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Owner of the document	Antibiotic Resistance Task Force, Antibiotic Stewardship subgroup Chief author: Marcio Da Fonseca Editor: Emma Veitch
Contact email	antibiotic-resistance@msf.org
Contributors, in alphabetical order	MSF Antibiotic Stewardship contact group: Marjolein de Bruycker, Kate Clezy, Caroline Henry-Ostian, Carolina Jiménez, Rupa Kanapathipillai, Ernestina Repetto, Emma de Miguel Other MSF working groups : Surgical Working group Gynecology and Obstetrics Working group Critical Care Working group External reviewers: Maria Eugenia Gómez, Clint Murray, Trisha Peel, Rosana Rangel, Jose Manuel Ruiz-Giardin, Juan Víctor San Martín
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Antibiotic Prophylaxis for Non-Trauma and Trauma Surgical Procedures

Abbreviations and Acronyms

ABR	Antibiotic Resistance
ABS	Antibiotic Stewardship
AMR	Antimicrobial Resistance
AST	Antibiotic Susceptibility Testing
CNS	Central Nervous System
CoNS	Coagulase-Negative *Staphylococcus*
CSF	Cerebrospinal Fluid
GAS	Group A *Streptococcus* (*S. pyogenes*)
GBS	Group B *Streptococcus* (*S. agalactiae*)
GI	Gastrointestinal
GU	Genitourinary
GNB	Gram-Negative Bacilli
GPC	Gram-Positive Cocci
HCAI	Healthcare Associated Infection
ID	Infectious Diseases
IM	Intramuscular
IPC	Infection Prevention and Control
IV	Intravenous
MDR	Multi-Drug Resistant
MRCoNS	Methicillin-Resistant Coagulase-Negative *Staphylococcus*
MSCoNS	Methicillin-Susceptible Coagulase-Negative *Staphylococcus*
MRSA	Methicillin-Resistant *Staphylococcus aureus*
MSSA	Methicillin-Susceptible *Staphylococcus aureus*
PO	*Per os* (oral)
SSI	Surgical Site Infection
XDR	Extensively Drug-Resistant

Definitions and Classifications

Surgical Site Infections

Surgical site infections (SSI)[1] are healthcare associated infections (HCAIs) that occur in the part of the body where surgery took place. They occur within 30 days of an operation (or, when an implant is left in place, within one year), where the infection is judged related to the surgery. There are three types of SSI:

- **Superficial Incisional Infections**: Involve only skin or the subcutaneous tissue of the incision.
- **Deep Incisional Infections**: Involve the deep soft tissues of the incision (e.g. fascial and muscle layers).
- **Organ/Space Infection**: Involves any part of the body that is opened/manipulated during the operative procedure except for skin incisions, fascia, or muscle layers. Organ/space infections often occur as intra-cavitary abscesses, peritonitis, endocarditis, pneumonia, empyema, mediastinitis, endometritis, vaginal cuff infection, urinary tract infections, endophthalmitis, osteomyelitis, septic arthritis, meningitis, ventriculitis, or brain abscess.

Surgical Wound Classification by Degree of Contamination

These definitions are based on the references in[2].

- **Clean Wounds**

An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.

- **Clean-Contaminated Wounds**

These are operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered. No evidence of infection is found (note: most Caesarean sections in an MSF setting are classified as clean-contaminated).

- **Contaminated Wounds**

Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (eg, open cardiac massage) or gross spillage from the gastrointestinal tract and incisions in which acute, non-purulent inflammation is encountered, including necrotic tissue without evidence of purulent drainage (eg, dry gangrene), are included in this category.

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[1]Mangram AJ et al. 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 Apr;27(2):97-132.

[2]National Healthcare Safety Network (NHSN) Wound Class, based on an adaptation of the American College of Surgeons classification. https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf (Accessed on June 16, 2017).

- **Dirty (Infected) Wounds**

Includes old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition covers the scenario whereby the organisms causing postoperative infection were present in the operative field before the operation.

Dosing

For details of dosing, see Section 3, Table 3.1.

- **Pre-operative ("Pre-op") Dose**

Refers to antibiotic(s) administered **before** surgery: ideally within 60 minutes of incision (60-120 minutes also acceptable; compulsory if using Ciprofloxacin or Vancomycin).

- **Intra-operative ("Intra-op") Dose**

Refers to antibiotics that need be re-administered ("re-dosing") **during** the course of a longer surgery, especially when there is significant blood loss, or when using antibiotics with shorter half-lives (like Cefazolin).

- **Post-operative ("Post-op") Dose**

Used mostly in trauma cases when antibiotic use may continue **after** the surgery, for a limited time.

Section 1: Introduction

"The best antibiotic is good surgery"
ICRC War Surgery Guidelines

Proper surgical technique is the most fundamental method for preventing SSI's. Teams carry primary responsibility for preventing SSIs, by using meticulous surgical techniques, implementing proper infection prevention and control (IPC) measures throughout all procedures, and post-operatively. For trauma, early, aggressive, extensive, and often repeated surgical debridement is the primary mode for preventing or eradicating infection, especially in contaminated or infected wounds.

Prophylactic antibiotics complement good surgical practice by decreasing the burden of microorganisms in the surgical field during the procedure, from incision to closure. Antibiotics target the most likely pathogenic bacteria but are not intended to provide coverage for all possible microorganisms, or to "sterilize" the wound.

How to Use This Chapter

Recommendations are given for non-trauma, and trauma surgeries separately. For each, procedures for which prophylactic antibiotics are recommended, are listed according to the anatomic site of operation, or by injury. The respective antibiotic options, followed by guidance on dosing and administration, are also provided. Definitions are given for severe drug reactions, SSI's, and wound classification by degree of contamination. When in doubt or in need of additional input, contact your Infectious Diseases (ID), Antimicrobial Resistance (AMR), Surgery, and/or Health Advisor.

Antibiotic Choices

The antibiotic recommendations given in this guide are in line with current evidence and recent guidelines and reviews, with input from MSF and external experts. These recommendations aim to maximize patient protection while minimizing negative consequences (such as **Antibiotic Resistance**, ABR) and adverse effects.

The pathogenic causes of SSI's are predictable, and mostly involve the patient's own bacteria at the surgical site: 'clean' surgeries usually involve skin pathogens, while 'clean-contaminated' and 'contaminated' surgeries (see "definitions and classifications") additionally involve microbes from the viscus. Trauma may also introduce environmental pathogens, depending on the degree of wound contamination, and any delays which have occurred in reaching proper care.

