

AAOS Appropriate Use Criteria Summary

American Academy of Orthopaedic Surgeons Appropriate Use Criteria: Prevention of Surgical Site Infections After Major Extremity Trauma

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ABSTRACT

The Major Extremity Trauma and Rehabilitation Consortium and the American Academy of Orthopaedic Surgeons have developed Appropriate Use Criteria for *the Prevention of Surgical Site Infections (SSIs) After Major Extremity Trauma*. Evidence-based information, in conjunction with the clinical expertise of physicians, was used to develop the criteria to determine appropriateness of various treatments for the prevention of SSIs after major extremity trauma. Scenarios were derived by identifying clinical indications typical of patients suspected of developing an SSI in clinical practice. Indications are most often parameters observable by the clinician, including symptoms or results of diagnostic tests. A total of 588 patient scenarios and 14 treatments were developed by the writing panel, a group of clinicians who are specialists in this Appropriate Use Criteria topic. Next, a separate, multidisciplinary voting panel (made up of specialists and nonspecialists) rated the appropriateness of treatment of each patient scenario using a 9-point scale to designate a treatment as “appropriate” (median rating, 7 to 9), “may be appropriate” (median rating, 4 to 6), or “rarely appropriate” (median rating, 1 to 3).

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The *Appropriate Use Criteria (AUC) for the Prevention of Surgical Site Infections (SSIs) After Major Extremity Trauma* were approved by the American Academy of Orthopaedic Surgeons (AAOS) Board of Directors on March 21, 2022. The purpose of these AUC was to help determine the appropriateness of clinical practice guideline recommendations for the heterogeneous patient population routinely seen in practice. Evidence-based information, in conjunction with the clinical expertise of physicians from multiple medical specialties, was used to develop the criteria to improve patient care and obtain best outcomes while considering the subtleties and distinctions necessary in making clinical decisions. To provide an evidence-based foundation for these AUC, the AAOS Department of Clinical Quality and Value provided the writing and voting panels with the *AAOS/Major*

*Extremity Trauma and Rehabilitation Consortium (METRC) Clinical Practice Guideline on the Prevention of SSI After Major Extremity Trauma*⁷. AAOS staff convened the independent volunteer physician writing and voting panels that developed these AUC.

AAOS and the METRC created these AUC to determine the appropriateness of preoperative, intraoperative, and postoperative interventions to reduce SSIs in patients who have sustained high-energy, severe extremity trauma. These AUC are intended to incorporate injury classification, characteristics of the soft-tissue injury, and patient-specific characteristics along with the intended acute surgical management plan by the treating physicians. These criteria are not intended to be comprehensive or a fixed protocol, and more than one treatment paradigm may be appropriate for a given patient. The use of the AUC should augment existing institutional or other protocols for multidisciplinary care, specific antibiotic management, and transfer to a trauma center with soft-tissue coverage capability. These AUC represent adult patients at their initial presentation without current infection present at the site of injury. The AUC do not guide decision making for children or patients who have not sustained high-energy trauma. The AUC can assist clinicians in identifying specific perioperative and intraoperative interventions to decrease the risk of SSIs in any high-energy extremity trauma injury. The clinician's independent medical judgment, given the individual patient's clinical circumstances, should always determine patient care and treatment.

Potential Harms and Contradictions

The prevention of SSIs after major trauma remains of critical importance to optimize patient outcomes, reduce healthcare costs, and reduce morbidity. SSIs can have a notable effect after major trauma, and the necessary tools required to combat infection vary depending on the clinical scenario, patient, and other factors. Although no single behavior, technique, or tool can provide absolute prevention, the use of multiple technical and protocol-driven steps can lead to optimal benefit for patients. Surgeons must consider a broad approach to the prevention of infection in the setting of major trauma starting immediately as the patient enters the hospital. Specific focus on clinical findings, symptoms, injury mechanism and location, energy of the traumatic injury, clinical time course, and associated contamination is critical for successful prevention. As with any tool, there are specific harms and contraindications to administration of antibiotics, surgical débridement, and staged versus primary stabilization; however, these must

be balanced with the potential opportunities to minimize infection.^{1,2} Débridement, both deep and superficial, can cause loss of soft-tissue coverage and an inability to close wounds, bone loss requiring reconstructive techniques, and even muscle or ligamentous loss leading to loss of function.^{3,4} In addition, in some cases, débridement and tissue damage may make the limb unusable if excessive or in the setting of extensive contamination. In a similar manner, the administration of antibiotics can lead to adverse effects such as increased bacterial drug resistance, anaphylaxis, and nephrotoxicity or ototoxicity. Primary or staged treatment of complex, contaminated wounds may lead to multiple operations, extended lengths of stay, and climbing healthcare-related expenditures.⁵ Although each treatment offers unique opportunities to reduce SSIs, clinical factors and careful situational application is required to maximize their utility. The AUC provide considered and calculated differential effects of treatment and can help guide decision making in these sometimes difficult cases. Each decision has established and specific risks. Owing to the morbidity associated with SSIs, it is critical that surgeons understand and apply treatment decisions in the context of individualized treatment plans for each patient, understanding the likelihood of adverse events and expected potential benefits.

