice for skin antisepsis, the NICE⁹ and WHO⁸ guidelines recommend using alcohol-based CHG solutions, while the ACS¹² guideline recommends

alcohol-based CHG or iodine solutions (recommendation strength was strong; evidence level ranged from very low to high where reported; recommendation strength not reported in the ACS and NICE guidelines and evidence level not reported in the ACS guideline). If alcohol-based CHG solutions are contraindicated, the NICE guideline recommends using alcohol-based povidone-iodine, aqueous CHG, or aqueous povidone-iodine solutions (strength of recommendation: not reported; evidence levels: very low to high).⁹ Similarly, if alcohol-based solutions are contraindicated, the ACS guideline also recommends aqueous CHG over the use of aqueous iodine solutions (strength of recommendation and level of evidence not reported).¹²

Recommendations Regarding Hair Removal

Four identified evidence-based guidelines provided recommendations regarding preoperative hair removal.^{8,9,11,12} The APSIC, NICE, ACS, and WHO guidelines recommend that hair should not be removed unless absolutely needed due to interference with the surgical procedure (recommendation strength was B or strong; evidence level ranged from III to moderate where reported; recommendation strength not reported in the ACS guideline and evidence level not reported in the ACS and NICE guidelines).^{8,9,11,12} Specifically, clippers should be used while razors should be avoided as per APSIC, NICE, ACS, and WHO guidelines (recommendation strength was A or strong; evidence level was I or moderate where reported; recommendation strength not reported in the ACS guideline and evidence level not reported in the ACS and NICE guidelines).^{8,9,11,12} As for the timing of hair removal, the NICE guideline⁹ recommends that it be performed on the day of surgery (recommendation strength: strong; evidence level: not reported), while the APSIC guideline¹¹ states that no recommendation can be made (recommendation strength: C; evidence level: III).

Recommendations Regarding Mechanical Bowel Preparation

Four identified evidence-based guidelines provided recommendations regarding preoperative mechanical bowel preparation.^{8,9,11,12} The APSIC, ACS, and WHO guidelines recommend the use of mechanical bowel preparation combined with oral antibiotics for elective colorectal surgical patients (recommendation strength A or conditional; evidence level was I or moderate where reported; recommendation strength and evidence level not reported in the ACS guideline),^{8,11,12} and the WHO guideline recommends against using mechanical bowel preparation alone without oral antibiotics for this population (recommendation strength: strong; evidence level: moderate). However, the NICE guideline recommends against the routine use of mechanical bowel preparation to help prevent SSIs, but did not specify the specific indication or whether this was irrespective of oral antibiotic use (recommendation strength: strong; evidence level: not reported).⁹

Recommendations Regarding Glucose Control

Two identified evidence-based guidelines provided recommendations regarding preoperative glucose control immediately prior to surgery.^{1,12} The ACS guideline recommends maintaining perioperative blood glucose levels between 110 to 150 mg/dL (6.1 to 8.3 mmol/L) for all patients living with or without diabetes and less than 180 mg/dL (10.0 mmol/L) for patients undergoing cardiac surgery (strength of recommendation and level of evidence not reported).¹² Furthermore, the ACS guideline states that blood glucose targets of less than 110 mg/dL (6.1 mmol/L) increase the risk of hypoglycemia without reducing the rates of SSIs (strength of recommendation and level of evidence not reported).¹² The CDC guideline recommends maintaining blood glucose levels under 200 mg/dL (11.1 mmol/L) without regard for diabetes status (recommendation strength: strong;

evidence level: A).¹ Due to the lack of evidence from RCTs, the CDC was not able to make recommendations regarding lower glucose targets, or regarding the optimal timing, duration, or delivery method of glucose control interventions.¹

Recommendations Regarding Antibiotic Prophylaxis

Six identified evidence-based guidelines provided recommendations regarding preoperative antibiotic prophylaxis.^{1,8-12}

The APSIC and ACS guidelines recommend that, when indicated, antibiotic prophylaxis should be administered within one hour prior to incision, except for vancomycin and fluoroquinolones that need to be given within two hours before incision (recommendation strength: A; evidence level: I where reported; recommendation strength and evidence level not reported in the ACS guideline). The WHO guideline recommends antibiotic prophylaxis be administered within two hours before incision with consideration of the half-life of the antibiotic (recommendation strength: strong; evidence level: moderate).⁸ The NICE guideline recommends considering the administration of a dose of antibiotic prophylaxis intravenously when anesthesia is started (recommendation strength: consider; evidence level: not reported).⁹ The CDC guideline recommends that the administration of parenteral antibiotic prophylaxis should be timed to ensure bactericidal concentration is reached when the incision is made (recommendation strength: strong; evidence level: low to very low-quality); however, no recommendation could be made on specific timing.¹

The CDC guideline recommends that the indication to use parenteral antibiotic prophylaxis should be based on published guidelines (recommendation strength: strong; evidence level: low to very low-quality).¹ Specifically, the CDC recommends that parenteral antibiotic prophylaxis should be given for all cesarean sections (recommendation strength: strong; evidence level: high).¹ The NICE guideline recommends the administration of antibiotic prophylaxis before contaminated procedures, clean-contaminated procedures, or clean procedures that involve prosthesis or implant placement (recommendation strength: strong; evidence level: not reported).⁹ However, the NICE guideline recommends against the routine use of antibiotic prophylaxis for clean non-prosthetic uncomplicated procedures (recommendation strength: strong; evidence level: not reported).⁹

The NICE⁹ guideline recommends that the choice of antibiotic should take into consideration local antibiotic formularies and possible side effects (recommendation strength: strong; evidence level: not reported), while the ACS guideline¹² recommends taking into account the type of surgical procedure and most likely etiological pathogens (strength of recommendation and level of evidence were not reported). Although the CDC guideline¹ was not able to make a recommendation on the effect of weight-adjusted parenteral antibiotic prophylaxis dosing due to the lack of RCTs, the ACS guideline recommends that antibiotic prophylaxis dosing should be weight-adjusted (strength of recommendation and level of evidence was not reported).¹²

The sixth guideline published by the Ministry of Health Malaysia focused on the use of antibiotic prophylaxis for the prevention of oral surgery-related SSIs.¹⁰ The guideline makes grade A recommendations stating that antibiotic prophylaxis is indicated for dental implants (evidence level: I), bone grafts (evidence level: I), clean-contaminated procedures (evidence levels: I, II-2, and III), and head and neck cancers (evidence levels: II-1, II-3, and III).¹⁰ The guideline makes grade B recommendations stating that antibiotic prophylaxis is indicated for medically compromised patients (evidence levels: I, II-2, and III), extended duration procedures (evidence levels: II-2 and III), and facial bone fracture procedures

(evidence levels: II-2, II-3, and III).¹⁰ The guideline makes grade B recommendations stating that amoxicillin, penicillin G, or clindamycin (evidence levels: I, II-1, II-3, and III) should be given within one hour before incision (evidence levels: II-2, II-3, and III) and at the full therapeutic dose (evidence levels: II-2 and II-3).¹⁰ Alternatively, cloxacillin, cefazolin or clindamycin should be administered if the procedure involves the skin (recommendation strength: C; evidence level: III).¹⁰

Limitations

One evidence-based guideline was created by oral surgeons and dental health specialists and was focused on the prevention of oral surgery-related SSIs; therefore, these recommendations may not be generalizable to other surgical procedures.¹⁰ Apart from one guideline that is intended for global use,⁸ the other five guidelines were developed for use in the Asia Pacific region,¹¹ Malaysia,¹⁰ United Kingdom,⁹ or United States.^{1,12} It is uncertain if these guidelines developed outside of Canada are generalizable to the Canadian context. Thus, considering the limitations mentioned, the recommendations summarized in this report need to be interpreted with caution.