Modifications to antibiotic recommendations in this guideline are only warranted if:

- Active surveillance of SSI's is available, including microbiologic diagnosis (culture/ antibiotic susceptibility testing; AST), and these show an increased incidence of SSI's caused by resistant bacteria
- Continuous access to a microbiology laboratory is available to diagnose SSI's and to properly adapt, and de-escalate, empiric antibiotic treatment regimens
- The facility has an active antibiotic stewardship program (ASP)
- Other IPC measures to prevent SSI's and hospital-based multidrug resistant/extensively drug-resistant (MDR/XDR) transmission are properly implemented
- The ID specialist/AMR advisor agrees with the proposed changes

Use of more "advanced" or "last-resort" antibiotics such as Carbapenems (Meropenem) or Vancomycin should only happen under strict controls that restrict access, require justification for use, undertake prospective audits, and demand authorization prior to use.

When to Use Prophylactic Antibiotics

All MSF surgical patients for whom there is an indication should benefit from antibiotic prophylaxis. For non-trauma surgeries, antibiotic prophylaxis is recommended for most 'clean-contaminated' procedures and selected 'clean' operations. In trauma surgeries, wounds are contaminated and demand longer antibiotic administration. For patients referred to surgery in non-MSF health units, the guidelines here can also be suggested to the clinical team providing surgical care. Importantly however, once a patient returns to an MSF facility, the unnecessary prolongation of prophylactic antibiotics should be avoided.

Timing and Duration of Administration

Optimal antibiotic concentrations must be present within tissue, when an incision is made and throughout a procedure (but **not afterwards**, unless trauma-related). Evidence shows that prolonged antibiotics do not provide additional protection but **do increase the risk** of ABR. If a tourniquet is used, complete all infusions at least 5-15 minutes before the tourniquet is inflated. Most non-trauma, clean, or clean-contaminated surgeries only need a single, pre-operative dose of prophylactic antibiotics. Intra-operative re-dosing is required only in cases of prolonged surgeries, when using antibiotics with shorter half-lives. This is particularly relevant for Cefazolin (table 3.1), or whenever estimated blood loss is greater than 1.5 liters (or 25 mL/kg for children). Prolongation of prophylactic antibiotics due to the presence of drains or intravenous (IV) catheters is **not** recommended. For trauma-related contaminated wounds, short post-operative antibiotic use is recommended for some procedures.

Severe Allergies or Hypersensitivities to any Penicillin or Cephalosporin

Use alternative antibiotics (non beta-lactams) in cases with a history of previous anaphylaxis (such as hypotension/shock, respiratory distress, angioedema, bronchospasm, urticaria); exfoliating skin reactions (Stevens-Johnson syndrome, toxic epidermal necrolysis), or any severe

systemic reaction. Recommendations for alternative antibiotics are presented for each procedure. For a non-severe allergy to any penicillin, Cefazolin is a safe option.

Prophylaxis vs Treatment

These guidelines refer to prophylactic antibiotic use for the **prevention** of SSI's. For patients who are diagnosed with an infection before, during, or after a procedure, transition to antibiotic **treatment** (see appropriate MSF guidelines and other relevant sources). For hospitals with microbiology laboratory access, including culture/AST, adjust antibiotic use according to AST results. Targeted therapy with de-escalation should always be done if possible.

For patients already receiving an antibiotic treatment regimen for a remote infection prior to surgery, aim to provide an extra dose of this same antibiotic treatment regimen 60-120 minutes before the surgery as prophylaxis. The duration of time to administer this antibiotic before surgery will depend on the specific drug in use. Add more antibiotics only if coverage is insufficient, contact the ID/ABR advisor, and take in account renal function and the total daily dose. All open wounds must be assessed to establish whether there is a need for tetanus prophylaxis. Animal bites and other exposures should be assessed to determine whether rabies prophylaxis is needed (see MSF Clinical Guidelines).

Section 2: Antibiotic Recommendations

Figure 1: Antibiotic Prophylaxis Regimens*

Regimen 1	**Cefazolin**
	Basic regimen - targets skin bacteria
Regimen 2	**Cefazolin + Metronidazole**
	Adds coverage for anaerobic bacteria to regimen 1
Regimen 3	**Cefazolin + Metronidazole + Gentamicin**
	Adds coverage for Gram-negative bacilli (GNB) to regimen 2

*For those with severe beta-lactam allergies, see below, under each procedure, for the recommended antibiotic regimen, duration, or alternative regimens. For doses, see Table 3.1.

Part I: Non-Trauma Surgical Procedures

All antibiotic regimens should be administered pre-operatively (for timing of pre-op antibiotics, intra-op redosing, and duration, see above "When to Use Antibiotics" and Table 3.1). For osteomyelitis-related surgery when microbiological sampling is planned, see Annex 2.1.

1.1 Skin and Soft Tissue

Indicated only for clean-contaminated plastic procedures (involving viscus incision) and skin grafting for chronic wounds.

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin

1.2 Orthopedic

This indication covers surgery with implantation of any foreign material (e.g. internal fixation hardware), any hip or spine surgery (with or without instrumentation) or reconstructive surgery (e.g. for bone defect related to osteomyelitis; includes skin grafting procedures).

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin
Notes	For surgical procedures collecting Osteomyelitis samples for microbiological diagnosis (culture/AST), see annex 2.1 for timing of antibiotic administration in relation to sampling.

1.3 Head & Neck

Indicated in the case of:

- Maxillo-facial clean surgeries (no incision through mucosa), but with placement of prosthetic material (exception: tympanostomy, not indicated)
- Neurosurgery: craniotomy (including CSF shunt procedures)

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin

- Maxillo-facial, clean-contaminated surgeries (incision through oral, nasal, pharyngeal or esophageal mucosa – exceptions: tonsillectomy, adenoidectomy or septoplasty - not indicated)

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	Clindamycin

1.4 Thoracic

Indicated in the case of open chest surgery (but not for chest tube insertion, unless trauma – see Trauma section).

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin

1.5 Abdominal (Gastrointestinal)

Indicated in the case of all clean-contaminated procedures, and selected clean procedures.

