Infection Prevention in Combat-Related Injuries

Part of the Joint Trauma System (JTS) Clinical Practice Guideline (CPG) Training Series
This CPG provides evidence-based guidelines for the prevention of infections in combat casualties.

This presentation is based on the JTS Infection Prevention in Combat-Related Injuries CPG, 27 Jan 2021 (ID: 24). It is a high-level review. Please refer to the complete CPG for detailed instructions. Information contained in this presentation is only a guideline and not a substitute for clinical judgment.
1. Summary
2. Summary of CPG Changes
3. Background
4. Standard Precautions
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6. Post Injury & Antimicrobial Agent Selection & Duration
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Summary

- Precautions should be taken to prevent transmission of organisms between care givers and patients.

- Appropriate antibiotics should be given for specific lengths of time based on injury type.
Summary of CPG Updates

1. New references based on new data from the Trauma Infectious Disease Outcomes Study supporting previous recommendations to limit gram negative therapy for prophylaxis of extremity wounds.

2. The duration of antibiotics for open fractures has been curtailed to only the first 24 hours and re-dosing with subsequent irrigation and debridement.

3. Clarification had been added to describe the cohorting of patients. Long term patients (>72 hours) had been clarified to mean host nation patients; short term (<72 hours) has been clarified to mean U.S. personnel.

4. Expanded antimicrobial stewardship recommendations to include the recommendation for facilities responsible for trauma care to monitor adherence to antimicrobial prophylaxis regimens.

5. Updated reach back information includes the ADvanced VIrtual Support for OpeRational forces (AD.VI.S.OR) network and to the updated Army Infection Control email address.

6. Updated vancomycin dosing to reflect weight-based dosing and clindamycin dosing has been simplified.

7. A tetanus prophylaxis appendix has been added.
The combat environment presents unique challenges to infection control.

- Multiple patient transfers between hospitals and teams
- Austere environment
- Long distance aeromedical evacuation
- Colonization of multi-drug resistant organisms
Standard Precautions

In all patients, regardless of suspected or confirmed infectious status, standard precautions are required to include:

- **Hand Washing**: Perform even if gloves are worn, before patient contact, before aseptic tasks, after body fluid exposure risk, after contact with patients and their surroundings.

- **Gloves**: Use when anticipating direct contact with non-intact skin, mucous membranes, and blood or bodily fluids.
Standard Precautions

Continued...

- **Gowns**: Isolation gowns are specified by standard and transmission-based precautions to protect arms and exposed body areas and prevent contamination of clothing with blood, body fluids and other potentially infectious material. Gowns are always used in conjunction with gloves.

- **Masks**: Protect from contact with infectious materials from patients and from contact with the patient during sterile techniques.

- **Goggles/Face Shields**: Use based on anticipated exposure to eyes. Eyeglasses and contacts are not considered adequate eye protection.
Preventing cross contamination of multi-drug resistant organisms (MDRO) and *C. difficile* requires special precautions:

- **Contact Precautions:** Gloves and gowns should be worn with all patients suspected or known to have MDRO or *C. difficile* infection (CDI).

- **Cohorting:** Cluster long-term (host nation patients, > 72 hour stay) and short-term patients (U.S. personnel), and separate when possible to reduce cross contamination.

- **Skin Care:** ICU patients should undergo daily chlorhexidine gluconate bath. Full protocol available in the CPG Appendix D: Sage Antiseptic Body Cleaning.

- **Antibiotic Control:** Avoid unnecessary empiric broad spectrum antibiotics, use local antibiogram, and limit duration of antibiotic therapy.
Transmission-based Precautions

- A broad array of injury types with prophylactic antibiotic choices along with durations are available in the CPG.
- For each traumatic injury, appropriate antibiotics should be chosen and given based on CPG recommendations.
Post Injury Antimicrobial Agent Selection and Duration based on Injury