Conclusions and Implications for Decision or Policy Making

This report provides a summary and critical appraisal of guidelines identified in a previous CADTH Reference List report;⁵ a companion CADTH report regarding the clinical effectiveness and cost-effectiveness of pre-operative nasal decolonization (with or without chlorhexidine gluconate washes or wipes) for the prevention of surgical site infections is published elsewhere.¹⁵ This report included six evidence-based guidelines regarding the use of preoperative interventions for the prevention of SSIs.^{1,8-12} One guideline published by the University of Toronto's Best Practice in Surgery¹⁶ was excluded from this report due to unclear methodology (see Appendix 5). Informed partly by the WHO⁸ and NICE⁹ guidelines, this guideline included similar recommendations on nasal decolonization, skin antisepsis, hair removal, and antibiotic prophylaxis tailored for University of Toronto affiliated hospitals.¹⁶

Of the included guidelines, four recommend nasal decolonization with mupirocin and body washing with CHG.^{8,9,11,12} Additionally, four guidelines recommend bathing with antimicrobial or non-antimicrobial soap before surgery.^{1,8,9,11} Two guidelines recommend taking into account the rates of *S. aureus*, MRSA, SSIs, and/or mupirocin resistance in the implementation of screening and decolonization measures.^{11,12} Four guidelines recommend alcohol-based solutions for skin antisepsis and recommend against hair removal.^{8,9,11,12} Three guidelines^{8,11,12} recommend mechanical bowel preparation with oral antibiotics for elective colorectal surgery, while one guideline⁹ recommends against its routine use but did not specify for which indications and did not mention oral antibiotic use. Two guidelines recommend maintaining perioperative blood glucose levels at 110 to 150 mg/dL (6.1 to 8.3 mmol/L)¹² or below 200 mg/dL (11.1 mmol/L)¹ without regard for diabetic status. Four guidelines recommend administering antibiotics at one^{11,12} or two⁸ hours prior to incision, or at the time of anesthesia.⁹ Focusing on antibiotic prophylaxis for oral surgical procedures, one guideline recommends the use of amoxicillin, penicillin G, or clindamycin, or cloxacillin, cefazolin, or clindamycin for procedures involving the skin.¹⁰

Overall, these recommendations ranged from conditional to strong and were based on evidence that ranged in quality from very low to high where reported (recommendation strength and/or evidence level was not reported for all ACS recommendations and some

NICE recommendations).^{1,8-12} In general, there was agreement across guidelines for the use of preoperative interventions for the prevention of SSIs; however, the variation in the strengths of recommendations and heterogeneity in the quality of evidence should be considered when interpreting the findings of this report. Guidelines developed with rigorous methodology that are specific to the Canadian context would provide additional guidance in preventing SSIs in a more local context.

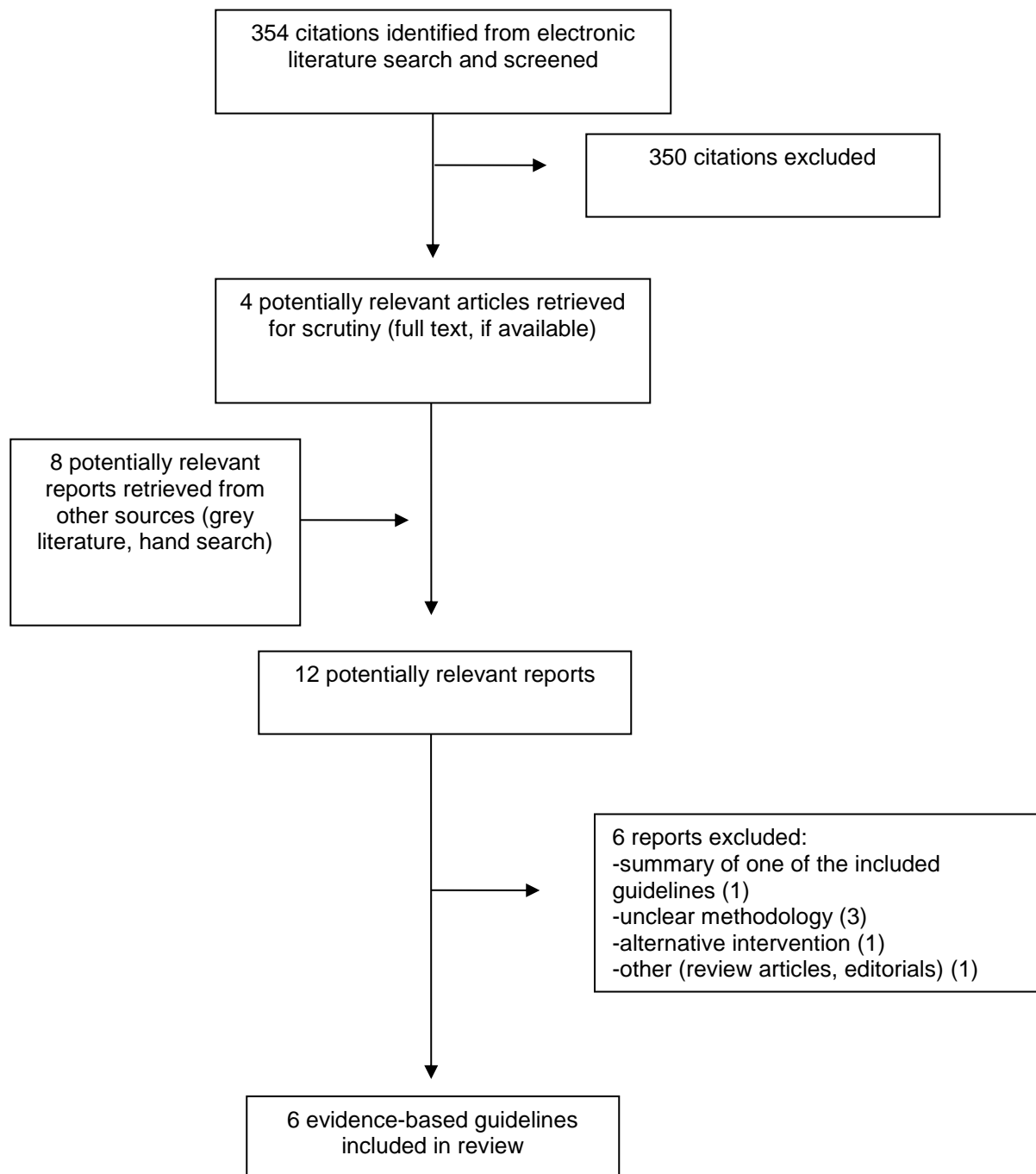
References

1. Berrios-Torres SI, Umscheid CA, Bratzler DW, et al. Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017. *JAMA Surg.* 2017 Aug;152(8):784-791.
2. Canadian Patient Safety Institute. Canadian surgical site infection prevention audit month [Recap report]. Ottawa (ON): Canadian Patient Safety Institute; 2016 Feb: https://www.patientsafetyinstitute.ca/en/toolsResources/Documents/SSI%20Audit%202016_Recap%20Report%20EN.pdf. Accessed 2020 May 22.
3. Anderson D, Sexton D. Overview of control measures for prevention of surgical site infection in adults. In: Post TW, ed. *UpToDate*. Waltham (MA): UpToDate; 2020 Apr: www.uptodate.com. Accessed 2020 Jun 15.
4. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. *Infect Control Hosp Epidemiol.* 2011;32(2):101-114.
5. Li Y, Severn M. Nasal decolonization for the prevention of surgical site infections: clinical effectiveness, cost-effectiveness, and guidelines. [CADTH rapid response report: reference list]. Ottawa (ON): CADTH; 2020 Mar: <https://cadth.ca/nasal-decolonization-prevention-surgical-site-infections-clinical-effectiveness-cost-effectiveness>. Accessed 2020 Apr 28.
6. Agree Next Steps C. The AGREE II Instrument. [Hamilton, ON]: AGREE Enterprise; 2017: <https://www.agreetrust.org/wp-content/uploads/2017/12/AGREE-II-Users-Manual-and-23-item-Instrument-2009-Update-2017.pdf>.
7. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol.* 2009;62(10):e1-e34.
8. Allegranzi B, Bischoff P, Kubilay Z, et al. Global guidelines for the prevention of surgical site infection. Geneva, Switzerland: World Health Organization (WHO); 2016: <https://apps.who.int/iris/bitstream/handle/10665/250680/9789241549882-eng.pdf?sequence=8>. Accessed 2020 Apr 28.
9. NICE. Surgical site infections: prevention and treatment [Clinical guideline NG125]. London (UK): National Institute for Health and Care Excellence; 2019 Apr: <https://www.nice.org.uk/guidance/ng125/resources/surgical-site-infections-prevention-and-treatment-pdf-66141660564421>. Accessed 2020 Apr 28.
10. Ministry of Health Malaysia, Oral Health Division. Antibiotic prophylaxis in oral surgery for prevention of surgical site infection *Clinical practice guidelines*. 2nd ed. Putrajaya, Malaysia: Ministry of Health Malaysia; 2015: <http://www.moh.gov.my/moh/penerbitan/CPG/CPG%20Antibiotic%20Prophylaxis%20in%20Oral%20Surgery%20Nov%202015.pdf>. Accessed 2020 Mar 03.
11. Ling ML, Apisarnthanarak A, Abbas A, et al. APSIC guidelines for the prevention of surgical site infections. *Antimicrob Resist Infect Control.* 2019;8:174.
12. Ban KA, Minei JP, Laronga C, et al. American College of Surgeons and Surgical Infection Society: surgical site infection guidelines, 2016 update. *J Am Coll Surg.* 2017;224(1):59-74.
13. National Collaborating Centre for Women's and Children's Health Guideline Development Group. Surgical site infection: prevention and treatment of surgical site infection. London (UK): National Collaborating Centre for Women's and Children's Health; 2008 Oct, (updated 2019 Apr): <https://www.nice.org.uk/guidance/ng125/evidence/october-2008-full-guideline-pdf-6727105694>. Accessed 2020 Jun 08.
14. NICE. Surgical site infection: prevention and treatment: evidence review for effectiveness of nasal decolonisation in prevention of surgical site infection [NICE guideline NG125]. London (UK): National Institute for Health and Care Excellence; 2019 Apr: <https://www.nice.org.uk/guidance/ng125/evidence/a-nasal-decontamination-in-the-prevention-of-surgical-site-infection-pdf-6727104398>. Accessed 2020 May 22
15. Brett K, Severn M. Nasal decolonization for the prevention of surgical site infections: a review of clinical effectiveness and cost-effectiveness [CADTH rapid response report: summary with critical appraisal]. Ottawa (ON): CADTH; 2020 May.
16. Bonnar P, Dhar P, Rotstein O, et al. Surgical site infection prevention [Clinical practice guideline]. Toronto (ON): University of Toronto Best Practice in Surgery; 2017 Sep: <http://bestpracticeinsurgery.ca/wp-content/uploads/2017/11/SSI-BPS-CPG-Nov20.pdf>. Accessed 2020 Apr 28.
17. Edmiston CE, Jr., Lee CJ, Krepel CJ, et al. Evidence for a standardized preadmission showering regimen to achieve maximal antiseptic skin surface concentrations of chlorhexidine gluconate, 4%, in surgical patients. *JAMA Surg.* 2015;150(11):1027-1033.
18. Nelson RL, Gladman E, Barbateskovic M. Antimicrobial prophylaxis for colorectal surgery. *Cochrane Database Syst Rev.* 2014(5):Cd001181.
19. Lefebvre A, Saliou P, Lucet JC, et al. Preoperative hair removal and surgical site infections: network meta-analysis of randomized controlled trials. *J Hosp Infect.* 2015;91(2):100-108.
20. Tanner J, Norrie P, Melen K. Preoperative hair removal to reduce surgical site infection. *Cochrane Database Syst Rev.* 2011(11):Cd004122.
21. Allegranzi B, Bischoff P, de Jonge S, et al. New WHO recommendations on preoperative measures for surgical site infection prevention: an evidence-based global perspective. *Lancet Infect Dis.* 2016;16(12):e276-e287.
22. van Rijen M, Bonten M, Wenzel R, Kluytmans J. Mupirocin ointment for preventing Staphylococcus aureus infections in nasal carriers. *Cochrane Database Syst Rev.* 2008(4):Cd006216.
23. Pofahl WE, Goettler CE, Ramsey KM, Cochran MK, Nobles DL, Rotondo MF. Active surveillance screening of MRSA and eradication of the carrier state decreases surgical-site infections caused by MRSA. *J Am Coll Surg.* 2009;208(5):981-986; discussion 986-988.