1.5.1 Clean surgeries

- Gastro-duodenal **high-risk** clean surgeries: perforation; obstruction; cancer; decreased gastric motility or bleeding or lower acidity (e.g. omeprazole use); morbid obesity; severely immunocompromised.
- Hernia repair using mesh – hernioplasty (prophylaxis is not recommended for hernia repairs done without mesh – herniorrhaphy).

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin; add **Gentamicin** for gastro-duodenal surgery

1.5.2 Clean-contaminated surgeries

- Esophageal or gastro-duodenal clean-contaminated surgeries (mucosa incision).
- Biliary surgery: open surgery/laparotomy.
- Small intestine surgeries without obstruction.

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin + **Gentamicin**

- Small Intestine with obstruction.
- Appendectomy, non-perforated (uncomplicated) appendicitis.
- Lower GI tract (colon and rectum).

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	**Metronidazole** + **Gentamicin**

1.5.3 Potentially contaminated

Indicated in the case of exploratory laparotomy with suspicion of perforated viscus. If intra-abdominal infection is diagnosed, proceed with antibiotic treatment.

Antibiotic Prophylaxis	**Cefazolin + Metronidazole + Gentamicin** (Regimen 3)
Alternative	**Metronidazole** + **Gentamicin**

1.6 Genitourinary

Indicated in the case of:

- Instrumentation of upper or lower urinary tract
- For lower tract, only if high-risk: positive urine culture, or urine culture not done; urinary catheter; placement of prosthetic material; or any manipulation e.g. biopsy.
- **Important**: placement of vesical/urinary catheter is **not** an indication for antibiotic prophylaxis.

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternatives	**Cotrimoxazole** PO (**Sulfamethoxazole/Trimethoprim** 800/160 mg 60 minutes before the procedure) Children: 4 mg/Kg of Trimethoprim component, or **Gentamicin** IV

- Open genitourinary tract surgery - entry via urinary tract

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	**Clindamycin**

- Open genitourinary surgery - entry via digestive tract

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	**Metronidazole** + **Gentamicin**

1.7 Gynecologic and Obstetric

Antibiotic Prophylaxis is indicated for:

- Obstetric procedures: caesarean section; manual removal of placenta, manual uterine exploration.
- Gynecologic procedures: hysterectomy (abdominal or vaginal, laparotomy or laparoscopy); ectopic pregnancy (laparotomy); pelvic reconstruction (urinary incontinence, uterine prolapse).

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)

Alternative	**Clindamycin + Gentamicin**

- Repair of 3rd or 4th degree perineal tears after delivery (anal sphincter lesions).

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	**Clindamycin + Gentamicin**

- Termination of pregnancy (surgical, manual vaccum aspiration).

Antibiotic Prophylaxis	• **Doxycycline** 200 mg PO 60 minutes before procedure • **Azithromycin** 500 mg-1 g or **Metronidazole** 500 mg-1 g PO are alternatives • May use **Doxycycline** 400 mg PO 10-12 hours before the procedure (may decrease nausea by avoiding using it on an empty stomach 1 hour before the procedure)

(Note: For treatment recommendations, such as endometritis and chorioamnionitis/intra-amniotic infections, and for prevention of *Streptococcus agalactiae*/GBS neonatal disease, see MSF Obstetric and Neonatal Guidelines).

1.8 Other

Vascular surgery (including placement of permanent access for hemodialysis and amputation due to ischemia, but excluding brachiocephalic procedures):

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	**Clindamycin**

Ophthalmic surgery (excluding intra-vitreal injections):

Antibiotic Prophylaxis	• **Ciprofloxacin** 0.3% eye drops - one drop every 5-15 minutes for a total of 5 doses in the hour before the procedure • for invasive higher-risk globe procedures, may add a single dose of subconjunctival **Cefazolin** (100 mg) or intra-cameral **Cefazolin** (1 mg) at the end of the procedure – to be decided by the ophthalmic surgeon

Part II: Trauma-Related Surgery

The required duration of antibiotic prophylaxis for most trauma surgical procedures is longer than that for non-trauma surgery – see below and Section 3.

2.1 Skin and Soft Tissue

Indicated in the case of:

- Wounds requiring formal surgical debridement: high energy or velocity projectile injury, gross contamination, extensive wounds.

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	**Clindamycin**
Duration	24 hours

- Skin grafting.
- Burns – only for excision and grafting definitive surgery (for dressings, only topical **Silver Sulfadiazine**).

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	**Clindamycin**
Duration	Pre-op (+ intra-op if redosing needed)

- High-risk human or animal bites (deep puncture wounds; wounds to face or hands; joints, tendons, ligaments or fractures; very contaminated wounds or those requiring debridement; patient is immunocompromised).

Antibiotic Prophylaxis	**Amoxicillin/Clavulanate** (ideally oral - PO)
Alternative	**Clindamycin + Cotrimoxazole** (for adults and children >8 years, may substitute Cotrimoxazole for Doxycycline)
Duration	5 days

2.2 Extremities – Bone and Joint

Indicated in the case of:

2.2.1 Closed fracture surgical treatment (including any implant/hardware); or local/regional flaps/fasciotomy; or skin grafting

2.2.2 Surgical amputation

2.2.3 Open fractures Gustilo I & II; Gustilo III if <6 hours from trauma; traumatic arthrotomy and/or traumatic dismemberment/amputation

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin

Duration	2.2.1: Pre-op (+ intra-op if redosing needed) 2.2.2: 24 hours 2.2.3: 24-72 hours. A longer duration required if: • ≥ 6 hours from trauma to surgical debridement • ≥ 3 hours from trauma to first dose of antibiotics • Gross contamination • Multiple wounds

2.2.4 Open fractures Gustilo III ≥6 hours from trauma

Antibiotic Prophylaxis	**Cefazolin + Metronidazole + Gentamicin** (Regimen 3)
Alternative	**Clindamycin** + **Gentamicin**
Duration	72 hours
Notes	For 2.2.1, 2.2.2, and 2.2.3, if early discharge, may continue with **Amoxicillin/Clavulanate** PO to complete 72 hours

2.3 Skull and Spine

Indicated in the case of:

- Craniotomy for closed head injury

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	**Clindamycin**
Duration	Pre-op (+ intra-op if redosing needed)

- Open (penetrating) skull or spine trauma without gross contamination nor penetrating abdominal cavity nor esophageal lesion