Methods

The AAOS uses the RAND/University of California Los Angeles (UCLA) Appropriateness Method⁶ to assess the appropriateness of a particular treatment.⁷ Two panels participated in the development of the AAOS AUC for *the Prevention of SSIs After Major Extremity Trauma*. Members of the writing panel developed a list of 588 patient scenarios, for which the appropriateness of 14 treatments was evaluated. The voting panel participated in two rounds of voting. During the first round of voting, the panel was given approximately one month to independently rate the appropriateness of each of the provided treatments of each of the relevant patient scenarios using an electronic ballot. After the first round of appropriateness ratings were submitted, AAOS staff calculated the median ratings for each patient scenario and specific treatment. A virtual voting panel meeting was held on Saturday, June 19, 2021.

During this meeting, voting panel members addressed the scenarios/treatments that generated disagreement after the first round of voting. Disagreements occurred when panel members' ratings were distributed on both the "rarely appropriate" and "appropriate" spectrums

Table 1. Patient Factors and the Corresponding Classification of Each Patient Indication

Patient Indications and Classifications	
Injury Classification	1. Closed (Comminuted, Intra-Articular, Vascular Injury; Soft Tissue Compromise: Severe Blistering, Extensive Abrasions, Massive Swelling, Local Ischemia) 2. Gustilo Anderson Type 1 or 2
	3. Gustilo Anderson Type 3A
	4. Gustilo Anderson Type 3B, C
Soft tissue characteristic(s)	1. Closed Injury: Significant Soft Tissue Compromise: (e.g., Fracture, Blisters, Massive Swelling) 2. Open Injury: Minimal/None surface Contamination; Superficial Penetrating Injury 3. Open Injury: Severe Contamination; Marine Event; Military Blasts; High Energy Penetrating Injury; Crush Injury; Compartment Syndrome
Host Factors/Medical Status	1. No or Limited Comorbidities (Healthy, ASA 1-2, Charlson Index ≤ 3) 2. Multiple Comorbidities (Frail, ASA 3-4, Charlson Index ≥ 4)
Surgical Treatment Administered	1. Acute Definitive Internal Fixation (ORIF/IMN)
	2. Acute Definitive External Fixator
	3. Temporary Acute External Fixator, with Plan for Staged Definitive Internal Fixation (ORIF/IMN)

of the rating scale. The voting panel members discussed the list of assumptions, patient indications, and treatments to identify areas that needed to be clarified/edited, so there was a common understanding of assumptions, patient indications, and treatments. After the discussion and subsequent changes, the group completed a second round of appropriateness voting. There was no attempt to obtain consensus about appropriateness.

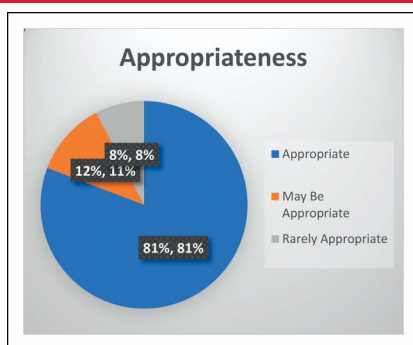
Indications and Classifications

Indications for determining the appropriateness of the various treatments reviewed were determined based on several assumptions. First, these AUC are not intended to be comprehensive or a fixed protocol because some patients may require more or less treatment or different means of diagnosis. Rather, these AUC represent patients and situations that clinicians treating or diagnosing musculoskeletal conditions are most likely to encounter. In addition, these AUC apply only to the initial presentation of adult patients without current infection presenting with high-energy trauma (i.e., most open fractures, most comminuted or intra-articular closed fractures, degloving or Morel-Lavallee injuries, gunshot/blast injuries, crush injuries, and any other injury resulting from moderate to high force). Table 1 provides the list of patient indications and classifications

developed by the *Prevention of SSIs After Major Extremity Trauma* AUC panels.

Treatment Options

1. Prophylactic antibiotics without anaerobic coverage on initial presentation to the medical center
2. Prophylactic Antibiotics with Anaerobic Coverage Upon Initial Presentation to the Medical Center
3. Prophylactic antibiotics at the time of fixation surgery
4. Standard surgical skin preparation with povidone-iodine
5. Standard surgical skin preparation with chlorhexidine
6. Early débridement and irrigation without additives (e.g., castile soap)
7. Débridement and primary closure or soft-tissue coverage
8. Multiple débridements and secondary closure or soft-tissue coverage
9. Local antimicrobial therapy (powdered antibiotic, resorbable depots, PMMA depots)
10. Negative pressure wound therapy inclusive of incisional negative pressure
11. Perioperative normothermia

Figure 1

Pie chart showing the breakdown of appropriateness ratings.