24. Maiwald M, Chan ES. The forgotten role of alcohol: a systematic review and meta-analysis of the clinical efficacy and perceived role of chlorhexidine in skin antiseptics. *PLoS One*. 2012;7(9):e44277.
25. Dumville JC, McFarlane E, Edwards P, Lipp A, Holmes A. Preoperative skin antiseptics for preventing surgical wound infections after clean surgery. *Cochrane Database Syst Rev*. 2013(3):Cd003949.
26. Anderson DJ, Podgorny K, Berríos-Torres SI, et al. Strategies to prevent surgical site infections in acute care hospitals: 2014 update. *Infect Control Hosp Epidemiol*. 2014;35(6):605-627.
27. Webster J, Osborne S. Preoperative bathing or showering with skin antiseptics to prevent surgical site infection. *Cochrane Database Syst Rev*. 2012(9).
28. Walsh EE, Greene L, Kirshner R. Sustained reduction in methicillin-resistant *Staphylococcus aureus* wound infections after cardiothoracic surgery. *Arch Intern Med*. 2011;171(1):68-73.
29. Schweizer ML, Chiang H-Y, Septimus E, et al. Association of a bundled intervention with surgical site infections among patients undergoing cardiac, hip, or knee surgery. *JAMA*. 2015;313(21):2162-2171.
30. Awad SS, Palacio CH, Subramanian A, et al. Implementation of a methicillin-resistant *Staphylococcus aureus* (MRSA) prevention bundle results in decreased MRSA surgical site infections. *Am J Surg*. 2009;198(5):607-610.
31. Reichman DE, Greenberg JA. Reducing surgical site infections: a review. *Rev Obstet Gynecol*. 2009;2(4):212-221.
32. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. *Am J Infect Control*. 1999;27(2):97-132; quiz 133-134; discussion 196.
33. Sidhwa F, Itani KMF. Skin Preparation Before Surgery: Options and Evidence. *Surg Infect*. 2015;16(1):14-23.
34. Cataife G, Weinberg DA, Wong HH, Kahn KL. The effect of Surgical Care Improvement Project (SCIP) compliance on surgical site infections (SSI). *Med Care*. 2014;52(2 Suppl 1):S66-73.
35. Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect*. 2013;14(1):73-156.
36. Vriesendorp TM, Moréls QJ, DeVries JH, Legemate DA, Hoekstra JBL. Early post-operative glucose levels are an independent risk factor for infection after peripheral vascular surgery. A retrospective study. *Eur J Vasc Endovasc Surg*. 2004;28(5):520-525.
37. Lazar HL, McDonnell MM, Chipkin S, Fitzgerald C, Bliss C, Cabral H. Effects of aggressive versus moderate glycemic control on clinical outcomes in diabetic coronary artery bypass graft patients. *Ann Surg*. 2011;254(3):458-464.
38. Kwon S, Thompson R, Dellinger P, Yanez D, Farrohi E, Flum D. Importance of perioperative glycemic control in general surgery: a report from the surgical care and outcomes assessment program. *Ann Surg*. 2013;257(1):8-14.
39. Kotagal M, Symons RG, Hirsch IB, et al. Perioperative hyperglycemia and risk of adverse events among patients with and without diabetes. *Ann Surg*. 2015;261(1):97-103.
40. Kirdemir P, Yildirim V, Kiris I, et al. Does continuous insulin therapy reduce postoperative supraventricular tachycardia incidence after coronary artery bypass operations in diabetic patients? *J Cardiothorac Vasc Anesth*. 2008;22(3):383-387.
41. Grey NJ, Perdrizet GA. Reduction of nosocomial infections in the surgical intensive-care unit by strict glycemic control. *Endocr Pract*. 2004;10(SUPPL. 2):46-52.
42. Emam IA, Allan A, Eskander K, et al. Our experience of controlling diabetes in the peri-operative period of patients who underwent cardiac surgery. *Diabetes Res Clin Pract*. 2010;88(3):242-246.
43. Desai SP, Henry LL, Holmes SD, et al. Strict versus liberal target range for perioperative glucose in patients undergoing coronary artery bypass grafting: a prospective randomized controlled trial. *J Thoracic Cardiovasc Surg*. 2012;143(2):318-325.
44. Chan RPC, Galas FRBG, Hajjar LA, Bello CN, Piccioni MA, Auler Jr JOC. Intensive perioperative glucose control does not improve outcomes of patients submitted to open-heart surgery: a randomized controlled trial. *Clinics*. 2009;64(1):51-60.
45. Bratzler DW, Hunt DR. The Surgical Infection Prevention and Surgical Care Improvement projects: national initiatives to improve outcomes for patients having surgery. *Clin Infect Dis*. 2006;43(3):322-330.
46. Bilotta F, Spinelli A, Giovannini F, Doronzio A, Delfini R, Rosa G. The effect of intensive insulin therapy on infection rate, vasospasm, neurologic outcome, and mortality in neurointensive care unit after intracranial aneurysm clipping in patients with acute subarachnoid hemorrhage: A randomized prospective pilot trial. *J Neurosurg Anesthesiol*. 2007;19(3):156-160.
47. Ata A, Lee J, Bestle SL, Desemone J, Stain SC. Postoperative hyperglycemia and surgical site infection in general surgery patients. *Arch Surg*. 2010;145(9):858-864.
48. Berríos-Torres SI, Umscheid CA, Bratzler DW, et al. Healthcare Infection Control Practices Advisory Committee. Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017 (Supplementary online content). *JAMA Surg*. 2017 May 3 (online publication);152(8).
49. World Health Organization. WHO Surgical site infection prevention guidelines web appendix 2: summary of a systematic review on preoperative bathing Geneva, Switzerland: WHO; 2016: <https://www.who.int/infection-prevention/tools/surgical/appendix2.pdf?ua=1>. Accessed 2020 May 21.