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin
Duration	5 days or until CSF leak closed, whichever longer

- Open (penetrating) skull or spine trauma with gross contamination or with penetrating abdominal cavity or with esophageal lesion

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	Clindamycin
Duration	5 days or until CSF leak closed, whichever longer

2.4 Maxillofacial, Neck and Chest

2.4.1 No mucosal penetration

Indicated in the case of:

- Maxillofacial closed fracture surgery with implants, or open fracture surgery – but no mucosal incision for both

- Blunt trauma - chest tube (thoracostomy): **only if hemothorax**

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin
Duration	Pre-op (+ intra-op if redosing needed)

- Penetrating neck/chest trauma without esophageal injury (with or without chest tube)

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)
Alternative	Clindamycin
Duration	24 hours

2.4.2 Mucosal penetration

Indicated in the case of:

- Maxillofacial fracture - incision through oral, nasal, pharyngeal or esophageal mucosa

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	**Clindamycin**
Duration	Pre-op (+ intra-op if redosing needed)

- Penetrating neck/chest trauma with esophageal injury (with or without chest tube)

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	**Clindamycin + Gentamicin**
Duration	Continue for 1 day after definitive debridement/wash out (max: 3 days)

2.5 Abdominal

Indicated in the case of:

- Penetrating abdominal injury without hollow viscus perforation

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	**Metronidazole + Gentamicin**
Duration	Pre-op (+ intra-op if redosing needed)

- Perineal injuries

Antibiotic Prophylaxis	**Cefazolin + Metronidazole** (Regimen 2)
Alternative	**Clindamycin + Gentamycin**
Duration	Continue for 1 day after definitive debridement/wash out (max: 3 days)

- Abdominal injury with hollow viscus perforation (suspected or confirmed), rectal injuries

Antibiotic Prophylaxis	**Cefazolin + Metronidazole + Gentamicin** (Regimen 3)
Alternative	**Metronidazole + Gentamycin**
Duration	Continue for 1 day after definitive debridement/wash out (max: 3 days)

2.6 Eye

Indicated in the case of:

- Burns or abrasions (non-penetrating trauma)

Antibiotic Prophylaxis	**Tetracycline** ophthalmic ointment - apply 4 times a day (or more times as needed for symptomatic relief) until epithelium healed (total 3 days or 24 hours after pain resolves, whichever shorter)

- Penetrating/open eye injury, globe salvageable

Antibiotic Prophylaxis	**Ciprofloxacin -** Until surgical repair, max: 7 days (longer if specialist evaluation is delayed; may use PO)
Alternative	**Cefazolin + Gentamycin**. If severe penicillin/cephalosporin allergy, substitute **Cefazolin** for **Clindamycin**
Notes	Intra-ocular (intra-vitreum) administration of antibiotics at the discretion of the ophthalmologist.

- Penetrating/open eye injury, destruction/loss of globe, enucleation/evisceration

Antibiotic Prophylaxis	**Cefazolin** (Regimen 1)**;** continue for 24 hours after debridement/enucleation
Alternative	**Clindamycin**

Section 3: Antibiotic Dosages for Surgical Prophylaxis and Trauma

Table 3.1: Antibiotic Dosages for Surgical Prophylaxis and Trauma (pre-op, intra-op, and post-op)

Antibiotic	Pre-op Dose[1]		Intra-op Redosing[3]	Post-op Doses for Trauma[4]	
	Adult >40 kg	Children[2] <40 kg		Adult	Children and Neonates
Cefazolin	<120 Kg: 2 g IV ≥120 Kg: 3 g IV	30 mg/kg IV (max: 2 g)	4 hours	IV: 2 g/dose every 8 hours	• IV: 25 mg/Kg/dose every 8 hours (max: 2 g/dose) • Neonates: same dose (unless <2 Kg **or** <7 days: 25 mg/kg/dose every 12 hours)
Ciprofloxacin[5]	400 mg IV	10 mg/Kg IV	Not applicable (12 hours)	• IV: 400 mg/dose every 12 hours • PO: 500 mg/dose every 12 hours	• IV: 10 mg/Kg/dose every 12 hours (max: 400 mg/dose) • PO: 15-20 mg/Kg/dose every 12 hours (max: 750 mg/dose) • Neonates: same dose
Clindamycin[6]	900 mg IV	10 mg/kg IV	6 hours	• IV: 600-900 mg/dose every 8 hours • PO: 600 mg/dose every 8 hours	• IV/PO: 10 mg/kg/dose every 8 hours (max: 600 mg/dose) • Neonates: 5 mg/kg/dose every 8 hours (unless < 2Kg **and** < 7 days: same dose every 12 hours)
Gentamicin[7]	5 mg/kg IV	5 mg/kg IV	Not applicable (24 hours)	IV: 5 mg/kg/dose every 24 hours	• 5 mg/kg/dose every 24 hours • Neonates: same dose (unless < 2Kg **and** <7 days: 3 mg/kg every 24 hours)
Metronidazole[8]	500 mg IV	15 mg/kg IV Neonates <1.2Kg: 7.5 mg/Kg	Not applicable (8 hours)	IV/PO: 500 mg/dose every 8 hours	• IV/PO: 10 mg/kg/dose every 8 hours (max: 500 mg/dose) • Neonates: • >2Kgs AND >7 days: use pediatric dose above • <2 Kg OR ≤7 days: loading dose: 15 mg/kg, then 7.5 mg/Kg/dose every 12 hours

1) Only antibiotics recommended for surgical prophylaxis are included here. For other antibiotics used for treatment indications, see MSF Essential Drugs and other MSF guidelines.
2) Maximum dose per day and/or per dosage: see Adult doses (should not surpass adult recommended doses).
3) Time from initial pre-op dose, **not** from incision. If "Not applicable", next dose follows routine dosing recommendations (see "post-op doses"). Redosing also always recommended in case of major blood loss: >1.5 liters for adults or >25 mL/Kg for children – use same regimens and doses used for pre-op. Consider earlier re-dosing as well for severe burns (>20% total body surface area, excluding first degree burns).
4) If renal impairment, dose adjustments may be necessary – calculate the estimated creatinine clearance (Cockcroft-Gault formula) and adjust accordingly (see Pathogen-Specific Antibiotic Guidelines).
5) Slow IV infusion over 60 minutes – differs from other recommended antibiotics in this protocol. Start **Ciprofloxacin** infusion earlier, between 120 and 60 minutes before incision. For pediatrics, use only if no other alternative.
6) Administer as diluted solution by slow IV infusion over 30 minutes.
7) Administer as diluted solution by slow IV infusion over 30 to 60 minutes. For neonates or small children, may consider slow IV infusion over 5 minutes (see MSF Pediatric Guidelines). If no creatinine monitoring possible, limit to maximum 5 days of use + maintain good hydration + avoid other nephrotoxic drugs. Obese patients: if the patient's actual weight is >20% above the ideal body weight (IBW), the dosing weight (DW) to calculate the dose to be administered should be calculated as: DW = IBW + 0.4*(actual weight – IBW).
8) Slow IV infusion over 30 minutes.

