BP802T · B.Pharm Semester VIII · Theory Notes

Clinical Pharmacotherapeutics

Unit IV — Bone, Joint & Infectious Disease Therapeutics (7 hours)

Unit IV (7 hours)

Pills & Python Notes

From-zero teaching standard: every technical term is defined before use.

Syllabus coverage: Unit IV (7 hours).

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CHAPTER 11: Rheumatoid Arthritis and Osteoarthritis

1. Learning Objectives

After studying this chapter, the student will be able to:

- Define arthritis, rheumatoid arthritis (RA), and osteoarthritis (OA).
- Distinguish RA (autoimmune, inflammatory) from OA (degenerative, mechanical) using clinical, pathological, and radiological features.
- Describe the etiopathogenesis of RA and OA with flow diagrams.
- List the common clinical manifestations of RA and OA.
- Name the investigations used in RA and OA (conceptually, without numerical cut-offs unless standard).
- Outline management of RA and OA by drug class: NSAIDs, DMARDs (conventional synthetic, biologic, targeted synthetic), corticosteroids, and physiotherapy principles.
- Explain the pharmacist's role in counselling patients on DMARD therapy, NSAID safety, and monitoring requirements.

2. Definitions

- **Arthritis** — inflammation of a joint. A joint is the place where two bones meet and move. Inflammation means the area becomes red, warm, swollen, and painful because the body's defence system has sent extra blood and cells there.
- **Articular** — relating to a joint. **Periarticular** — the tissues around a joint (ligaments, muscles, tendons).
- **Rheumatoid arthritis (RA)** — a chronic (long-lasting), systemic (whole-body), **autoimmune** disease in which the body's immune system mistakenly attacks the **synovium** (the thin lining inside joints), causing symmetric (both sides of the body) inflammatory arthritis, and in some patients damaging other organs (lungs, eyes, heart).
- **Osteoarthritis (OA)** — a chronic, **degenerative** joint disease in which the **articular cartilage** (the smooth cushion covering bone ends inside a joint) gradually wears away, the bone underneath reacts, and the joint becomes stiff and painful. It is mainly a "wear-and-tear with poor repair" disease, not an immune attack.
- **Autoimmune** — a state in which the immune system, which normally attacks germs, wrongly attacks the body's own tissues.
- **Synovium** — the soft inner lining of a joint capsule that produces synovial fluid (joint oil) to lubricate the joint.
- **Pannus** — the thickened, inflamed synovial tissue in RA that grows over and destroys cartilage and bone. Think of it as an angry, overgrown lining that eats the joint.

- **Cartilage** — smooth, rubbery tissue covering the ends of bones in a joint; it lets bones glide without friction.
- **DMARD** — Disease-Modifying Anti-Rheumatic Drug: a drug that slows down or changes the course of RA itself (reduces joint damage), not just the pain.
- **NSAID** — Non-Steroidal Anti-Inflammatory Drug: a drug that reduces pain, swelling, and fever, but does not stop joint damage in RA.
- **Biologics** — medicines made from living cells (proteins/antibodies) that block one specific part of the immune system. Given by injection or infusion.
- **Morning stiffness** — stiffness of joints after waking that takes time to loosen up. Long morning stiffness (>30–60 minutes) points toward inflammatory arthritis like RA; short stiffness (<30 minutes) points toward OA.
- **Crepitus** — a crackling or grating feeling/sound in a joint when it moves (common in OA).
- **Deformity** — a change in the shape of a joint because of long-standing disease (for example, bent fingers in late RA).

3. Terminology Table

Term	Simple Meaning
Synovitis	Inflammation of the joint lining (synovium)
Erosion	A bite-like loss of bone at the joint edge seen on X-ray (typical of RA)
Osteophyte	A bony outgrowth/spur at the joint margin (typical of OA)
Joint space narrowing	The gap between bones on X-ray becomes smaller because cartilage is lost
Rheumatoid factor (RF)	An antibody found in the blood of many RA patients; not perfectly specific
Anti-CCP antibody	A blood test antibody that is more specific for RA than RF
ESR / CRP	Blood tests that rise when there is inflammation in the body (erythrocyte sedimentation rate; C-reactive protein)
Symmetric polyarthritis	Many joints inflamed on both sides of the body (RA pattern)
Asymmetric oligoarthritis	A few joints, not mirror-image (more typical of OA pattern)
Flare	A period when disease activity suddenly worsens
Remission	A period when disease activity is very low or absent
Heberden's nodes	Hard bony bumps at the fingertip joints (DIP) in OA of the hands
Bouchard's nodes	Hard bony bumps at the middle finger joints (PIP) in OA of the hands
Boutonnière deformity	A finger deformity in RA (middle joint bent down, tip joint bent up)
Swan-neck deformity	A finger deformity in RA (middle joint bent up, tip joint bent down)