50. World Health Organization. WHO Surgical site infection prevention guidelines web appendix 3: summary of a systematic review on decolonization with mupirocin ointment with or without chlorhexidine gluconate body wash for the prevention of Staphylococcus aureus infection in nasal carriers undergoing surgery. Geneva, Switzerland: WHO; 2016: <https://www.who.int/gpsc/appendix3.pdf?ua=1>. Accessed 2020 May 21.
51. World Health Organization. WHO global guidelines for the prevention of surgical site infection web appendix 5: summary of a systematic review on optimal timing for preoperative surgical antibiotic prophylaxis. Geneva, Switzerland: WHO; 2016: <https://www.who.int/gpsc/Appendix5.pdf?ua=1>. Accessed 2020 May 21.
52. World Health Organization. WHO Surgical site infection prevention guidelines web appendix 6: summary of a systematic review on mechanical bowel preparation and the use of oral antibiotics. Geneva, Switzerland: WHO; 2016: <https://www.who.int/gpsc/appendix6.pdf?ua=1>. Accessed 2020 May 21.
53. World Health Organization. WHO Surgical site infection prevention guidelines web appendix 7: summary of a systematic review on the effectiveness and optimal method of hair removal. Geneva, Switzerland: WHO; 2016: <https://www.who.int/gpsc/appendix7.pdf?ua=1>. Accessed 2020 May 21.
54. World Health Organization. WHO Surgical site infection prevention guidelines web appendix 8: summary of a systematic literature review on surgical site preparation. Geneva, Switzerland: WHO; 2016: <https://www.who.int/gpsc/appendix8.pdf?ua=1>. Accessed 2020 May 21.

Appendix 1: Selection of Included Studies



Appendix 2: Characteristics of Included Publications

Table 2: Characteristics of Included Guideline

Intended Users, Target Population, Country, Funding Source	Intervention and Practice Considered	Major Outcomes Considered	Evidence Collection, Selection, and Synthesis	Evidence Quality Assessment	Recommendations Development and Evaluation	Guideline Validation
Asia Pacific Society of Infection Control (APSIC) Guideline, 2019¹¹						
<p>Intended users: Surgical staff who provide care for surgical patients</p> <p>Target population: Patients undergoing surgical procedures</p> <p>Asia Pacific region</p> <p>Funding source: Educational grant from 3 M Asia Pacific</p>	The guideline provided recommendations regarding preoperative washing, mechanical bowel preparation, antibiotic prophylaxis, hair removal, skin antiseptic, and nasal decolonization.	Incidence of SSIs	The APSIC working group conducted literature searches in PubMed and screened published guidelines (e.g., WHO, CDC, Cochrane). SRs, RCTs and non-randomized studies were eligible for inclusion.	<p>Categories for quality of evidence:</p> <p>I: Evidence derived from ≥ one RCT</p> <p>II: Evidence derived from ≥ one well-designed non-randomized study, cohort or case-controlled study, or critical results from uncontrolled studies</p> <p>III: Opinions of respected authorities based on clinical experience, descriptive studies, or expert committee reports</p>	<p>The working group engaged in discussions in person and via email to complete the guideline.</p> <p>Recommendation grading system:</p> <p>A: Good evidence to support recommendation for use</p> <p>B: Moderate evidence to support recommendation for use</p> <p>C: Insufficient evidence to recommend for or against use</p> <p>D: Moderate evidence to recommend against use</p> <p>E: Good evidence to recommend against use</p>	The guideline was validated by two external reviewers, APSIC Executive Committee, and national Infection Control societies in Asia Pacific.
National Institute for Health and Care Excellence (NICE) Guideline, 2019⁹						
<p>Intended users: Health care professionals, commissioners and providers, and those undergoing surgery</p> <p>Target population: Adults, young people, and children undergoing surgical procedures</p> <p>United Kingdom</p>	The guideline provided recommendations regarding preoperative washing, mechanical bowel preparation, antibiotic prophylaxis, hair removal, antiseptic skin preparation, and	Incidence of SSIs, mortality, duration of hospital stay, postoperative antibiotic use, hospital readmission, infection complications, antimicrobial resistance, adverse events, and	Literature searches were conducted on March 15, 2018 in various databases (e.g., Medline, Embase, Cochrane Database of Systematic Reviews). Retrieved articles were screened for RCTs and SRs of RCTs.	Evidence quality was assessed using the GRADE approach and presented in GRADE tables with quality of evidence ranked from very low to high.	<p>The GDG develops recommendations based on scientific evidence and other evidence such as expert testimony and stakeholder views. The guideline development group reaches an agreement on the strength of recommendations through an informal consensus process.</p> <p>The strength of recommendations is reflected in the wording:</p>	Draft NICE guidelines are posted online for review by registered stakeholders. Albeit not mentioned in this guideline, NICE occasionally solicits external

Intended Users, Target Population, Country, Funding Source	Intervention and Practice Considered	Major Outcomes Considered	Evidence Collection, Selection, and Synthesis	Evidence Quality Assessment	Recommendations Development and Evaluation	Guideline Validation
<p>Funding source: The United Kingdom government</p>	nasal decolonization.	other nosocomial infections			Offer/Advise: Strong recommendation (i.e., clear evidence of benefit) Consider: Evidence of benefit is less certain	experts for review.
American College of Surgeons (ACS) & Surgical Infection Society Guideline, 2017 ¹²						
<p>Intended users: Surgical staff who provide care for surgical patients</p> <p>Target population: Patients undergoing surgical procedures</p> <p>United States</p> <p>Funding source: ACS & Surgical Infection Society</p>	The guideline provided recommendations regarding preoperative washing, bowel preparation, antibiotic prophylaxis, hair removal, skin preparation, nasal decolonization, glucose control, and MRSA screening.	Incidence of SSIs	Literature searches were conducted in PubMed on specific topics to fill knowledge gaps in previous guidelines. This is an update to a previous version of the guideline. Retrieved articles were screened for SRs, RCTs and non-randomized studies.	Quality assessment of the included evidence was not mentioned.	Consensus agreement was reached by internal and external experts for this guideline update. There was no mention of using a grading system for strength of recommendations.	The guideline was validated by an internal expert panel and external expert reviewers.
Centers for Disease Control and Prevention (CDC) Guideline, 2017 ¹						
<p>Intended users: Health care professionals, professional societies/organizations</p> <p>Target population: Patients undergoing surgical procedures</p> <p>United States</p> <p>Funding source: CDC</p>	The guideline provided recommendations regarding preoperative washing, antibiotic prophylaxis, and glucose control.	Incidence of SSIs, mortality, duration of hospital stay, hospital readmission, adverse events, and antimicrobial resistance	A systematic review was conducted from 1998 through April 2014 in various databases (e.g., Medline, Embase, CINAHL, Cochrane Library). Retrieved articles were screened for RCTs and SRs.	Evidence quality was assessed using a modified GRADE approach. Categories for quality of evidence: A: High to moderate-quality evidence that suggest net benefit or harm B: Low-quality evidence that suggest net benefit or harm, or an accepted practice supported by low to very low-quality evidence C: Required by state/federal regulation	The guideline development group develops recommendations based on the literature review and a consensus process. Recommendation grading system: I: Strong recommendation II: Weak recommendation: supported by any quality evidence that suggest a trade-off between risk and benefit No recommendation: Low to very low-quality evidence with an uncertain trade-off of risk and benefit, or no	The guideline was reviewed by a panel of experts, HICPAC members, and members of the public.

Intended Users, Target Population, Country, Funding Source	Intervention and Practice Considered	Major Outcomes Considered	Evidence Collection, Selection, and Synthesis	Evidence Quality Assessment	Recommendations Development and Evaluation	Guideline Validation
					published evidence deemed critical	
WHO Guideline, 2016 ⁸						
<p>Intended users: Surgeons, nurses, support staff, anesthesiologists, pharmacists, and other professionals providing surgical care</p> <p>Target population: Patients undergoing surgical procedures</p> <p>Global</p> <p>Funding sources: WHO and Fleming Fund of the United Kingdom Government</p>	The guideline provided recommendations regarding preoperative washing, bowel preparation, antibiotic prophylaxis, hair removal, skin preparation, and nasal decolonization.	Incidence of SSIs and SSI-related deaths	A SREG made up of researchers and professionals conducted multiple systematic reviews between December 2013 and October 2015 to provide the evidence for this guideline. Literature searches were conducted in various databases (e.g., Medline, Excerpta Medica Database, CINAHL, Cochrane Central Register of Controlled Trials, WHO regional databases) for studies published after January 1, 1990. Retrieved articles were screened for RCTs and non-randomized studies.	<p>Evidence quality was assessed using GRADE.</p> <p>Categories for quality of evidence: High: very confident that the true effect lies close to the effect estimate Moderate: moderately confident that the true effect lies close to the effect estimate Low: the true effect may differ considerably from the effect estimate Very low: the true effect likely differs considerably from the effect estimate</p>	<p>The GDG develops recommendations based on the literature review and a consensus process.</p> <p>Recommendation grading system: Strong recommendation: GDG was confident that the benefits outweigh the risks Conditional recommendation (may use the terminology “suggests considering”): GDG considered that the benefits probably outweighed the risks</p>	The guideline was reviewed by an External Peer Review Group with five technical experts with extensive knowledge in surgery and infection prevention and control measures.
Ministry of Health Malaysia Guideline, 2015 ¹⁰						
Intended users: Oral and maxillofacial surgeons, dental practitioners, and	The guideline provided recommendations regarding	Incidence of oral SSIs	Literature searches were conducted in various databases	Evidence quality was assessed using the US/Canadian Preventive Services Task Force	The guideline development group and review committee develop recommendations based on the literature	The guideline was reviewed