Annex 1: Empiric Antibiotic Treatment for Surgical Site Infections

Non-Trauma Surgeries

Likely Pathogens: Clean Wounds	
Skin Microbiota	• Gram-positive cocci (GPC), especially *Staphylococcus aureus* methicillin-susceptible (MSSA) • Risk of methicillin-resistant *S. aureus* (MRSA) depends on local prevalence and risk factors • *Streptococcus pyogenes* (group A, GAS) • Gas gangrene due to *Clostridium* sp. is rare with proper infection control, antisepsis and hygiene

- If a foreign body is present (e.g. prosthesis, drains, catheters, hardware); also *Staphylococcus* coagulase-negative (CoNS - most commonly *S. epidermidis;* most are methicillin-resistant, MRCoNS).
- If incision on the perineum or axilla: also enteric gram-negative bacilli – *Enterobacteriaceae* (e.g. *Escherichia coli, Klebsiella pneumoniae, Enterobacter* sp, etc), and anaerobes.

Likely Pathogens: Clean-Contaminated and Contaminated Wounds (Viscus Penetration)	
Skin bacteria + resident bacteria from microbiota of manipulated viscus mucosa	Usually gram-negative bacteria, mostly *Enterobacteriaceae* (coliforms), and anaerobes (progressively more Clindamycin-resistant descending the GI tract).

- For respiratory tract: also pathogens such as *S. pneumoniae, H. influenzae* and *M. catarrhalis.*
- For genital tract: also sexually transmitted pathogens such as *N. gonorrhoeae* and *Chlamydia trachomatis*: for obstetric complications, also *Ureaplasma urealyticum* and *Mycoplasma* sp.

Note: if there is severe immunodeficiency (e.g. advanced HIV infection WHO stage 4 or CD4<200/mm3; cancer; neutropenia; severe malnutrition), increased overall risk of GNB, including *Pseudomonas aeruginosa* if neutropenia.

Before prescribing antibiotics, always check for recent antibiotic use, hospitalization, risk of MDR bacteria, (discuss with ABS MD or ID/AMR advisor), and the patient's drug allergy history.

When culture/AST results are available, adjust the antibiotic regimen in use (targeted therapy): narrow the spectrum (de-escalate) or, if resistant pathogens are present, change to an active

antibiotic. However, for intra-abdominal and pelvic infections (especially abscesses), **always keep coverage for anaerobes** (ideal: Metronidazole or Amoxicillin/Clavulanate - for lower GI, Clindamycin less desirable due to risk of *Bacteroides* sp. resistance).

Source control is **essential** for cure (e.g. drainage of collections, debridement, foreign body removal/exchange if possible/indicated, relief of obstructions).

Incisional SSI

Most cases resolve **without antibiotics** (only local care). Antibiotics are indicated only if there is erythema >5cm from the margins of the incision, or systemic signs of infection eg, fever >38°C, tachycardia, tachypnea or leucocytosis.

Minimum duration for treatment for incisional SSI is as follows:

- **Mild infection** - 3-5 days (PO).
- **Severe infection** (sepsis, organ dysfunction, hypotension/shock, toxemia): 5-10 days (total IV + PO – shift to PO antibiotics after important clinical improvement).
- Duration may need to be extended if slow response or complications (e.g. abscesses).

Necrotizing Fasciitis merits urgent surgical assessment – aggressive and repeated debridement is essential for cure. Continue antibiotics for **2 weeks after definitive debridement**.

Table A1.1: Empiric Antibiotic Therapy - Incisional Surgical Site Infections

Surgery	Empiric Antibiotic
Clean, no foreign body	• PO (mild): Cloxacillin or Cephalexin • Severe: IV Cloxacillin or Cefazolin
Foreign body	• PO (mild): Clindamycin (alt: Cloxacillin or Cephalexin) • Severe: Vancomycin (alt: Clindamycin)
Axillar/perineum incision	• PO (mild): Amoxicillin/Clavulanate (alt: Cephalexin) • Severe: Cloxacillin + Ceftriaxone + Metronidazole
Immunosuppression (severe)	• PO (mild): Cephalexin or Amoxicillin/Clavulanate • Severe: Cloxacillin + Ceftriaxone (alt: + Ceftazidime)
Clean-Contaminated or Contaminated (GI, GU)	• PO (mild): Cephalexin or Amoxicillin/Clavulanate • Severe: Cloxacillin + Ceftriaxone + Metronidazole
Necrotizing Fasciitis	• IV: Cloxacillin + Ceftriaxone + Clindamycin • or Amoxicillin/Clavulanate + Clindamycin
Observations	
Vancomycin (or Clindamycin) instead of Cefazolin/ Cloxacillin is preferred in cases of: Sepsis or Necrotizing Fasciitis **and:** high prevalence of MRSA **or** MRSA colonization **or** previous MRSA infection **or** foreign body.	

Organ/Space SSI

For most, antibiotics are key for cure (with **source control**, if indicated). Duration depends on the site of infection and aetiology; shorter therapy is warranted if early source control is achieved. Most demand initial IV antibiotics; however, shifting to oral antibiotics is possible for

most infections if: clinical response by 48-72 hours of antibiotics is evident, **and** proper source control has been achieved, **as well as** that infections do not involve the Central Nervous System (CNS).

