

Ciprofloxacin: Indications, MOA, Dosage and Side effects

Ciprofloxacin is a 4-quinolone derivative. It is a fluorinated analogs of **nalidixic acid**.

Ciprofloxacin is highly active against gram-negative bacteria and moderately active against gram-positive bacteria.

Class: Fluoroquinolone antibiotic (4-quinolone derivative; fluorinated nalidixic acid analog)

Trade Names: Cipro, Cipro I.V., Cipro XR, Proquin XR

Spectrum of Activity

- **Highly active:** Gram-negative bacteria (e.g., *E. coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Shigella*, *Salmonella*, *Neisseria gonorrhoeae*)
- **Moderately active:** Gram-positive bacteria (e.g., *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Enterococcus faecalis*)

Indications

- Urinary tract infections (UTIs), including complicated and uncomplicated
- Acute pyelonephritis (usually *E. coli*)
- Upper and lower respiratory tract infections (excluding pneumococcal infections)
- Skin, soft tissue, bone & joint infections by gram-negative organisms
- Infectious diarrhea (*Shigella*, *Salmonella*, *E. coli*, *Campylobacter*)
- Septicemia, meningococcal contacts
- Chronic bacterial prostatitis
- Sexually transmitted infections (STIs) like chlamydia and gonorrhea
- Sinusitis caused by gram-negative bacteria
- Anthrax (inhalation post-exposure prophylaxis and treatment)

Note: Ineffective against most anaerobic infections.

Mechanism of Action

- **Bactericidal:** Inhibits bacterial DNA synthesis.
- Targets **topoisomerase II (DNA gyrase)** in gram-negative bacteria, preventing DNA supercoiling.
- In gram-positive bacteria, inhibits **topoisomerase IV** , disrupting chromosome separation during replication.
- Prevents resealing of cleaved DNA strands, leading to bacterial cell death.

DNA Gyrase (Topoisomerase II)

- Enzyme essential for DNA supercoiling and compaction in bacteria.

- Catalyzes opening and closing of DNA strands without the need to rotate entire DNA loops.
- Targeted by ciprofloxacin to disrupt DNA replication.

Pharmacokinetics

- **Absorption:** Oral bioavailability ~70-80%, affected by food, iron, calcium.
- **Distribution:** Widely distributed, including eyes and cerebrospinal fluid (CSF) at ~10% plasma levels when meninges not inflamed.
- Crosses placenta and into breast milk.
- **Metabolism:** Hepatic metabolism, biliary excretion, and fecal elimination contribute to clearance.
- **Excretion:** Primarily renal via glomerular filtration and tubular secretion; probenecid inhibits excretion.
- Half-life ~4 hours; prolonged in renal impairment and elderly.
- Plasma protein binding: 20-40%
- Not significantly removed by dialysis.

Dosage and Administration

Condition	Adult Dose	Duration
Acute uncomplicated UTI	250–500 mg PO every 12 hours	3–14 days
Complicated UTI	500–750 mg PO every 12 hours	7–14 days
Acute sinusitis	500 mg PO every 12 hours	10 days
Bone and joint infections	500–750 mg PO every 12 hours	4–6 weeks
Skin and soft tissue infections	500–750 mg PO every 12 hours	7–14 days
Infectious diarrhea	500 mg PO every 12 hours	5–7 days
Chronic bacterial prostatitis	500 mg PO every 12 hours	28 days
Anthrax (inhalation)	Adults: 500 mg PO every 12 hours for 60 days	60 days
Gonococcal infections	Single 250 mg PO dose	Single dose

- Adjust dose in renal impairment based on creatinine clearance.
- Elderly should receive the lowest effective dose.
- Take with plenty of fluids; can be taken with or without food.

Use in Pregnancy and Pediatrics

- **Category C:** Not recommended due to risk of cartilage damage (inhibition of chondrogenesis).
- Contraindicated during pregnancy, lactation, and in children.

Drug Interactions

- **Decreased absorption:** Antacids, iron supplements, sucralfate, zinc.
- **Increased plasma levels/toxicity risk:** Clozapine, methotrexate, methylxanthines, olanzapine.
- **Increased serum creatinine:** Cyclosporine.

- **Seizure risk:** With high-dose ciprofloxacin plus NSAIDs.
- **Enhanced anticoagulant effect:** Oral anticoagulants.