Intended Users, Target Population, Country, Funding Source	Intervention and Practice Considered	Major Outcomes Considered	Evidence Collection, Selection, and Synthesis	Evidence Quality Assessment	Recommendations Development and Evaluation	Guideline Validation
<p>academics involved in dentist training</p> <p>Target population: Patients undergoing oral and maxillofacial surgical procedures</p> <p>Malaysia</p> <p>Funding source: Malaysia Ministry of Health</p>	<p>antibiotic prophylaxis.</p>		<p>(e.g., PubMed/Medline, Cochrane Database of Systematic Reviews, ISI Web of Knowledge, OVID) for articles published from 2003 onwards. Retrieved articles were screened for SRs, RCTs and non-randomized studies.</p>	<p>guide.</p> <p>Categories for quality of evidence: I: Evidence derived from ≥ one RCT II-1: Evidence derived from ≥ one well-designed non-randomized study II-2: Evidence derived from ≥ one well-designed cohort or case-controlled study, preferably from ≥ one research group II-3: Evidence derived from multiple time series with or without the intervention III: Opinions of respected authorities based on clinical experience, descriptive studies, or expert committee reports</p>	<p>review and a consensus process.</p> <p>Recommendation grading system (SIGN): A: Evidence from ≥ one meta-analysis, systematic review, or RCT that is pertinent to the target population B: Evidence from well-conducted clinical trials that are pertinent to the target population and demonstrate consistency of results; or evidence extrapolated from meta-analyses, systematic reviews or RCTs C: Evidence from opinions of respected authorities or expert committee reports</p>	<p>externally by a clinician and academic.</p>

ACS = American College of Surgeons; APSIC = Asia Pacific Society of Infection Control; ASHP = American Society of Health-System Pharmacists; CDC = Centers for Disease Control and Prevention; CINAHL = Cumulative Index to Nursing and Allied Health Literature; CPSI = Canadian Patient Safety Institute; GDG = Guidelines Development Group; GRADE = Grading of Recommendations, Assessment, Development, and Evaluation; HICPAC = Healthcare Infection Control Practices Advisory Committee; MRSA = *methicillin-resistant Staphylococcus aureus*; NICE = National Institute for Health and Care Excellence; NR = not reported; RCT = randomized controlled trial; SIGN = Scottish Intercollegiate Guidelines Network; SR = systematic review; SREG = Systematic Reviews Expert Group; SSI = surgical site infection.

Appendix 3: Critical Appraisal of Included Publications

Table 3: Strengths and Limitations of Guidelines using AGREE II⁶

Item	Guideline					
	APSIC, 2019 ¹¹	NICE, 2019 ⁹	ACS, 2017 ¹²	CDC, 2017 ¹	WHO, 2016 ⁸	Ministry of Health Malaysia, 2015 ¹⁰
Domain 1: Scope and Purpose						
1. The overall objective(s) of the guideline is (are) specifically described.	Yes	Yes	Yes	Yes	Yes	Yes
2. The health question(s) covered by the guideline is (are) specifically described.	Yes	Yes	Yes	Yes	Yes	Yes
3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.	Yes	Yes	Yes	Yes	Yes	Yes
Domain 2: Stakeholder Involvement						
4. The guideline development group includes individuals from all relevant professional groups.	Yes	Yes	Yes	Yes	Yes	Yes
5. The views and preferences of the target population (patients, public, etc.) have been sought.	No	Yes	No	Yes	Yes	No
6. The target users of the guideline are clearly defined.	Apparent but not explicitly described	Yes	Apparent but not explicitly described	Yes	Yes	Yes
Domain 3: Rigour of Development						
7. Systematic methods were used to search for evidence.	Unclear	Yes	Unclear	Yes	Yes	Yes
8. The criteria for selecting the evidence are clearly described.	No	Yes	No	Yes	Yes	Yes
9. The strengths and limitations of the body of evidence are clearly described.	Yes	Yes	No	Yes	Yes	Yes
10. The methods for formulating the recommendations are clearly described.	Unclear	Yes	Yes	Yes	Yes	Yes

Item	Guideline					
	APSIC, 2019 ¹¹	NICE, 2019 ⁹	ACS, 2017 ¹²	CDC, 2017 ¹	WHO, 2016 ⁸	Ministry of Health Malaysia, 2015 ¹⁰
11. The health benefits, side effects, and risks have been considered in formulating the recommendations.	Yes	Yes	Yes	Yes	Yes	Yes
12. There is an explicit link between the recommendations and the supporting evidence.	Yes	Yes	Yes	Yes	Yes	Yes
13. The guideline has been externally reviewed by experts prior to its publication.	Yes	Yes	Yes	Yes	Yes	Yes
14. A procedure for updating the guideline is provided.	No	Yes	No	Yes	Yes	No
Domain 4: Clarity of Presentation						
15. The recommendations are specific and unambiguous.	Yes	Yes	Yes	Yes	Yes	Yes
16. The different options for management of the condition or health issue are clearly presented.	Yes	Yes	Yes	Yes	Yes	Yes
17. Key recommendations are easily identifiable.	Yes	Yes	Yes	Yes	Yes	Yes
Domain 5: Applicability						
18. The guideline describes facilitators and barriers to its application.	No	Yes	No	Yes	Yes	No
19. The guideline provides advice and/or tools on how the recommendations can be put into practice.	No	Yes	No	Yes	Yes	No
20. The potential resource implications of applying the recommendations have been considered.	No	Yes	No	No	Yes	No
21. The guideline presents monitoring and/or auditing criteria.	Yes	Yes	Yes	Yes	Yes	Yes
Domain 6: Editorial Independence						

Item	Guideline					
	APSID, 2019 ¹¹	NICE, 2019 ⁹	ACS, 2017 ¹²	CDC, 2017 ¹	WHO, 2016 ⁸	Ministry of Health Malaysia, 2015 ¹⁰
22. The views of the funding body have not influenced the content of the guideline.	Yes	Yes	Yes	Yes	Yes	Yes
23. Competing interests of guideline development group members have been recorded and addressed.	Yes	Yes	Yes	Yes	Yes	Yes

ACS = American College of Surgeons; AGREE II = Appraisal of Guidelines for Research and Evaluation II; APSIC = Asia Pacific Society of Infection Control; CDC = Centers for Disease Control and Prevention; NICE = National Institute for Health and Care Excellence.

Appendix 4: Main Study Findings and Authors' Conclusions

Table 4: Summary of Recommendations in Included Guidelines

Recommendations and supporting evidence	Quality of evidence and strength of recommendation
Asia Pacific Society of Infection Control (APSIC) Guideline, 2019 ¹¹	
<p>Evidence-based guideline regarding preoperative measures for the prevention of SSIs.</p> <p>1. Preoperative washing: “It is necessary for patients who will undergo surgery to have at least 1 preoperative bath with soap (antimicrobial or non-antimicrobial).”¹¹ (p2)</p> <ul style="list-style-type: none"> This recommendation was informed by one article¹⁷ <p>2. Mechanical bowel preparation: “Combination mechanical bowel preparation and oral antibiotic preparation are recommended for all elective colorectal surgery in adults.”¹¹ (p2)</p> <ul style="list-style-type: none"> This recommendation was informed by one article¹⁸ <p>3. Hair removal:</p> <p>a. “Hair removal should be avoided unless hair interferes with the operative procedure.”</p> <p>b. “If hair removal is necessary, a razor should be avoided and an electric clipper should be used.”</p> <p>c. “No recommendation regarding the timing of hair removal by clipper is made.”¹¹ (p3)</p> <ul style="list-style-type: none"> These recommendations were informed by two articles^{19,20} <p>4. Nasal decolonization:</p> <p>a. “Hospitals should evaluate their SSI, <i>Staphylococcus aureus</i> (<i>S. aureus</i>) and MRSA rates, and mupirocin resistant rate, if available, to determine whether implementation of a screening program is appropriate.”</p> <p>b. “Patients undergoing cardiothoracic and orthopedic surgery with known nasal carriage of <i>S. aureus</i> should receive perioperative intranasal application of mupirocin 2% ointment with or without a combination of CHG body wash.”¹¹ (p3)</p> <ul style="list-style-type: none"> These recommendations were informed by three articles²¹⁻²³ <p>5. Skin antiseptic preparation: “Alcohol based skin antiseptic preparations should be used, unless contraindicated.”¹¹ (p4)</p> <ul style="list-style-type: none"> This recommendation was informed by three articles²⁴⁻²⁶ <p>6. Antibiotic prophylaxis: “Administration of prophylaxis antimicrobials should only be performed when indicated. Prophylactic antimicrobials should be administered within 1 h before incision for all antimicrobials except vancomycin and fluoroquinolones where it should be administered within 2 h. Re-dosing should be considered to maintain adequate tissue levels based on agent half-life. A single dose of antimicrobial prophylactic is adequate for most surgical procedures.”¹¹ (p4)</p> <ul style="list-style-type: none"> These recommendations were informed by two articles^{12,26} 	<p>1. Quality of evidence: II Recommendation strength: B</p> <p>2. Quality of evidence: I Recommendation strength: A</p> <p>3. a. Quality of evidence: III Recommendation strength: B b. Quality of evidence: I Recommendation strength: A c. Quality of evidence: III Recommendation strength: C</p> <p>4. a. Quality of evidence: II Recommendation strength: B b. Quality of evidence: I Recommendation strength: A</p> <p>5. Quality of evidence: I Recommendation strength: A</p> <p>6. Quality of evidence: I Recommendation strength: A</p>
National Institute for Health and Care Excellence (NICE) Guideline, 2019 ⁹	
<p>Evidence-based guideline regarding preoperative measures for the prevention and treatment of SSIs. These recommendations were informed by a review of the published SRs and RCTs.</p> <p>1. Preoperative washing and nasal decolonization:</p>	<p>The wording of recommendations reflects the recommendation strength: Offer/Advise: Strong recommendation (i.e., clear evidence of benefit) Consider: Evidence of benefit is less certain</p>