Table A1.2: Empiric Antibiotic Therapy – Organ Space Surgical Site Infections

Surgical Site/Organ	Empiric Antibiotic	Duration	Observation
Clean Wounds			
Head & Neck (excl. CNS) Orthopedic Vascular	**Cloxacillin** or **Cefazolin**	Abscess: 7-14 days Bacteremia: 7-14 days Osteomyelitis: 4-6 weeks Septic Arthritis: 2-3 weeks	• Preference for Vancomycin (or Clindamycin) over Cefazolin/Cloxacillin if: high prevalence of MRSA; MRSA colonization or previous infection; foreign body. • If perineum/axilla incision: add Ceftriaxone + Metronidazole.
CNS	**Cloxacillin** + **Ceftazidime** (alt: + **Ceftriaxone**)	Meningitis: 2-3 weeks Abscess: 4-8 weeks	Preference for **Vancomycin** over **Cloxacillin**: same criteria as above.
Clean-Contaminated or Contaminated Wounds			
Head & Neck	**Ceftriaxone** + **Clindamycin** (alt: + **Metronidazole**); or **Amoxicillin/Clavulanate**	Abscess: 10-14 days	
Thorax	**Ceftriaxone** + **Clindamycin** (or + **Metronidazole**); or **Amoxicillin/Clavulanate**	Pneumonia: 5-7 days Empyema: 10-14 days Mediastinitis: 3 weeks	If severe pneumonia + criteria for MRSA above, add **Vancomycin**.
Abdominal	**Ceftriaxone** + **Metronidazole** (or + **Clindamycin** if upper GI) Biliary: add **Ampicillin**	5-10 days (shorter if complete source control)	For complicated intra-abdominal infections diagnosed only during exploratory laparotomy, use the same regimen (e.g. peritonitis; abscess; appendicitis w/ perforation or gangrene; acute cholecystitis w/ empyema or cholangitis; hernia with ischemia or perforation).
Genito-urinary	**Ciprofloxacin** (add **Metronidazole** if GI incision)	Cystitis: 3 days Pyelonephritis: 5 -10 days	For cystitis without obstruction: also **Nitrofurantoin** or **Fosfomycin** (PO)
Obs & Gyn.	**Ampicillin** + **Gentamicin** + **Metronidazole**	7-10 days	If no creatinine monitoring, preference for **Ceftriaxone** if >5 days of Gentamicin

Trauma Surgeries

Traumatic wounds are **different** from non-trauma surgery.

- In **non-trauma surgery**, most procedures are clean or clean-contaminated and antibiotics can be provided **before** incision.
- In **trauma surgery**, the wounds are contaminated or already dirty/infected at presentation and **antibiotics cannot be started** before "incision".

This is reflected in a **longer** recommended administration of antibiotics. If signs of infection are already noted at presentation (or during surgery), proceed with **full treatment** regimens; otherwise provide antibiotics as recommended in the prophylaxis tables above.

The time from trauma to antibiotic administration and surgical treatment (debridement and irrigation) is crucial: the longer this delay, the higher the risk of infection.

If multiple wounds are present,
use an antibiotic regimen covering all likely pathogens with the longest duration.

The most likely pathogens in trauma surgeries include the same bacteria from the human microbiota that cause SSIs in non-trauma surgery (see above). However, environmental pathogens are also important in heavily contaminated wounds, especially if surgical treatment is delayed.

Table A1.3: Empiric Antibiotic Treatment – Most Likely Pathogens in Trauma Surgeries

Wound Characteristics	Additional Pathogens
Gross soil contamination	*Clostridium perfringens* (and other clostridia), *Bacillus cereus* (and other *Bacillus* sp) and *P. aeruginosa* (and other *Pseudomonas* sp and GNB)
Important water exposure	*Aeromonas hydrophila, Vibrio* sp and *P. aeruginosa*
Severe burns	GNB: *P. aeruginosa* and *Enterobacteriaceae* (late infections, also *Candida* sp)
Animal bites (cats, dogs)	*Pasteurella multocida* (resistant to Cephalexin/Cefazolin, Cloxacillin, Clindamycin) and *Capnocytophaga canimorsus*
Human bites	*Eikenella corrodens* and various oral anaerobes

The same antibiotic regimens recommended for non-trauma surgery can be used for trauma related infections, according to anatomic site – see tables above. However, additions or changes may be needed depending on particular exposures or characteristics of trauma: see table below.

Table A1.4: Empiric Antibiotic Treatment for Trauma Related Infections (Including Surgery)

Trauma		Antibiotic Changes/Additions
Soft Tissue	Burns (severe)	**Cloxacillin** (or **Cefazolin**) + **Ceftazidime** (or **Ciprofloxacin** or **Gentamicin**)
	Bites	**Amoxicillin/Clavulanate**
	Gross soil contamination	**Amoxicillin/Clavulanate**
Post-Traumatic Osteomyelitis		**Clindamycin + Ciprofloxacin**

Skull & Spine: GI perforation, or penetrating w/ gross contamination, or paranasal sinus involvement	Add **Metronidazole** to **Cloxacillin + Ceftazidime**
Endophthalmitis post-open globe trauma	**Vancomycin** (or **Clindamycin**) + **Ceftazidime**, via intravitreal route if possible (may need vitrectomy for severe cases; associate also antibiotics IV).
Notes	
• **Vancomycin** (or **Clindamycin** if no CNS infection) is preferred instead of Cefazolin/Cloxacillin with: Sepsis, necrotizing fasciitis, or CNS infection **and:** a high prevalence of MRSA **or** MRSA colonization **or** previous MRSA infection **or** foreign body. • In cases of Necrotizing Fasciitis: add **Clindamycin** to the recommended antibiotic regimen.	

Annex 2: Orthopedic Surgery

Osteomyelitis Sampling and the Timing of Antibiotics

Antibiotics for the treatment of osteomyelitis should ideally be guided by the results of culture/AST after testing representative deep samples (bone and deep tissue/fluids) collected during surgery.

- Antibiotics in use (prophylactic or therapeutic, especially if ≥72 hours) decrease the yield of cultures.