<table>
<thead>
<tr>
<th>Injury</th>
<th>Preferred Agent(s)</th>
<th>Alternate Agent(s)</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremity Wounds (Includes Skin, Soft Tissue, and Bone)</td>
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<tr>
<td>Skin, soft tissue, no open fractures</td>
<td>Cefazolin, 2 gm IV q6-8h†‡</td>
<td>Clindamycin (450 mg PO TID or 900 mg IV q8h)</td>
<td>24 hours</td>
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<tr>
<td>Skin, soft tissue, with open fractures, exposed bone, or open joints</td>
<td>Cefazolin, 2 gm IV q6-8h†‡ §</td>
<td>Clindamycin 900 mg IV q8h</td>
<td>24 hours initially and repeat with each subsequent I&amp;D until soft tissue coverage.</td>
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<tr>
<td>Thoracic Wounds</td>
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<tr>
<td>Penetrating chest injury without esophageal disruption</td>
<td>Cefazolin, 2 gm IV q6-8h†‡</td>
<td>Clindamycin (450 mg PO TID or 900 mg IV q8h)</td>
<td>1 day</td>
</tr>
<tr>
<td>Penetrating chest injury with esophageal disruption</td>
<td>Cefazolin, 2 gm IV q6-8h†‡ PLUS metronidazole 500 mg IV q8-12h</td>
<td>Ertapenem 1 gm IV x 1 dose, OR Moxifloxacin 400 mg IV x 1 dose</td>
<td>Stop 24 hours after definitive closure</td>
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<tr>
<td>Abdominal Wounds</td>
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<tr>
<td>Penetrating abdominal injury with suspected/known hollow viscus injury and soilage; may apply to rectal/perineal injuries as well</td>
<td>Cefazolin, 2 gm IV q6-8h†‡ PLUS metronidazole 500 mg IV q8-12h</td>
<td>Ertapenem 1 gm IV x 1 dose, OR Moxifloxacin 400 mg IV x 1 dose</td>
<td>Stop 24 hours after control of contamination</td>
</tr>
<tr>
<td>Maxillofacial And Neck Wounds</td>
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<tr>
<td>Open maxillofacial fractures, or maxillofacial fractures with foreign body or fixation device</td>
<td>Cefazolin, 2 gm IV q6-8h†‡</td>
<td>Clindamycin 900 mg IV q8h</td>
<td>24 hours</td>
</tr>
<tr>
<td>Central Nervous System Wounds</td>
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<tr>
<td>Penetrating brain injury</td>
<td>Cefazolin 2 gm IV q6-8h. †‡Consider adding metronidazole 500 mg IV q8-12h if gross contamination with organic debris</td>
<td>Cetraxone 2 mg IV q24h. Consider adding metronidazole 500 mg IV q8-12h if gross contamination with organic debris. For patients with a history of anaphylaxis or allergies to cephalosporins, vacomycin 15-20mg/kg IV q 8-12h PLUS ciprofloxacin 400 mg IV q8-12h</td>
<td>5 days or until CSF leak is closed, whichever is longer</td>
</tr>
<tr>
<td>Penetrating spinal cord injury</td>
<td>Cefazolin, 2 gm IV q6-8h. †‡ ADD metronidazole 500 mg IV q8-12h if abdominal cavity is involved</td>
<td>As above. ADD metronidazole 500 mg IV q8-12h if abdominal cavity is involved</td>
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</tbody>
</table>
### Post Injury Antimicrobial Agent Selection and Duration based on Injury

<table>
<thead>
<tr>
<th>Injury</th>
<th>Preferred Agent(s)</th>
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<tbody>
<tr>
<td><strong>Eye Wounds</strong></td>
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<tr>
<td>Eye injury, burn or abrasion</td>
<td>Topical: Erythromycin or Bacitracin ophthalmic ointment QID and PRN for symptomatic relief. Systemic: No systemic treatment required</td>
<td>Fluoroquinolone 1 drop QID</td>
<td>Until epithelium healed (no fluorescein staining)</td>
</tr>
<tr>
<td>Eye injury penetrating</td>
<td>Levofloxacin 750 mg IV/PO once daily + vancomycin 15-20 mg/kg IV q8-12h. Prior to primary repair, no topical agents should be used unless directed by ophthalmology</td>
<td>Moxifloxacin 400 mg IV/PO once daily</td>
<td>7 days or until evaluated by an ophthalmologist</td>
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<tr>
<td><strong>Burns</strong></td>
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<tr>
<td>Superficial burns</td>
<td>Topical antimicrobials with daily dressing changes (include mafenide acetate** or silver sulfadiazine; may alternate between the two), OR silver impregnated dressing changed q3-5d, OR Biobrane</td>
<td>Silver nitrate solution applied to dressings</td>
<td>Until healed</td>
</tr>
<tr>
<td>Deep partial thickness burns</td>
<td>Topical antimicrobials with daily dressing changes, OR silver impregnated dressing changed q3-5d, PLUS excision and grafting</td>
<td>Silver nitrate solution applied to dressings PLUS excision and grafting</td>
<td>Until healed or grafted</td>
</tr>
<tr>
<td>Full thickness burns</td>
<td>Topical antimicrobials with daily dressing changes PLUS excision and grafting</td>
<td>Silver nitrate solution applied to dressings PLUS excision and grafting</td>
<td>Until healed or grafted</td>
</tr>
<tr>
<td><strong>Point of Injury/Delayed Evacuation</strong></td>
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<tr>
<td>Expected delay to reach surgical care</td>
<td>Moxifloxacin 400 mg PO x 1 dose. Ertapenem 1 g IV or IM if penetrating abdominal injury, shock, or unable to tolerate PO medications</td>
<td>Levofloxacin 500 mg PO x 1 dose. Cefotetan 2 g IV or IM q12h if penetrating abdominal injury, shock, or unable to tolerate PO medications</td>
<td>Single dose therapy</td>
</tr>
</tbody>
</table>