Recommendations and supporting evidence	Quality of evidence and strength of recommendation
<p>a. “Advise patients to shower or have a bath (or help patients to shower, bath or bed bath) using soap, either the day before, or on the day of, surgery.”⁹ (p5)</p> <ul style="list-style-type: none"> This recommendation was informed by a SR referenced in the original 2008 guideline¹³ <p>b. “Consider nasal mupirocin in combination with a chlorhexidine body wash before procedures in which <i>Staphylococcus aureus</i> is a likely cause of a surgical site infection. This should be locally determined and take into account the type of procedure, individual patient risk factors, the increased risk of side effects in preterm infants, and the potential impact of infection. Maintain surveillance on antimicrobial resistance associated with the use of mupirocin.”⁹ (p6)</p> <ul style="list-style-type: none"> These recommendations were informed by an evidence review conducted by NICE¹⁴ <p>2. Hair removal: “Do not use hair removal routinely to reduce the risk of surgical site infection. If hair has to be removed, use electric clippers with a single-use head on the day of surgery. Do not use razors for hair removal, because they increase the risk of surgical site infection.”⁹ (p6)</p> <ul style="list-style-type: none"> These recommendations were informed by a SR and an RCT referenced in the original 2008 guideline¹³ <p>3. Mechanical bowel preparation: “Do not use mechanical bowel preparation routinely to reduce the risk of surgical site infection.”⁹ (p7)</p> <ul style="list-style-type: none"> These recommendations were informed by 12 RCTs referenced in the original 2008 guideline¹³ <p>4. Antibiotic prophylaxis:</p> <p>a. “Give antibiotic prophylaxis to patients before: clean surgery involving the placement of a prosthesis or implant, clean-contaminated surgery, and contaminated surgery.”</p> <p>b. “Do not use antibiotic prophylaxis routinely for clean non-prosthetic uncomplicated surgery.”</p> <p>c. “Use the local antibiotic formulary and always take into account the potential adverse effects when choosing specific antibiotics for prophylaxis.”</p> <p>d. “Consider giving a single dose of antibiotic prophylaxis intravenously on starting anaesthesia. However, give prophylaxis earlier for operations in which a tourniquet is used.”</p> <p>e. “Before giving antibiotic prophylaxis, take into account the timing and pharmacokinetics (for example, the serum half-life) and necessary infusion time of the antibiotic. Give a repeat dose of antibiotic prophylaxis when the operation is longer than the half-life of the antibiotic given.”</p> <p>f. “Give antibiotic treatment (in addition to prophylaxis) to patients having surgery on a dirty or infected wound.”</p> <p>g. “Inform patients before the operation, whenever possible, if they will need antibiotic prophylaxis, and afterwards if they have been given antibiotics during their operation.”⁹ (p. 7)</p> <ul style="list-style-type: none"> These recommendations were informed by 18 SRs and 22 RCTs referenced in the original 2008 guideline¹³ <p>5. Antiseptic skin preparation:</p> <p>a. “Prepare the skin at the surgical site immediately before incision using an antiseptic preparation.”</p> <p>b. “Be aware of the risks of using skin antiseptics in babies, in particular the risk of severe chemical injuries with the use of chlorhexidine (both alcohol-based and aqueous solutions) in preterm babies.”</p>	<p>1. a. The quality of evidence was assessed, but was not reported online</p> <p>b. The quality of the supporting evidence ranged from very low to high</p> <p>2. The quality of evidence was assessed, but was not reported online</p> <p>3. The quality of evidence was assessed, but was not reported online</p> <p>4. The quality of evidence was assessed, but was not reported online</p> <p>5. The quality of the supporting evidence ranged from very low to high</p>

Recommendations and supporting evidence	Quality of evidence and strength of recommendation										
<p>c. “When deciding which antiseptic skin preparation to use, options may include those in table [below].”⁹ (p9)</p> <ul style="list-style-type: none"> These recommendations were informed by an evidence review conducted by NICE¹⁴ <table border="1" data-bbox="126 535 1055 735"> <thead> <tr> <th>Indication</th> <th>Antiseptic Option</th> </tr> </thead> <tbody> <tr> <td>First option</td> <td>Alcohol-based solution of chlorhexidine</td> </tr> <tr> <td>If chlorhexidine is contraindicated</td> <td>Alcohol-based solution of povidone-iodine</td> </tr> <tr> <td>If the area is close to a mucous membrane</td> <td>Aqueous solution of chlorhexidine</td> </tr> <tr> <td>If an alcohol-based solution and chlorhexidine are both unsuitable</td> <td>Aqueous solution of povidone-iodine</td> </tr> </tbody> </table>	Indication	Antiseptic Option	First option	Alcohol-based solution of chlorhexidine	If chlorhexidine is contraindicated	Alcohol-based solution of povidone-iodine	If the area is close to a mucous membrane	Aqueous solution of chlorhexidine	If an alcohol-based solution and chlorhexidine are both unsuitable	Aqueous solution of povidone-iodine	
Indication	Antiseptic Option										
First option	Alcohol-based solution of chlorhexidine										
If chlorhexidine is contraindicated	Alcohol-based solution of povidone-iodine										
If the area is close to a mucous membrane	Aqueous solution of chlorhexidine										
If an alcohol-based solution and chlorhexidine are both unsuitable	Aqueous solution of povidone-iodine										
American College of Surgeons (ACS) & Surgical Infection Society Guideline, 2017 ¹²											
<p>Evidence-based guideline regarding preoperative measures for the prevention and treatment of SSIs. These recommendations were informed by a review of published literature.</p> <p>1. Preoperative washing: “Routine preoperative washing with chlorhexidine (when not part of a decolonization protocol or preoperative bundle) decreases skin surface pathogen concentrations, but has not been shown to reduce SSI.”¹² (p61)</p> <ul style="list-style-type: none"> This recommendation was informed by one article²⁷ <p>2. MRSA screening:</p> <p>a. “Decision about whether or not to implement global <i>Staphylococcus aureus</i> screening and decolonization protocols should depend on baseline SSI and MRSA rates.”</p> <p>b. “Clinical practice guidelines from the American Society of Health-System Pharmacists recommend screening and nasal mupirocin decolonization for <i>S aureus</i>-colonized patients before total joint replacement and cardiac procedures.”</p> <p>c. “MRSA bundles (screening, decolonization, contact precautions, hand hygiene) are highly effective if adhered to, otherwise there is no benefit.”</p> <p>d. “No standard decolonization protocol supported by literature; consider nasal mupirocin alone vs nasal mupirocin plus chlorhexidine gluconate washing.”</p> <p>e. “Decolonization protocols should be completed close to date of surgery to be effective.”</p> <p>f. “Vancomycin should not be administered as prophylaxis to MRSA-negative patients.”¹² (p61)</p> <ul style="list-style-type: none"> These recommendations were informed by four articles^{23,28-30} <p>3. Bowel preparations: “Combination mechanical and antibiotic (po) preparation is recommended for all elective colectomies.”¹² (p61)</p> <ul style="list-style-type: none"> This recommendation was informed by one article¹⁸ <p>4. Hair removal: “Hair removal should be avoided unless hair interferes with surgery. If hair removal is necessary, clippers should be used instead of a razor.”¹² (p62)</p> <ul style="list-style-type: none"> This recommendation was informed by three articles^{26,31,32} <p>5. Skin preparation: “Alcohol-containing preparation should be used unless contraindication exists (eg fire hazard, surfaces involving mucosa, cornea, or ear). No clear superior agent (chlorhexidine vs iodine) when combined with alcohol. If alcohol cannot be included in the preparation, chlorhexidine should be used instead of iodine unless contraindications exist.”¹² (p62)</p> <ul style="list-style-type: none"> This recommendation was informed by two articles^{24,33} 	<p>The quality of the evidence and the strength of the recommendations were not reported.</p>										