- a. In the context of these AUC, it refers to the maintenance of body temperature at or above 36°C perioperatively.
12. Perioperative glucose control
 - a. In the context of these AUC, it refers to the maintenance of blood glucose levels less than 180 mg/dL preoperatively, during surgery, and during recovery.
13. Supplemental perioperative oxygenation
 - a. In the context of these AUC, it refers to the maintenance of at least 92% oxyhemoglobin saturation as measured by pulse oximetry by titration of supplemental oxygen and return to room air as soon as homeostasis is restored.
14. Change of gloves at regular intervals

Results of Appropriateness Ratings

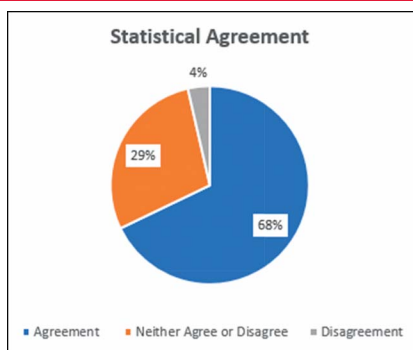
Of 588 total voting items, 475 (81%) were rated as “appropriate,” 68 (12%) were rated as “may be appropriate,” and 45 (8%) were rated as “rarely appropriate” (Figure 1). In addition, the voting panel members were in statistical agreement on 399 voting items (68%) and sta-

tistical disagreement on 21 voting items (4%) (Figure 2). The final appropriateness ratings assigned by the 17 voting panel members of the AAOS *Prevention of SSIs After Major Extremity Trauma* AUC can be accessed using the web-based mobile application www.orthoguidelines.org.

As part of dissemination efforts for the AAOS *Prevention of SSIs After Major Extremity Trauma* AUC, this web-based mobile platform was developed to provide physicians with immediate access to information to assist them with providing evidence-based patient care. The mobile platform includes the list of patient indications and treatment recommendations. After the clinician enters a patient profile specifying Injury Classification (e.g., closed, Gustilo Anderson Type 1 or 2, Gustilo Anderson Type 3A, Gustilo Anderson Type 3B,C), Soft Tissue Characteristic(s) (Closed Injury: Significant Soft Tissue Compromise, Open Injury: Minimal/None Surface Contamination; Superficial Penetrating Injury, Open Injury: Severe Contamination; Marine Environment; Military Blasts; High Energy Penetrating Injury; Crush Injury; Compartment Syndrome), Host Factors/Medical Status (No or Limited Comorbidities [healthy, ASA 1-2, Charlson Index <3], Multiple Comorbidities [Frail, ASA 3-4, Charlson Index.4]), and Surgical Treatment Administered (Acute Definitive Internal Fixation [ORIF/IMN], Acute Definitive External Fixator, Temporary Acute External Fixator, with Plan for Staged Definitive Internal Fixation [ORIF/IMN]), a list of treatment recommendations is provided. For the selected patient profile, green circle “check marks” reflect appropriate treatments, yellow “caution” symbols reflect treatments that may be appropriate, and red circled “X’s” reflect treatments that are rarely considered appropriate.

The complete AUC for *the Prevention of SSIs After Major Extremity Trauma*, including all tables, figures, and appendices, as well as the details of the methods used to prepare these AUC, are available at <https://www.aaos.org/ssitraumaau>.

Prevention of SSIs After Major Extremity Trauma Writing Panel: Ashton Goldman, MD; Kevin Tetsworth, MD; Aidin Eslam Pour, MD, FAAOS; Eric Ricchetti, MD, FAAOS; Ryan Harrison, MD, FAAOS; Robin Patel, MD; Kali Tileston, MD, FAAOS; Christopher Gross, MD, FAAOS; Gregory Della Rocca, MD, FACS, PhD, FAAOS; Utku Kandemir, MD, FAAOS; William Obremskey, MD, MPH; Manjari Joshi, MBBS; Robert O’Toole, MD; and Renan Castillo, PhD. *Voting Panel:* Nicholas Tedesco, DO, FAAOS; Jared Huston, MD; Charles Reitman, MD, FAAOS; Christopher Renninger, MD; Vinay Aggarwal, MD; Amy Steinhoff, MD, FAAOS; Wendy Wong, MD, FAAOS; Jason Strelzow,

Figure 2

Pie chart showing the breakdown of agreement among voting panel members.

MD, FAAOS; Michael Leslie, DO, FAAOS; Julie Adams, MD, FAAOS; Elie Berbari, MD; Jeannie Huh, MD; Michael Bosse, MD, FAAOS; Mike Weaver, MD, FAAOS, FACS; Reza Firoozabadi, MD, FAAOS; Arun Aneja, MD, PhD; and Lauren Tatman, MD. *Voting Panel Moderator*: Antonia Chen, MD, MBA, FAAOS. *Contributing Members*: Clay Spitler, MD, FAAOS; Brian Mullis, MD, FAAOS; and Saam Morshed, MD, FAAOS. *AAOS/METRC Staff*: Ellen MacKenzie, PhD; Jayson Murray, MA; Kaitlyn Sevarino, MBA, CAE; Danielle Schulte, MS; Tyler Verity; and Jennifer Rodriguez.

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