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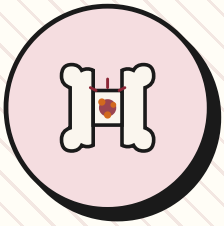
Osteomyelitis

A serious bacterial infection of bone tissue marked by inflammation, vascular compromise, and necrosis. Requires **prolonged IV antibiotics** (4–6 weeks) and meticulous wound management.



SYSTEM: MUSCULOSKELETAL × INFECTIOUS DISEASE

1 Definition & Overview

FOUNDATION

Osteomyelitis is an **acute or chronic infection of bone** involving the cortex, marrow, and/or periosteum. Infection triggers inflammation that **compresses blood vessels inside the rigid bone**, cutting off circulation and causing bone death (**sequestrum**). New bone (**involucrum**) may form around the dead tissue but cannot eradicate the infection without antibiotics and often surgical debridement.

- **Acute:** < 4 weeks duration — responds to IV antibiotics
- **Chronic:** > 4 weeks or recurrent — sequestrum present, very hard to cure
- **#1 organism:** **Staphylococcus aureus** (~80% of cases, MRSA increasingly common)

Quick Facts

MOST COMMON CAUSE	S. aureus / MRSA
SICKLE CELL PT	Salmonella!
PUNCTURE THRU SHOE	Pseudomonas
BEST EARLY IMAGING	MRI
GOLD STANDARD DX	Bone biopsy
ANTIBIOTIC DURATION	4–6 weeks IV
KEY LABS ↑	WBC, ESR, CRP

2 Pathophysiology

MECHANISM

From Pathogen to Bone Necrosis

Bacteria enter the bone, multiply within the rigid cortex, raise intramedullary pressure, and shut down local blood supply — leading to dead bone (sequestrum) that becomes a sanctuary for ongoing infection.

1. **Invasion** — Bacteria reach bone via blood, contiguous tissue, or trauma
2. **Inflammation** — WBCs & cytokines flood bone → edema, pus
3. **Pressure** — Rigid cortex traps swelling → vessels compressed
4. **Ischemia & Necrosis** — Bone dies → forms **sequestrum**
5. **Chronicity** — New bone (**involucrum**) walls off infection → sinus tract drainage

Three Routes of Entry

01 Hematogenous

Bacteria travel through the **bloodstream** from a distant source (UTI, pneumonia, IV drug use). Most common in **children** — often affects long bones (femur, tibia).

↑ RISK: IV DRUG USE, BACTEREMIA

02 Contiguous Spread

Infection spreads from **adjacent soft tissue** — diabetic foot ulcers, pressure injuries, cellulitis, sinusitis. Most common in **adults**.

↑ RISK: DIABETES, PVD, PRESSURE INJURY

03 Direct Inoculation

Bacteria enter through **open trauma, surgery, or puncture wound**. Common after open fractures, orthopedic hardware, joint replacements.

↑ RISK: OPEN FX, SURGERY, GUNSHOT

Who's at Risk?

Vascular

- Diabetes mellitus
- Peripheral vascular disease
- Sickle cell disease (→ Salmonella)

Immune

- Immunocompromised (HIV, chemo)
- Chronic corticosteroid use
- Malnutrition, alcoholism

Trauma / Surgical

- Open fractures, deep wounds
- Recent orthopedic surgery / hardware
- Prosthetic joints, IV drug use

3 Signs & Symptoms

ASSESSMENT CUES

Acute Osteomyelitis < 4 WK

- ⚠ **High fever** (often > 101°F / 38.3°C), chills
- ⚠ **Constant, pulsating bone pain** — worse with movement, unrelieved by rest
- ⚠ Localized **warmth, redness, swelling** over affected bone
- ⚠ Restricted ROM, guarding of the extremity
- ⚠ Malaise, fatigue, anorexia
- ⚠ Tachycardia, possible hypotension if bacteremic
- ⚠ ↑ WBC (left shift), ↑ ESR, ↑ CRP

Chronic Osteomyelitis > 4 WK

- ★ **Persistent drainage from sinus tract** — foul-smelling, may contain bone fragments
- ★ **Non-healing ulcer** overlying infected bone
- ★ Low-grade or absent fever (often afebrile)
- ★ Dull, achy bone pain that comes and goes
- ★ Thickening / deformity of bone on imaging
- ★ **Sequestrum** (dead bone) visible on X-ray
- ★ Risk of **pathologic fracture** through weakened bone

RED FLAGS — Escalate Immediately

Signs of **sepsis** (T > 101°F, HR > 100, RR > 22, AMS, hypotension) • **Pathologic fracture** (sudden severe pain, deformity) • **Unrelieved pain** despite analgesics • **Compartment syndrome** (the 6 P's) • Sudden purulent drainage with fever

4 Priority Nursing *Interventions*

ABCS → SAFETY → COMFORT

1 Cultures BEFORE Antibiotics

Obtain **blood cultures × 2 and wound/bone cultures** before the first antibiotic dose. After abx start, organism may not grow → empiric therapy continues blindly.