Recommendations and supporting evidence	Quality of evidence and strength of recommendation
<p>6. Antibiotic prophylaxis:</p> <p>a. “Administer prophylactic antibiotics only when indicated.”</p> <p>b. “Choice of prophylactic antibiotic should be dictated by the procedure and pathogens most likely to cause SSI.”</p> <p>c. “Prophylactic antibiotic should be administered within 1 hour before incision or within 2 hours for vancomycin or fluoroquinolones.”</p> <p>d. “Prophylactic antibiotic dosing should be weight-adjusted.</p> <p>e. “Re-dose antibiotics to maintain adequate tissue levels based on agent half-life or for every 1,500 mL blood loss.”</p> <p>f. “There is no evidence that prophylactic antibiotic administration after incision closure decreases SSI risk; prophylactic antibiotics should be discontinued at time of incision closure (exceptions include implant-based breast reconstruction, joint arthroplasty, and cardiac procedures where optimal duration of antibiotic therapy remains unknown).”¹² (p62)</p> <ul style="list-style-type: none"> • These recommendations were informed by three articles^{26,34,35} <p>7. Glucose control: “Hyperglycemia in the immediate preoperative period is associated with an increased risk of SSI. Target perioperative blood glucose should be between 110 to 150 mg/dL in all patients, regardless of diabetic status, except in cardiac surgery patients where the target perioperative blood glucose is <180 mg/dL. Target blood glucose rates <110 mg/dL have been tied to adverse outcomes and increased episodes of hypoglycemia and do not decrease SSI risk.”¹² (p62)</p> <ul style="list-style-type: none"> • This recommendation was informed by 13 articles^{26,36-47} 	
Centers for Disease Control and Prevention (CDC) Guideline, 2017 ¹	
<p>Evidence-based guideline regarding preoperative measures for the prevention of SSIs. The systematic review used to inform specific recommendations was presented in the online supplemental section.⁴⁸</p> <p>1. Antibiotic prophylaxis (parenteral):</p> <p>a. “Administer preoperative antimicrobial agents only when indicated based on published clinical practice guidelines and timed such that a bactericidal concentration of the agents is established in the serum and tissues when the incision is made.”</p> <p>b. “No further refinement of timing can be made for preoperative antimicrobial agents based on clinical outcomes.”</p> <ul style="list-style-type: none"> • No recommendation/unresolved issue <p>c. “Administer the appropriate parenteral prophylactic antimicrobial agents before skin incision in all cesarean section procedures.”</p> <p>d. “The literature search did not identify randomized controlled trials that evaluated the benefits and harms of weight-adjusted parenteral antimicrobial prophylaxis dosing and its effect on the risk of SSI.”¹ (p786)</p> <ul style="list-style-type: none"> • No recommendation/unresolved issue <p>2. Glucose control:</p> <p>a. “Implement perioperative glycemic control and use blood glucose target levels less than 200 mg/dL in patients with and without diabetes.”</p> <p>b. “The search did not identify randomized controlled trials that evaluated lower (<200mg/dL) or narrower blood glucose target levels than recommended in this guideline nor the optimal timing, duration, or delivery method of perioperative glycemic control for the prevention of SSI.”¹ (p787)</p> <ul style="list-style-type: none"> • No recommendation/unresolved issue 	<p>1.</p> <p>a. Quality of evidence: B (accepted practice) Recommendation strength: I</p> <p>c. Quality of evidence: A (high-quality evidence) Recommendation strength: I</p> <p>2.</p> <p>a. Quality of evidence: A (high to moderate-quality evidence) Recommendation strength: I</p>

Recommendations and supporting evidence	Quality of evidence and strength of recommendation
<p>3. Preoperative washing:</p> <p>a. “Advise patients to shower or bathe (full body) with soap (antimicrobial or nonantimicrobial) or an antiseptic agent on at least the night before the operative day.”</p> <p>b. “Randomized controlled trial evidence suggested uncertain trade-offs between the benefits and harms regarding the optimal timing of the preoperative shower or bath, the total number of soap or antiseptic agent applications, or the use of chlorhexidine gluconate washcloths for the prevention of SSI.”¹ (p787)</p> <ul style="list-style-type: none"> No recommendation/unresolved issue 	<p>3.</p> <p>a. Quality of evidence: B (accepted practice)</p> <p>Recommendation strength: I</p>
<p>WHO Guideline, 2016⁸</p>	
<p>Evidence-based guideline regarding preoperative measures for the prevention of SSIs and SSI-related deaths.</p> <p>1. Preoperative washing:</p> <p>a. “It is good clinical practice for patients to bathe or shower prior to surgery. The panel suggests that either a plain or antimicrobial soap may be used for this purpose.”</p> <ul style="list-style-type: none"> This recommendation was informed by a SR⁴⁹ <p>b. “The panel decided not to formulate a recommendation on the use of chlorhexidine gluconate (CHG)-impregnated cloths for the purpose of reducing SSI due to the limited and very low quality evidence.”⁸ (p58)</p> <p>2. Nasal decolonization:</p> <p>a. “The panel recommends that patients undergoing cardiothoracic and orthopaedic surgery with known nasal carriage of <i>S. aureus</i> should receive perioperative intranasal applications of mupirocin 2% ointment with or without a combination of CHG body wash.”</p> <p>b. “The panel suggests considering to treat also patients with known nasal carriage of <i>S. aureus</i> undergoing other types of surgery with perioperative intranasal applications of mupirocin 2% ointment with or without a combination of CHG body wash.”⁸ (p63)</p> <ul style="list-style-type: none"> These recommendations were informed by a SR⁵⁰ <p>3. Optimal time for antibiotic prophylaxis:</p> <p>a. “The panel recommends the administration of SAP prior to the surgical incision when indicated (depending on the type of operation).”</p> <p>b. “The panel recommends the administration of SAP within 120 minutes before incision, while considering the half-life of the antibiotic.”⁸ (p71)</p> <ul style="list-style-type: none"> These recommendations were informed by a SR⁵¹ <p>4. Mechanical bowel preparation and oral antibiotics:</p> <p>a. “The panel suggests that preoperative oral antibiotics combined with mechanical bowel preparation (MBP) should be used to reduce the risk of SSI in adult patients undergoing elective colorectal surgery.”</p> <p>b. “The panel recommends that MBP alone (without administration of oral antibiotics) should not be used for the purpose of reducing SSI in adult patients undergoing elective colorectal surgery.”⁸ (p76)</p> <ul style="list-style-type: none"> These recommendations were informed by a SR⁵² <p>5. Hair removal: “The panel recommends that in patients undergoing any surgical procedure, hair should either not be removed or, if absolutely necessary, it should be removed only with a clipper. Shaving is strongly discouraged at all times, whether preoperatively or in the operating room (OR).”⁸ (p82)</p> <ul style="list-style-type: none"> These recommendations were informed by a SR⁵³ 	<p>1.</p> <p>a. Quality of evidence: Moderate quality</p> <p>Recommendation strength: Conditional</p> <p>2.</p> <p>a. Quality of evidence: Moderate quality</p> <p>Recommendation strength: Strong</p> <p>b. Quality of evidence: Moderate quality</p> <p>Recommendation strength: Conditional</p> <p>3.</p> <p>a. Low quality</p> <p>Recommendation strength: Strong</p> <p>b. Moderate quality</p> <p>Recommendation strength: Strong</p> <p>4.</p> <p>a. Quality of evidence: Moderate quality</p> <p>Recommendation strength: Conditional</p> <p>b. Moderate quality</p> <p>Recommendation strength: Strong</p> <p>5. Quality of evidence: Moderate quality</p> <p>Recommendation strength: Strong</p>