*Post-injury antimicrobial agents are recommended to prevent early post-traumatic infectious complications, including sepsis, secondary to common bacterial flora. Selection is based on narrowest spectrum and duration required to prevent early infections prior to adequate surgical wound management. This narrow spectrum is selected to avoid selection of resistant bacteria. The antimicrobials listed are not intended for use in established infections, where multidrug-resistant (MDR) or other nosocomial pathogens may be causing infection.

†Cefazolin may be dosed based on body mass: 1 gram if weight < 80 kg (176 lbs), 2 grams if weight 81-160 kg (177-352 lbs), 3 grams if weight > 160 kg (>352 lbs); doses up to 12 grams daily are supported by FDA-approved package insert.
§Pediatric dosing: cefazolin, 20-30 mg/kg IV q6-8h (maximum, 100 mg/kg/day); metronidazole, 15 mg/kg IV q24h; clindamycin 25-40mg/kg/day IV divided q6-8h; ertapenem, 15 mg/kg IV or IM q12 (children up to 12 years) or 20 mg/kg IV or IM once daily (children over 12 years; maximum, 1 gm/day); ceftriaxone, 100 mg/kg/day IV divided q12-24h (dosing for CNS injury); levofloxacin, 8 mg/kg IV or PO q12h (levofloxacin is only FDA-approved in children for prophylaxis of inhalational anthrax in children > 6 months of age, but this dose is commonly used for other indications); vancomycin 60 mg/kg/day IV divided q6h (dosing for CNS injury); ciprofloxacin, 10mg/kg IV (or 10-20mg/kg PO) q12h.
††These guidelines do not advocate adding enhanced Gram negative bacteria coverage (i.e., addition of fluoroquinolone or aminoglycoside antimicrobials) in type III fractures.
**Mafenide acetate is contraindicated in infants less than 2 months of age.
‡‡Post-injury antimicrobial therapy as suggested by the Acute Traumatic Wound Management in the Prolonged Field Care Setting CPG.
Healthcare workers and personnel are at risk for exposure of bloodborne pathogens.

- Blast injuries can introduce bloodborne pathogens if body parts from other people are impaled into the trauma patients.
- Healthcare workers are at risk during care of trauma patients for blood exposure to non-intact skin, eyes or mucosa and during breaks in surgical technique.

If exposed, source testing should be obtained for Hepatitis B (HBV) and C (HCV) Virus, and Human Immunodeficiency Virus (HIV) at time of exposure and 6 months post exposure.
**Bloodborne Pathogens**

- **HBV Exposure:**
  - Military personnel are required to have Hepatitis B vaccines, but confirmation of anti-HGV status is recommended.
  - Hepatitis B Immune Globulin is available for personnel not adequately immunized.

- **HIV Exposure:** 28 days of post-exposure prophylaxis should be administered within 1-2 hours, but no later than 72 hours.

- **HCV Exposure:** No post exposure prophylaxis is available, but testing for the virus can be done.
Infection Control Based on Role of Care

- Role 2 and above should have a designated infection control officer.
- Infection prevention and control or antimicrobial utilization questions can be fielded through ic.consult.army@mail.mil.
- CPG provides general recommendations for each role of care.
### Infection Control Based on Role of Care

<table>
<thead>
<tr>
<th>Common Surgical Diagnoses</th>
<th>Care Category</th>
<th>Recommendations</th>
</tr>
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</table>
| Role 1 (Prehospital)      | Initial care in the field | - Bandage wounds with sterile dressings (avoid pressure over eye wounds)  
                          | - Stabilize fractures  
                          | - Transfer to surgical support as soon as feasible  
                          |
|                           | Post-injury antimicrobials | - Provide single dose point of injury antimicrobials (Appendix B) if evacuation is delayed or expected to be delayed  
                          |
| Role 1 and Role 2 without surgical support (IIa) | Post-injury antimicrobials | - Provide intravenous antimicrobials for open wounds (Appendix B) within 3 hours of injury.  
                          | - Provide tetanus toxoid and immune globulin as appropriate (see Appendix C).  
                          | - Gram negative coverage with aminoglycoside or fluoroquinolone not recommended.  
                          | - Addition of penicillin to prevent clostridial gangrene or streptococcal infection is not recommended.  
                          | - Re-dose antimicrobials if large volume blood product resuscitation.  
                          | - Use only topical antimicrobials for burns.  
                          |
|                           | Debridement and irrigation | - Irrigate minor wounds to remove gross contamination with normal saline, sterile, or potable water without additives.  
                          | - Debridement and irrigation of large wounds should be done at a surgical facility (Role 2b or 3).  
                          | - Do not attempt to remove retained deep soft tissue fragments meeting criteria listed above.  
                          | - Provide cefazolin 2 gm IV x 1 dose.  
                          | - Refer to the [JTS War Wounds: Debridement and Irrigation CPG](#).  
                          |
# Infection Control Based on Role of Care