2 Long-term IV Antibiotics (4–6 wk)

Anticipate **PICC line or central line** placement. Administer empiric vancomycin until cultures return, then narrow spectrum. Monitor peak/trough levels.

3 Immobilize the Extremity

Use **splint, cast, or traction** to rest the bone, reduce pain, and **prevent pathologic fracture** through weakened cortex. Maintain proper alignment.

4 Neurovascular Checks (CSM)

Assess **Color, Sensation, Movement, pulses, cap refill** distal to infection every 1–2 hours. Watch for the **6 P's of compartment syndrome**.

5 Sterile Wound Care

Use **strict aseptic technique** for dressing changes. Document drainage amount, color, odor. Prepare for surgical debridement of necrotic bone.

6 Contact Precautions if MRSA

Private room, gown + gloves, dedicated equipment. Educate visitors. Hand hygiene before/after EVERY contact.

7 Pain Management — Around the Clock

Bone pain is **severe and constant**. Give scheduled analgesics (not PRN only). Reassess pain 30–60 min after each dose. Use non-pharm adjuncts (positioning, heat/cold).

8 Nutrition for Bone Healing

High-protein, high-calorie diet. Push **vitamin C** (collagen), **vitamin D + calcium** (bone matrix), iron, zinc. Monitor blood glucose tightly if diabetic.

5 Pharmacology

HIGH-YIELD DRUG PROFILES

DRUG / CLASS	COVERS	KEY ADVERSE EFFECTS	NURSING PEARLS
Vancomycin *Glycopeptide*	**MRSA**, gram (+) including resistant strains. *First-line empiric.*	Nephrotoxicity, ototoxicity, **Red Man Syndrome** (infusion reaction), thrombophlebitis	Infuse over **≥ 60 min**. Trough 15–20 mcg/mL. Monitor BUN/Cr, hearing. Hold for trough > 20.
Nafcillin / Oxacillin *Penicillinase-resistant PCN*	**MSSA** (methicillin-sensitive S. aureus)	Interstitial nephritis, hepatotoxicity, phlebitis, hypersensitivity	Verify **no PCN allergy**. Rotate IV sites. Monitor LFTs, BUN/Cr.
Cefazolin *1st-gen cephalosporin*	MSSA, streptococci, some gram (-)	GI upset, rash, rare anaphylaxis	**~10% cross-reactivity with PCN allergy**. Watch for C. diff with prolonged use.
Ciprofloxacin *Fluoroquinolone*	**Pseudomonas**, gram (-). Oral option for step-down therapy.	**Tendon rupture** (Achilles), QT prolongation, CNS effects, C. diff, photosensitivity	Avoid in < 18 y/o. Don't take with dairy/antacids/iron. **Stop if tendon pain**.
Clindamycin *Lincosamide*	Gram (+), anaerobes, some MRSA. Good bone penetration.	**C. difficile colitis** (highest risk!), rash, hepatotoxicity	Stop & report any new-onset diarrhea. Take with full glass of water.
Gentamicin *Aminoglycoside*	Gram (-), used with PCN/cephalosporin for synergy	**Nephrotoxicity, ototoxicity** (hearing loss, vertigo), neuromuscular blockade	Monitor peak (5–10) & trough (< 2). Daily BUN/Cr. Report tinnitus, vertigo immediately.

6 NCLEX Test *Traps*

WRONG VS RIGHT

✗ COMMON WRONG ANSWER	✓ NCLEX-CORRECT ACTION
✗ Stopping antibiotics after fever & pain resolve (only ~1 wk in)	✓ **Complete the full 4–6 weeks** of IV antibiotics — even if symptom-free
✗ Choosing **X-ray** as best early imaging	✓ **MRI** is most sensitive in early disease; X-ray changes lag 10–14 days
✗ Treating bone pain as **PRN only**	✓ Give analgesics on a **scheduled, around-the-clock** basis
✗ Encouraging full weight-bearing ambulation early	✓ **Immobilize** to prevent pathologic fracture
✗ Sickle cell + bone pain + fever → "vaso-occlusive crisis only"	✓ Sickle cell + bone infection → suspect **Salmonella osteomyelitis**
✗ Starting antibiotics **before** obtaining cultures	✓ Obtain **cultures FIRST**, then start empiric antibiotics
✗ Using clean (not sterile) technique for dressing changes	✓ **Sterile technique** for all dressing changes
✗ Routine wound care for the cesium-style implant… wait — that's a different topic 😉	✓ For acute infection priority = ABCs & sepsis screening

7 Patient *Education*

DISCHARGE TEACHING

Medication Adherence

- **Complete the FULL course** of antibiotics (4–6 weeks) even if you feel better
- Stopping early causes recurrence and antibiotic resistance
- Report side effects: rash, diarrhea, hearing changes, tendon pain
- Don't take fluoroquinolones with dairy, antacids, iron, or calcium

PICC Line / Home IV Care

- Keep insertion site clean & **dry**; cover before showering
- Hand hygiene before every line access
- Watch for redness, swelling, drainage, fever — call provider
- No swimming, no BP cuff or labs in PICC arm