4. Detailed Explanation

4.1 What arthritis is

Every movable joint has two bone ends covered with smooth cartilage, a capsule around them, and a synovial lining inside that makes lubricating fluid. Arthritis is disease of this system. The two commonest chronic types are RA and OA, and they are almost opposites in cause:

- **RA = the immune system attacks the joint lining.** The synovium becomes inflamed, thickens into pannus, and this pannus destroys cartilage and bone. Because the immune attack circulates in the blood, many joints on both sides are affected, and other organs can suffer too.
- **OA = the cartilage cushion wears out and repair fails.** The trigger is mechanical stress plus aging plus weak repair. The bone underneath thickens and grows spurs (osteophytes). Inflammation is mild and secondary. It usually affects the joints that carry load (knees, hips, spine) and the hands, often asymmetrically.

4.2 Rheumatoid arthritis in more detail

RA most often begins in middle age and is more common in women. Typical early story: small joints of the hands and feet become painful and swollen on both sides, with morning stiffness lasting an hour or more. Without treatment, inflammation persists, pannus forms, and over years the joints deform (ulnar deviation of fingers, swan-neck, boutonnière) and lose function. Some patients develop lumps under the skin (**rheumatoid nodules**), dry eyes/mouth, lung involvement, or inflammation of blood vessels.

Diagnosis is clinical plus supportive tests: blood tests may show RF and anti-CCP antibodies, raised ESR/CRP; X-rays in early disease may be normal, later showing erosions and joint space narrowing; ultrasound/MRI can show synovitis early. The key clinical clue is **persistent symmetric small-joint inflammatory arthritis with prolonged morning stiffness**.

4.3 Osteoarthritis in more detail

OA is the commonest arthritis overall and rises sharply with age and obesity. Typical story: knee or hip pain that worsens with activity and eases with rest, short morning stiffness (minutes), crepitus, and gradual loss of movement. Hand OA gives bony nodes (Heberden's, Bouchard's). Diagnosis is mainly clinical plus X-ray showing joint space narrowing, osteophytes, and bone hardening (subchondral sclerosis). Blood tests are usually normal — an important contrast with RA.

4.4 Why the distinction matters

RA needs early, aggressive DMARD therapy to prevent irreversible joint destruction ("window of opportunity" — treating early gives far better outcomes). OA needs pain management, weight control, exercise, and, in advanced cases, joint replacement. Giving only painkillers to RA misses the disease; giving DMARDs to OA is useless and harmful.

5. Classifications

Table 5.1 — RA vs OA: head-to-head comparison

Feature	Rheumatoid Arthritis	Osteoarthritis
Nature	Autoimmune, inflammatory, systemic	Degenerative ("wear and tear" + failed repair), mainly local
Age of onset	Usually 30–60 years (any adult age)	Usually >50 years, rises with age

Feature	Rheumatoid Arthritis	Osteoarthritis
Sex	More common in women	Slightly more common in women, especially hand/knee OA
Joints affected	Small joints of hands/feet first, symmetric, polyarticular	Weight-bearing joints (knee, hip, spine), hands; often asymmetric
Morning stiffness	Prolonged, typically >60 minutes	Brief, typically <30 minutes
Pain pattern	Worse with rest, better with movement	Worse with activity, better with rest
Swelling	Soft, warm, boggy (synovitis)	Hard, bony (osteophytes), mild effusion possible
Systemic features	Fatigue, fever, nodules, lung/eye involvement	None (disease stays in the joint)
Blood tests	RF, anti-CCP often positive; ESR/CRP raised	Usually normal
X-ray	Erosions, periarticular bone loss	Osteophytes, joint space narrowing, subchondral sclerosis
Course	Fluctuating, can destroy joints	Slowly progressive mechanical failure

Table 5.2 — DMARD classification (RA)

Category	Examples (drug names for identification)	Key idea
Conventional synthetic DMARDs (csDMARDs)	Methotrexate, sulfasalazine, leflunomide, hydroxychloroquine	First-line; methotrexate is the anchor drug; slow onset (weeks)
Biologic DMARDs — TNF inhibitors	Adalimumab, etanercept, infliximab	Block tumour necrosis factor, a master inflammatory signal
Biologic DMARDs — other targets	Rituximab (B cells), tocilizumab (IL-6 receptor), abatacept (T-cell co-stimulation)	Block one specific immune pathway each
Targeted synthetic DMARDs (tsDMARDs)	Tofacitinib, baricitinib (JAK inhibitors)	Small molecules taken orally; block Janus kinase signalling inside cells