Recommendations and supporting evidence	Quality of evidence and strength of recommendation
<p>6. Skin antiseptic: “The panel recommends alcohol-based antiseptic solutions based on CHG for surgical site skin preparation in patients undergoing surgical procedures.”⁸ (p87)</p> <ul style="list-style-type: none"> • These recommendations were informed by a SR⁵⁴ 	<p>6. Quality of evidence: Low to moderate quality Recommendation strength: Strong</p>
<p>Ministry of Health Malaysia, 2015¹⁰</p>	
<p>Evidence-based guideline regarding antibiotic prophylaxis for the prevention of oral SSIs.</p> <ol style="list-style-type: none"> 1. “Antibiotic prophylaxis is indicated for all surgical procedures carried out on medically compromised patients especially those with ASA score of 3 or more.”¹⁰ (p3) <ul style="list-style-type: none"> • This recommendation was informed by two SRs, one guideline, and one primary study 2. “Antibiotic prophylaxis is not indicated for clean surgery in healthy patients.”¹⁰ (p4) <ul style="list-style-type: none"> • This recommendation was informed by five primary studies 3. “Antibiotic prophylaxis is not indicated for lower third molar surgery.”¹⁰ (p5) <ul style="list-style-type: none"> • This recommendation was informed by one SR and seven primary studies 4. “Antibiotic prophylaxis is not recommended for routine periodontal surgery.”¹⁰ (p5) <ul style="list-style-type: none"> • This recommendation was informed by two primary studies 5. “Antibiotic prophylaxis may be indicated for minor surgery with a high degree of difficulty in which the duration of the surgery is predicted to be long.”¹⁰ (p6) <ul style="list-style-type: none"> • This recommendation was informed by two primary studies 6. “Antibiotic prophylaxis is indicated for surgery to place dental implants.”¹⁰ (p6) <ul style="list-style-type: none"> • This recommendation was informed by two SRs 7. “Antibiotic prophylaxis is indicated for minor oral surgical procedures in which a bone graft is inserted.”¹⁰ (p7) <ul style="list-style-type: none"> • This recommendation was informed by one primary study 8. “Antibiotic prophylaxis is indicated for major clean contaminated maxillofacial surgery.”¹⁰ (p7) <ul style="list-style-type: none"> • This recommendation was informed by two SRs and three primary studies 9. “Antibiotic prophylaxis is indicated in all forms of head and neck cancer surgery.”¹⁰ (p8) <ul style="list-style-type: none"> • This recommendation was informed by four primary studies 10. “Antibiotic prophylaxis is indicated for open reduction and internal fixation of facial bone fractures. Antibiotics should not be continued postoperatively.”¹⁰ (p9) <ul style="list-style-type: none"> • This recommendation was informed by four primary studies 11. <ol style="list-style-type: none"> a. “Amoxicillin, Penicillin G and Clindamycin are appropriate choices of antibiotics for oral surgical prophylaxis.”¹⁰ (p13) <ul style="list-style-type: none"> • This recommendation was informed by six primary studies b. “Cloxacillin, cefazolin or clindamycin should be considered if the surgery extends onto the skin.”¹⁰ (p13) <ul style="list-style-type: none"> • This recommendation was informed by one primary study 	<ol style="list-style-type: none"> 1. Quality of evidence: Level I, II-2, and III Recommendation strength: Grade B 2. Quality of evidence: Level II-2, II-3, and III Recommendation strength: Grade B 3. Quality of evidence: Level I, II-2, and III Recommendation strength: Grade A 4. Quality of evidence: Level III Recommendation strength: Grade B 5. Quality of evidence: Level II-2 and III Recommendation strength: Grade B 6. Quality of evidence: Level I Recommendation strength: Grade A 7. Quality of evidence: Level I Recommendation strength: Grade A 8. Quality of evidence: Level I, II-2, and III Recommendation strength: Grade A 9. Quality of evidence: Level II-1, II-3, and III Recommendation strength: Grade A 10. Quality of evidence: Level II-2, II-3, and III Recommendation strength: Grade B 11. Quality of evidence: Level I, II-1, II-3, and III <ol style="list-style-type: none"> a. Recommendation strength: Grade B b. Recommendation strength: Grade C

Recommendations and supporting evidence	Quality of evidence and strength of recommendation
<p>12. “The dose of antibiotic to be administered for surgical prophylaxis should be at the full therapeutic dose of the antibiotic.”¹⁰ (p13)</p> <ul style="list-style-type: none"> This recommendation was informed by two primary studies <p>13. “The first dose of the antibiotic should be administered within 60 minutes prior to the surgical incision.”¹⁰ (p15)</p> <ul style="list-style-type: none"> This recommendation was informed by seven primary studies <p>14.</p> <p>a. “Additional doses of prophylactic antibiotics should be administered if the length of surgery exceeds either two half-lives or half the therapeutic interval of the drug.”¹⁰ (p15)</p> <p>b. “The additional dose strength should be the same as the initial prophylactic dose of the antibiotic.”¹⁰ (p16)</p> <ul style="list-style-type: none"> These recommendations were informed by three primary studies 	<p>12. Quality of evidence: Level II-2 and II-3 Recommendation strength: Grade B</p> <p>13. Quality of evidence: Level II-2, II-3, and III Recommendation strength: Grade B</p> <p>14. Quality of evidence: Level II-1, II-2, and II-3 a. Recommendation strength: Grade B b. Recommendation strength: Grade C</p>

ACS = American College of Surgeons; APBI = accelerated partial breast radiation; APSIC = Asia Pacific Society of Infection Control; ASA = American Society of Anesthesiologists; CDC = Centers for Disease Control and Prevention; CHG = chlorhexidine gluconate; MBP = mechanical bowel preparation; MRSA = *methicillin-resistant Staphylococcus aureus*; NICE = National Institute for Health and Care Excellence; NR = not reported; NRS = non-randomized study; OP = operating room; PPA = perioperative prophylactic antibiotic; RCT = randomized controlled trial; SAP = surgical antibiotic prophylaxis; SR = systematic review; SSI = surgical site infection.

Appendix 5: Additional References of Potential Interest

Previous CADTH Reports

1. Li KX, Grobelna A. Decolonization for the treatment of methicillin resistant staphylococcus aureus: clinical effectiveness and guidelines [*CADTH rapid response report: reference list*]. Ottawa (ON): CADTH; 2019 Jan: <https://cadth.ca/sites/default/files/pdf/htis/2019/RA1005%20ARO%20Decolonization%20Final.pdf> Accessed 2020 Mar 3.
2. Banerjee S, Argáez C. Topical antibiotics for infection prevention: a review of the clinical effectiveness and guidelines [*CADTH rapid response report: summary with critical appraisal*]. Ottawa (ON): CADTH; 2017 Mar: <https://www.ncbi.nlm.nih.gov/books/NBK487430/> Accessed 2020 Mar 3.
3. Chlorhexidine gluconate wipes for infection prevention in acute and critical care: a review of clinical effectiveness and cost-effectiveness [*CADTH rapid response report: summary with critical appraisal*]. Ottawa (ON): CADTH; 2016 Apr: <https://cadth.ca/sites/default/files/pdf/htis/apr-2016/RC0769%20Chlorhexidine%20Wipes%20Final.pdf> Accessed 2020 Mar 3.

Overview of Systematic Reviews

4. Gillespie BM, Walker RM, McInnes E, et al. Preoperative and postoperative recommendations to surgical wound care interventions: a systematic meta-review of Cochrane reviews. *Int J Nurs Stud.* 2020 Feb;102:103486. [PubMed: PM31810020](https://pubmed.ncbi.nlm.nih.gov/31810020/)

Guidelines

Unclear Methodology

5. Consensus guideline on preoperative antibiotics and surgical site infection in breast surgery. Columbia (MD): The American Society of Breast Surgeons; 2018: <https://www.breastsurgeons.org/docs/statements/Consensus-Guideline-on-Preoperative-Antibiotics-and-Surgical-Site-Infection-in-Breast-Surgery.pdf> Accessed 2020 Mar 3.
6. Bonnar P, Dhar P, Rotstein O, et al. Surgical site infection prevention. Toronto (ON): University of Toronto Best Practice in Surgery; 2017 Sep: <http://bestpracticeinsurgery.ca/wp-content/uploads/2017/11/SSI-BPS-CPG-Nov20.pdf> Accessed 2020 Mar 3.
7. Centre for Health Protection. Recommendations on prevention of surgical site infection. 2nd ed. Kowloon, Hong Kong: Scientific Committee on Infection Control, and Infection Control Branch, Centre for Health Protection, Department of Health; 2017 Sep: https://www.chp.gov.hk/files/pdf/recommendations_on_prevention_of_surgical_site_infection_2nd_edition.pdf Accessed 2020 Mar 3.

Summary of WHO 2016 Guideline

8. Allegranzi B, Bischoff P, de Jonge S, et al. New WHO recommendations on preoperative measures for surgical site infection prevention: an evidence-based global perspective. *Lancet Infect Dis*. 2016 Dec;16(12):e276-e287.
[PubMed: PM27816413](#)

Alternative Intervention

9. Don't order peri-operative antibiotics beyond a 24-hour post-operative period for non-complicated instrumented cases in patients who are not at high risk for infection or wound contamination. Administration of a single preoperative dose for spine cases without instrumentation is adequate. Toronto (ON): Choosing Wisely Canada; 2019 Jul: <https://choosingwiselycanada.org/spine/> Accessed 2020 Mar 3.