Nutrition for Bone Healing

- **Protein** (eggs, lean meat, beans) at every meal
- **Vitamin C** (citrus, peppers, berries) for collagen formation
- **Calcium + Vitamin D** for bone remodeling
- Tight **glucose control** if diabetic — high sugar feeds bacteria

Signs to Report Immediately

- Fever > 101°F (38.3°C), chills, new pain
- Increased redness, warmth, swelling, or drainage
- Foul odor from wound or sudden gush of drainage
- Sudden inability to bear weight (possible fracture)

Activity & Mobility

- Follow weight-bearing restrictions (often non- or partial-WB)
- Use assistive devices (crutches, walker) as prescribed
- Elevate the affected extremity to reduce swelling
- Range-of-motion exercises only as directed by PT

Follow-up & Labs

- Weekly **CBC, ESR, CRP** labs to monitor response
- Drug levels for vancomycin/gentamicin (peak & trough)
- Repeat MRI or X-ray as ordered to assess healing
- Keep ALL provider, lab, and home health appointments

8 Memory *Boosters*

MNEMONICS & PATTERNS

"BONE" — Core Concepts

B **Bone pain — constant & pulsating**
Worse with movement; unrelieved by rest

O **Organism = S. aureus #1**
Salmonella in sickle cell; Pseudomonas in puncture-thru-shoe

N **Necrosis = Sequestrum**
Dead bone fragments; harbor chronic infection

E **Extended antibiotics (4–6 wk IV)**
Via PICC; complete the FULL course

"SOS" — Bone Infection Emergencies

S **Sequestrum present**
Surgical debridement needed — antibiotics alone won't work

O **Open sinus tract drainage**
Foul, purulent; chronic osteomyelitis hallmark

S **Sepsis brewing**
Fever + tachycardia + AMS → escalate STAT

Pattern Pearls

Sickle cell pt + bone pain + fever? → Think Salmonella osteo, not just crisis.
Diabetic foot ulcer non-healing? → Probe to bone test (+) = osteo until proven otherwise.
Vanc trough > 20? → Hold dose, call provider, check renal function.
Sudden severe pain in immobilized limb? → Suspect pathologic fracture or compartment syndrome.

9 NCJMM Clinical *Judgment*

SIX-STEP MODEL

▼ Clinical Scenario

A with poorly controlled Type 2 diabetes presents to the ED with a . He now reports increased pain, fever, and yellow-green drainage from the wound. He has a history of peripheral neuropathy and continues to ambulate on the foot.

BP 138/82 | HR 102 | RR 20 | SpO_2 96% | T 101.8°F | WBC 18,500 | ESR 82 | CRP 14.5 | Glucose 312 | X-ray: bony erosion

1 RECOGNIZE CUES

What's relevant?

Concerning: Non-healing diabetic ulcer × 6 wk, fever 101.8°F, purulent drainage, ↑ WBC (18.5K), ↑ ESR (82), ↑ CRP (14.5), tachycardia (HR 102), bony erosion on X-ray, hyperglycemia (312). **Risk factors:** Uncontrolled DM, peripheral neuropathy, continued weight-bearing.

2 ANALYZE CUES

What do the cues mean together?

Clinical picture strongly suggests **acute osteomyelitis via contiguous spread** from the diabetic foot ulcer. Inflammatory markers + bony changes + systemic signs raise concern for **bacteremia and impending sepsis**. Hyperglycemia is impairing immune response and feeding the infection.

3 PRIORITIZE HYPOTHESES

What's most urgent?

#1 Acute osteomyelitis with risk of sepsis (life-threatening). **#2** Uncontrolled hyperglycemia worsening infection. **#3** Risk of amputation if treatment delayed. **#4** Pain management. Sepsis recognition trumps all other concerns — apply ABCs first.

4 GENERATE SOLUTIONS

What interventions are appropriate?

Obtain **blood & wound cultures BEFORE antibiotics** → begin empiric IV vancomycin + piperacillin-tazobactam → insert IV access (2 large-bore) → fluid resuscitation per sepsis protocol → consult orthopedics for debridement → consult endocrinology for glycemic control → MRI to confirm bone involvement → non-weight-bearing status with splinting → sterile dressing changes.

5 TAKE ACTIONS

What does the nurse do — and in what order?

Immediate: ABCs, monitor cardiac rhythm, draw cultures × 2 + lactate + CMP. **Within 1 hr (sepsis bundle):** administer broad-spectrum IV antibiotics, give 30 mL/kg crystalloid bolus if hypotensive or lactate > 2. **Ongoing:** initiate insulin drip for glucose > 180, schedule PICC placement for long-term abx, perform sterile wound care, immobilize the foot, around-the-clock analgesia, monitor I&O hourly.

6

How do we know it's working?

Expected over hours–days: ↓ fever, ↓ HR, hemodynamic stability, glucose < 180. **Days–weeks:** trending ↓ WBC, ESR, CRP; cultures becoming negative; decreased drainage; improving wound appearance; return of distal pulses;

EVALUATE OUTCOMES

pain reduction. **Re-evaluate:** If markers worsen, suspect resistant organism, abscess, or need for surgical intervention — escalate.