Table 5.3 — OA management categories

Category	Examples	Role
Non-drug measures	Weight loss, quadriceps/hip strengthening, physiotherapy, walking aids, heat/cold	Foundation of OA care
Topical agents	Topical NSAID gels	First-line for hand/knee OA pain
Oral analgesics/NSAIDs	Paracetamol, oral NSAIDs (with GI protection when needed)	Pain control; lowest effective dose, shortest duration
Intra-articular therapy	Corticosteroid injections into the joint	Short-term relief of a flared joint
Surgical	Joint replacement (arthroplasty)	End-stage disease with severe pain/disability

6. Mechanisms / Pathophysiology Flow

Flow 6.1 — RA pathogenesis (autoimmune chain)

```
Genetic susceptibility (e.g., HLA-DR4) + environmental trigger (e.g., smoking, infection)
        |
        v
Loss of immune tolerance --> autoantibodies form (RF, anti-CCP)
        |
        v
Immune cells enter the synovium --> synovitis (swollen, inflamed lining)
        |
        v
Inflammatory cytokines released (TNF-alpha, IL-1, IL-6) --> more cells recruited
        |
        v
Synovium thickens into PANNUS --> pannus invades cartilage and bone
        |
        v
Cartilage destroyed + bone eroded --> joint deformity, loss of function
        |
        v
Systemic inflammation --> fatigue, nodules, lung/eye/vessel involvement
```

Flow 6.2 — OA pathogenesis (degenerative chain)

```
Ageing + excess load (obesity) + joint injury + weak cartilage repair
        |
        v
Cartilage matrix breaks down faster than it is rebuilt
        |
        v
Cartilage thins and frays --> joint space narrows
        |
        v
Bone underneath is exposed and reacts: hardens (sclerosis) + grows spurs (osteophytes)
        |
        v
Mild secondary inflammation of synovium --> pain, stiffness, small effusions
        |
        v
Muscle weakness around joint + altered mechanics --> more load --> cycle continues
```

Flow 6.3 — How NSAIDs work (both diseases)

```
Arachidonic acid --(COX-1 / COX-2 enzymes)--> Prostaglandins
                                                    |
Prostaglandins cause pain, fever, swelling <--------+
                                                    |
NSAID blocks COX enzymes --> fewer prostaglandins --> less pain/swelling/fever
(BUT: blocking COX-1 also removes stomach protection and affects platelets/kidney)
```

Flow 6.4 — How methotrexate helps in RA (concept)

```
Methotrexate (weekly, low dose in RA)
        |
        v
Interferes with folate-dependent steps in rapidly dividing immune cells
        |
        v
Fewer activated T and B cells + less cytokine production
        |
        v
Synovial inflammation cools down --> less pannus --> less joint damage
(Note: folic acid is co-prescribed to reduce side effects — it does not cancel the benefit)
```

7. Diagrams / Flowcharts

Diagram 7.1 — The joint in health, RA, and OA (text sketch)

```
HEALTHY JOINT            RHEUMATOID ARTHRITIS             OSTEOARTHRITIS
 bone                    bone                            bone
  || cartilage (smooth)   || cartilage being eaten         || cartilage thin/frayed
  ||                      || by PANNUS (thick angry        ||  ~~osteophyte (spur)
 [synovium: thin]        [synovium: THICK, inflamed]      [synovium: mildly irritated]
  joint fluid: clear      joint fluid: inflammatory       joint fluid: mildly changed
```

Diagram 7.2 — RA treatment ladder (conceptual)

```
New diagnosis of RA
        |
        v
Start csDMARD promptly (methotrexate anchor unless contraindicated)
   + short bridging corticosteroid if needed for rapid symptom control
        |
        v
Assess response in weeks–months --> target: remission or low disease activity
        |
   inadequate? --> add/switch csDMARD, or add biologic DMARD, or JAK inhibitor
        |
        v
Ongoing: monitor blood counts, liver, infection risk; physiotherapy; protect joints
```

Diagram 7.3 — OA management pyramid

```
            [Joint replacement — end stage]
         [Intra-articular steroid — flared joint]
       [Oral NSAID/paracetamol — persistent pain]
    [Topical NSAID — hand/knee pain]
[Weight loss + exercise + physiotherapy + aids — EVERY patient, always]
```