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| Role 2 with surgical support and Role 3 | Post Injury Antimicrobials | • Provide intravenous antimicrobials (Appendix B), within 3 hours of injury.  
• Provide tetanus toxoid and immune globulin as appropriate (Appendix C).  
• Re-dose Cefazolin with each debridement until bone has soft tissue coverage (Appendix B).  
• Gram negative coverage with aminoglycoside or fluoroquinolone not recommended.  
• Addition of penicillin to prevent clostridial gangrene or streptococcal infection is not recommended.  
• Re-dose antimicrobials if large volume blood product resuscitation.  
• Use only topical antimicrobials for burns.  
• Refer to the *JTS Invasive Fungal Infection CPG* for dismounted blast injuries, high amputations, and cases of recurring necrosis on staged debridements.  
• Provide post splenectomy immunizations if indicated. (See the *JTS Blunt Abdominal Trauma, Splenectomy, and Post-splenectomy Vaccination CPG.*).

| Debridement and irrigation | | • Refer to the *JTS War Wounds: Debridement and Irrigation CPG.*
• Antimicrobial beads pouches, or topical powder may be used.
• Do not attempt to remove retained deep soft tissue fragments if criteria above are met.
• Do not obtain cultures unless infection is suspected.
• Do not attempt primary wound closure (except for dura and face).

| Other Surgical Irrigation | | N/A |
Infection Control: Role 4

Infection Control Based on Role of Care

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<tr>
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</table>
| Role 4                      | Post-injury antimicrobials  | • Re-dose Cefazolin for 24 hours with each subsequent washout involving exposed bone.  
• Antimicrobial beads or pouches may be used.  
• Refer to the *JTS Invasive Fungal Infection CPG* for dismounted blast injuries, high amputations, and cases of recurring necrosis on staged debridements.  
• Provide post splenectomy immunizations if not documented. (See the *JTS Blunt Abdominal Trauma, Splenectomy, and Post-splenectomy Vaccination CPG*.) |
| Debridement and irrigation  | N/A                        | • Refer to the *JTS War Wounds: Debridement and Irrigation CPG*.  
• Do not attempt to remove retained deep soft tissue fragments if criteria above are met.  
• Do not obtain cultures unless infection is suspected.  
• Wounds should not be closed until 3-5 d post-injury when wound is clean and all devitalized tissue is removed. |
| Other surgical management   | N/A                        |                                                                                                                                         |
Intent (Expected Outcomes)

- All patients in the population of interest receive the preferred or alternate antibiotic, or reason for different choice is documented.
- All patients in population of interest have antibiotic administered within 3 hours of injury.
- All patients in population of interest have a duration of prophylactic antibiotic use less than 72 hours, or documentation of reason for extended use.
- All patients in population of interest admitted to the ICU have daily antiseptic body cleaning (for example, Sage, Chlorhexadine).

Data Source

- Patient Record
- Department of Defense Trauma Registry
Performance/Adherence Measures

- Number and percentage of patients in the population of interest who receive the preferred or alternate antibiotic.
- Number and percentage of patients in the population of interest who receive other antibiotics (or and reason for different choice of antibiotics is documented).
- Number and percentage of patients in the population of interest who have an antibiotic administered within three hours of injury.
- Number and percentage of patients in the population of interest who have a duration of prophylactic antibiotic use less than 72 hours or documentation of reason for extended use.
- Number and percentage of patients in the population of interest admitted to the ICU that have antiseptic body cleaning daily.
Appendices

- **Appendix A**: Recommendations to Prevent Infections Linked To Combat-related injuries
- **Appendix B**: Post-injury Antimicrobial Agent Selection and Duration
- **Appendix C**: Tetanus Prophylaxis Recommendations
- **Appendix D**: Post Exposure Management of Personnel
- **Appendix E**: Chlorhexidine Antiseptic Body Cleaning
- **Appendix F**: Additional Information Regarding Off-label Uses in CPGs
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