The following scenarios should be considered, with respective recommendations:

Antibiotics for Treatment of Osteomyelitis

- In cases where acute osteomyelitis is suspected or confirmed but the patient is not yet on empirical antibiotic treatment:
    - The initiation of antibiotics should be **postponed** until after sampling if: procedure foreseen within 72 hours **and** no signs of severity (no toxaemia/sepsis, no neurologic signs or compressive phenomena, no necrotizing fasciitis). Otherwise, start immediately after collection of blood cultures.
    - For patients with strong suspicion of acute hematogenous osteomyelitis due to *S. aureus* (e.g. obvious skin port of entry for bacteraemia, or child osteomyelitis), **do not delay start of antibiotic treatment ≥ 12 hours**.
- In cases where osteomyelitis patient is already on empiric antibiotic treatment (e.g. referrals) but needs new sampling procedure:
    - **Temporarily stop** the antibiotics for sampling: if possible for **at least 72 hours** before the procedure; if not severe, wait results to start directed therapy.
    - If **chronic osteomyelitis** (especially if hardware and/or posttraumatic): **at least 1 week** without antibiotics*;* wait results to start directed therapy.
- In all severe cases / unstable patients (e.g. sepsis, toxaemia, neurologic signs, necrotizing fasciitis):
    - **Immediately start empirical antibiotic treatment** after collection of blood cultures; if already in use, do not stop.

Antibiotics for Prophylaxis in Osteomyelitis-Related Surgery

- In cases of surgery for sampling / microbiological diagnosis (culture/AST) of **confirmed or suspected** osteomyelitis*:*
    - **Delay** administration of prophylactic antibiotics until **after** sampling: the "pre-op" dose (or the empiric antibiotic treatment) should be postponed and administered "intra-op" just after sampling - this includes both surgery for debridement of infected tissue or reassessment after osteomyelitis treatment failure.

- In cases of surgery where microbiological sampling is **foreseen**, but suspicion of active osteomyelitis is low or absent: (e.g. second-stage reconstructive surgery for after apparent successful osteomyelitis antibiotic treatment):
    - **Do not delay** administration of prophylactic antibiotics (provide pre-op dose as recommended).
- In cases of **revision surgery** with sampling because there are doubts that osteomyelitis has been cured (resolved):
    - **Delay antibiotic prophylaxis until after sampling** (administer "intra-op" after sampling).

Important: for initial surgical treatment of fractures (acute phase of trauma, damage control surgery), do NOT collect material for culture/AST if there is no suspicion of active infection at that time.

Staphylococcus aureus (MSSA & MRSA) Pre-Op Decolonization

- Pre-op identification of nasal carriers of *Staphylococcus aureus* (MRSA or MSSA) followed by decolonization may decrease their risk of SSI in orthopaedic surgery.

Pre-op *S. aureus* decolonization may be considered for hospitals with a high volume of orthopaedic surgery using hardware implantation. This is particularly the case for hospitals facing high SSI rates, in spite of having proper IPC measures in place, or if they are already doing active MRSA colonization screening for IPC purposes. The decolonization scheme involves five days with twice daily intranasal Mupirocin 2% cream + daily Chlorhexidine 2% showers. There are two possible implementation approaches:

- Screen patients in pre-operatively using microbiology lab capacity (nasal swab cultures, ideally including AST for Mupirocin) + proceed with **targeted decolonization** for positive cases.
- Universal decolonization, without screening, for all patients undergoing orthopedic surgery with hardware implantation (monitoring for Mupirocin resistance is desirable in whatever strategy, if possible).

Both strategies may be considered for MSF hospitals that offer orthopedic surgery with internal fixation (e.g. those that have the laboratory capacity, volume of surgeries, human resources, supplies, IPC activities already in place, level of resistance, ministry of health plans, etc).

Gustilo Classification

Table A2.1: Gustilo Classification

	Gustilo Type				
Parameter	**I**	**II**	**IIIA**	**IIIB**	**IIIC**
Energy	Low energy	Moderate	High	High	High
Wound size	< 1 cm	> 1cm	>10cm	>10cm	>10cm
Soft tissue	Minimal	Moderate	Extensive	Extensive	Extensive

Contamination	Clean	Moderate contamination	Extensive	Extensive	Extensive
Fracture pattern	Simple fx pattern with minimal comminution	Moderate comminution	Severe comminution or segmental fractures	Severe comminution or segmental fractures	Severe comminution or segmental fractures
Periosteal stripping	No	No	Yes	Yes	Yes
Skin coverage	Local coverage	Local coverage	Local coverage including	Requires free tissue flap or rotational flap coverage	Typically requires flap coverage
Neurovascular injury	Normal	Normal	Normal	Normal	Exposed fracture with arterial damage that requires repair

Annex 3: Antibiotic Tables

For neonatal doses, see Table 3.1. All antibiotics to be administered IV within 60 minutes of incision unless specified.

Non-Trauma Surgeries

Duration of antibiotic prophylaxis for all procedures: give only pre-op doses (and intra-op for longer procedures).

Table A3.1.1: Antibiotic Dosages for Non-Trauma Surgery – Skin and Soft Tissue

Surgical procedures	Antibiotics
Clean-contaminated plastic procedures (incl. skin grafting for chronic wounds)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)

Table A3.1.2: Antibiotic Dosages for Non-Trauma Surgery – Orthopedic

Surgical procedures	Antibiotics
Clean surgery with implantation of any foreign material (e.g. internal fixation hardware), any hip or spine surgery (with or without instrumentation)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Reconstructive surgery (including related to osteomyelitis and skin grafting)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)

Table A3.1.3: Antibiotic Dosages for Non-Trauma Surgery – Head and Neck

Surgical procedures	Antibiotics
Maxillo-facial - clean: only if placement of prosthetic material	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Maxillo-facial - clean-contaminated (incision through mucosa)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)
Neurosurgery: craniotomy (including CSF shunt procedures)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)

Table A3.1.4: Antibiotic Dosages for Non-Trauma Surgery - Thoracic

Surgical procedures	Antibiotics

Open chest surgery (incl. cardiac device insertion)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)

Table A3.1.5: Antibiotic Dosages for Non-Trauma Surgery – Abdominal (Gastrointestinal)

Surgical procedures	Antibiotics
Appendectomy, non-perforated (uncomplicated) appendicitis	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole**
Biliary: open surgery / laparotomy	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Exploratory laparotomy with suspicion of perforated viscus	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Gentamicin** 5 mg/kg **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)
Gastroduodenal: clean surgeries – only if **high risk**	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Esophageal or Gastroduodenal: clean-contaminated surgeries	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Hernia repair using mesh (hernioplasty)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Lower GI tract (colon and rectum)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)
Small Intestine: **without** obstruction	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Small Intestine: **with** obstruction	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)