8. Infographic Concepts (Text Boxes)

```
+-------------------------------------------------------------+
| RA OR OA? ASK THREE QUESTIONS                               |
| 1. Morning stiffness: HOURS (RA) or MINUTES (OA)?           |
| 2. Rest vs activity: worse at REST (RA) or with             |
|    ACTIVITY (OA)?                                           |
| 3. Blood tests/X-ray: inflammatory markers + erosions       |
|    (RA) or normal bloods + bony spurs (OA)?                 |
+-------------------------------------------------------------+

+-------------------------------------------------------------+
| THE RA WINDOW OF OPPORTUNITY                                |
| Joint damage in RA becomes IRREVERSIBLE once bone is        |
| eroded. Starting a DMARD EARLY (weeks, not years)           |
| protects joints for life. Painkillers alone never do.       |
+-------------------------------------------------------------+

+-------------------------------------------------------------+
| OA: THE KNEE'S MATH                                         |
| Every extra kilogram of body weight adds several            |
| kilograms of load on the knee with each step.               |
| Weight loss is a drug-free "dose reduction" for the         |
| joint — the most powerful OA intervention.                   |
+-------------------------------------------------------------+
```

9. Tables (Comparisons, Summaries)

Table 9.1 — Drug classes in RA: what each does and watch-points

Class	What it does	Key counselling/monitoring points (conceptual)
NSAIDs	Pain and stiffness relief; no joint protection	Take with food; watch stomach pain, black stools, swelling, blood pressure; avoid in ulcer/bleed history
Corticosteroids	Fast, powerful anti-inflammatory "bridge"	Short courses preferred; long use risks sugar rise, weight gain, bone thinning, infection
Methotrexate (csDMARD)	Anchor DMARD; slows joint damage	Weekly dosing (not daily — a famous error); folic acid co-prescribed; avoid alcohol; monitor blood counts and liver; avoid in pregnancy
Other csDMARDs (sulfasalazine, leflunomide, hydroxychloroquine)	Add-on or alternative DMARDs	Slow onset; regular blood monitoring; hydroxychloroquine needs eye checks
Biologics (TNF inhibitors etc.)	Targeted immune blockade for inadequate responders	Screen for latent TB and hepatitis before starting; infection risk; injections/infusions
JAK inhibitors	Oral targeted therapy	Infection and clot-risk counselling; blood monitoring

Table 9.2 — Investigations: RA vs OA

Test	RA	OA
RF / anti-CCP	Often positive (supportive, not mandatory)	Negative
ESR / CRP	Raised in active disease	Usually normal
X-ray	Erosions, periarticular osteopenia	Osteophytes, joint space narrowing, sclerosis
Synovial fluid	Inflammatory (many white cells)	Non-inflammatory
Ultrasound/MRI	Shows synovitis, early erosions	Shows cartilage loss, osteophytes

10. Worked Examples (Patient-Case Vignettes)

Case 1 — RA. A 42-year-old woman has 3 months of pain and swelling in the knuckles of both hands and both wrists, with morning stiffness lasting about 2 hours. She feels tired and has lost appetite. Examination: warm, boggy swelling of the small hand joints, symmetric. Blood tests show raised ESR/CRP and positive anti-CCP. X-ray: no erosions yet. Interpretation: early RA. Management principles: start a DMARD promptly (methotrexate-based, as per current guidelines — confirm latest edition) rather than NSAIDs alone; short corticosteroid bridging for symptoms; physiotherapy for hand function; counsel on weekly methotrexate dosing, folic acid, alcohol avoidance, and need for regular blood monitoring; screen and vaccinate as advised before any biologic.

Case 2 — OA. A 63-year-old man with obesity has 2 years of right knee pain, worse when climbing stairs and at the end of the day, better with rest. Morning stiffness lasts 10 minutes. Examination: bony enlargement of the knee, crepitus, mild effusion, no warmth. Blood tests normal. X-ray: joint space narrowing with osteophytes. Interpretation: knee OA. Management principles: weight reduction,

quadriceps strengthening, walking stick, topical NSAID; oral analgesic/NSAID at lowest effective dose for shortest duration if needed; intra-articular corticosteroid if one joint flares; discuss joint replacement only if severe persistent pain and disability despite conservative care.

Case 3 — Counselling. A newly diagnosed RA patient asks why she must take "a chemotherapy drug" (methotrexate) when her pain is mild. Pharmacist's explanation: in RA the dose and purpose are different — low weekly doses calm the immune attack on joints and prevent permanent damage; painkillers only mask pain. Emphasise weekly (not daily) dosing, folic acid, contraception discussion, alcohol avoidance, and that blood tests monitor safety.