Table A3.1.6: Antibiotic Dosages for Non-Trauma Surgery - Genitourinary

Surgical procedures	Antibiotics
Genitourinary clean-contaminated surgery (entry via digestive tract lumen)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)
Lower urinary tract instrumentation - only if **high risk**; or upper urinary tract instrumentation	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Open genitourinary tract surgery (entry via urinary tract lumen)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)

Table A3.1.7: Antibiotic Dosages for Non-Trauma Surgery – Gynecologic and Obstetric

Surgical procedures	Antibiotics
Cesarean Section	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Ectopic Pregnancy - Laparotomy	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Hysterectomy (abdominal, vaginal, laparotomy, laparoscopic)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Manual removal of placenta, manual uterine exploration	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Pelvic reconstruction (urinary incontinence, uterine prolapse)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)
Repair of 3rd or 4th degree perineal tears after delivery	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500mg; children: 15 mg/kg (max: 500 mg)
Termination of Pregnancy (surgical, manual vacuum aspiration)	**Doxycycline** (PO) 200 mg 60 min before procedure (children: 4.4 mg/Kg, max: 200 mg)

Table A3.1.8: Antibiotic Dosages for Non-Trauma Surgery - Other

Surgical procedures	Antibiotics
Ophthalmic surgery **excluding intravitreal injections**	**Ciprofloxacin** 0.3% one drop every 5-15 minutes, total of 5 doses in the hour before; for invasive higher risk globe procedures, subconjunctival **Cefazolin** (100 mg) or intra-cameral **Cefazolin** (1 mg) at the end – to be decided by the ophthalmic surgeon.
Vascular surgery (including placement of permanent access for hemodialysis and amputation due to ischemia) **excluding brachiocephalic procedures**	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)

Trauma Surgeries

Table A3.2.1: Antibiotic Dosages for Trauma Surgery – Soft Tissue

Anatomic Region & Injury	Antibiotics	Duration
Bites (human or animal) – only if high risk	**Amoxicillin/Clavulanate** (PO) (see MSF Clinical Guidelines for dose)	5 days
Burns - dressings	**Silver Sulfadiazine** (topical)	Until healed or grafted
Burns - excision and grafting definitive surgery; skin grafting for other indications	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30mg/Kg (max: 2g)	Pre-op (+ intra-op)

Wounds requiring formal surgical debridement: high energy/velocity projectile injury, gross contamination, extensive wounds	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	24 hours

Table A3.2.2: Antibiotic Dosages for Trauma Surgery – Extremities (Bone & Joint)

Anatomic Region & Injury	Antibiotics	Duration
Amputation (surgical)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	24 hours
Closed fractures surgical treatment (including any implant/hardware)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	Pre-op (+ intra-op)
Local/regional flaps/fasciotomy; skin grafting	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2g)	Pre-op (+ intra-op)
Open fractures Gustilo I & II; Traumatic arthrotomy and/or traumatic dismemberment/amputation	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	24 – 72 hours
Open fractures Gustilo III (<6 hours from trauma)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2g)	24 – 72 hours
Open fractures Gustilo III (≥6 hours from trauma)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30mg/Kg (max: 2g) **+ Gentamicin** 5 mg/kg **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)	72 hours

Table A3.2.3: Antibiotic Dosages for Trauma Surgery – Skull and Spine

Anatomic Region & Injury	Antibiotics	Duration
Craniotomy for closed head injury	**Cefazolin** <120 Kg: 2 g; ≥120 Kgs 3 g; children: 30 mg/Kg (max: 2 g)	Pre-op (+ intra-op)
Open (penetrating) skull or spine trauma without gross contamination nor penetrating abdominal cavity nor esophageal lesion	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	5 days or until CSF leak closed (whichever longer)
Open (penetrating) skull or spine trauma with gross contamination or with penetrating abdominal cavity or with esophageal lesion	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg	5 days or until CSF leak closed (whichever longer)

	(max: 500 mg)	

Table A3.2.4: Antibiotic Dosages for Trauma Surgery – Maxillofacial, Neck & Chest

Anatomic Region & Injury	Antibiotics	Duration
Blunt trauma - chest tube (thoracostomy): **only if hemothorax**	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	Pre-op (+ intra-op)
Maxillofacial closed fracture – surgery w/ implants but no mucosal incision (oral, nasal, pharyngeal or esophageal)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	Pre-op (+ intra-op)
Maxillofacial fracture - incision through mucosa	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)	Pre-op (+ intra-op)
Maxillofacial open fracture surgery but no mucosal incision	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	Pre-op (+ intra-op)
Penetrating chest trauma without esophageal injury (with or without chest tube)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	24hs
Penetrating neck/chest trauma w/ esophageal injury (with or without chest tube)	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)	Continue for 1 day after definitive debridement/wash out (max: 3 days)

Table A3.2.5: Antibiotic Dosages for Trauma Surgery - Abdominal

Anatomic Region & Injury	Antibiotics	Duration
Abdominal injury with hollow viscus perforation (suspected or confirmed), rectal injuries	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Gentamicin** 5 mg/kg **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)	Continue for 1 day after definitive debridement/wash-out (max: 3 days)

Penetrating abdominal injury without hollow viscus perforation	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)	Pre-op (+ intra-op)
Perineal injuries	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g) **+ Metronidazole** 500 mg; children: 15 mg/kg (max: 500 mg)	Continue for 1 day after definitive debridement/wash out (max: 3 days)

Table A3.2.6: Antibiotic Dosages for Trauma Surgery - Eye

Anatomic Region & Injury	Antibiotics	Duration
Burns or abrasions (non-penetrating trauma)	**Tetracycline** ophthalmic ointment 2 applications/day (more frequent depending on pain)	Until epithelium healed (3 days or 24 hours after pain resolves, whichever shorter)
Penetrating/open eye injury, globe salvageable	**Ciprofloxacin:** IV: 400 mg/dose, PO: 500 mg/dose - every 12 hours Children: IV: 10 mg/Kg/dose every 12 hours (max: 400 mg/dose), PO: 15-20 mg/Kg/dose every 12 hours (max: 750 mg/dose)	Until surgical repair, max: 7 days (longer if specialist evaluation is delayed - PO)
Penetrating/open eye injury, destruction/loss of globe, enucleation/evisceration	**Cefazolin** <120 Kg: 2 g; ≥120 Kg: 3 g; children: 30 mg/Kg (max: 2 g)	24 hours after debridement/enucleation

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