11. Analogies

- **RA vs OA:** RA is like termites eating a house from the inside (the immune system silently destroying the joint lining and then the structure). OA is like the tread wearing off a car tyre (the cushion gradually thinning from use and poor repair).
- **Pannus:** like ivy growing over and cracking a wall — the overgrown synovium creeps over cartilage and bone and destroys them.
- **DMARD vs NSAID:** an NSAID is like turning down the volume on a fire alarm (less noise/pain, fire still burning); a DMARD is like calling the fire brigade (attacks the fire itself).
- **Morning stiffness difference:** RA stiffness is like a rusted gate that needs an hour of oiling (prolonged); OA stiffness is like a stiff door hinge that loosens in minutes.
- **Biologics:** like a sniper removing one enemy commander (one cytokine) instead of bombing the whole city (broad immunosuppression) — though infection vigilance is still needed.

12. Pharmacy Relevance (What the Pharmacist Does)

- **Spot the pattern:** prolonged morning stiffness + symmetric small-joint swelling → refer promptly for RA evaluation; do not just sell painkillers.
- **Methotrexate safety:** the single most important counselling point — RA dosing is WEEKLY, not daily; daily dosing causes fatal toxicity. Dispense with clear labelling, confirm the patient knows the weekday, and co-dispense folic acid as prescribed.
- **NSAID stewardship:** counsel to take with food, use the lowest effective dose for the shortest time, and watch for stomach pain, black stools, swelling, or blood pressure rise; flag interactions (e.g., with blood thinners) to the prescriber.
- **DMARD monitoring:** remind patients about scheduled blood tests (blood counts, liver function), eye checks for hydroxychloroquine, and TB/hepatitis screening before biologics; advise reporting fever or infection promptly while on biologics/JAK inhibitors.
- **Corticosteroid counselling:** explain short-course purpose, tapering if prescribed, and long-term risks (blood sugar, bones, weight, infection).
- **OA support:** reinforce weight loss, exercise adherence, correct use of topical NSAIDs, walking aids, and heat/cold; counsel on realistic expectations of joint injections.
- **Adherence:** RA drugs take weeks to work — prepare patients so they do not stop early; use pill organisers and follow-up calls.

13. India Context

- Musculoskeletal diseases including OA are among the commonest causes of chronic pain and disability in India's ageing population; knee OA is a leading reason for orthopaedic consultation, and obesity and sedentary lifestyles are rising risk factors in urban India.
- RA affects adults in their productive years; delayed referral is common because early joint pains are dismissed as "general weakness" or treated with over-the-counter painkillers — pharmacists are often the first contact and can trigger early rheumatology referral.
- India's national health programmes focus heavily on communicable diseases; arthritis care is delivered mainly through general medicine, orthopaedics, and rheumatology outpatient services in government and private hospitals. Affordable csDMARDs (methotrexate, sulfasalazine, hydroxychloroquine) are widely available, while biologics remain expensive — biosimilars have improved access in recent years (availability and prices change; confirm current status locally).
- Physiotherapy departments in district hospitals and community health centres support OA and RA rehabilitation; the pharmacist can link patients to these services.
- Traditional medicine use is common; counsel patients not to stop DMARDs in favour of unproven remedies without medical advice, and to disclose all concurrent therapies.

14. Key Points

- RA is autoimmune and systemic; OA is degenerative and local — opposite causes, different treatment.
- Prolonged morning stiffness + symmetric small-joint arthritis = think RA; brief stiffness + activity-related pain in weight-bearing joints = think OA.
- RA: RF/anti-CCP and raised ESR/CRP support the diagnosis; erosions appear on X-ray. OA: blood tests normal; osteophytes and joint space narrowing on X-ray.
- RA must be treated early with DMARDs (methotrexate anchor) to prevent irreversible joint damage; NSAIDs alone are insufficient.
- OA management is built on weight loss, exercise, and physiotherapy; drugs are for symptom control; joint replacement is for end-stage disease.
- Methotrexate in RA is dosed WEEKLY — daily dosing is a fatal error.
- Biologics and JAK inhibitors are for inadequate response to csDMARDs; screen for latent TB/hepatitis first and watch for infection.

15. Common Confusions (with Clarifications)

- **"RA and OA are just two names for joint pain."** No — RA is an immune attack on the joint lining (systemic, destructive); OA is cartilage wear with failed repair (mechanical, local).
- **"A positive rheumatoid factor means RA."** Not alone — RF can be positive in other conditions and in some healthy older adults; anti-CCP is more specific, and diagnosis is clinical.
- **"NSAIDs treat RA."** They relieve RA pain and stiffness but do not prevent joint destruction — only DMARDs modify the disease.

- **"Methotrexate daily like other tablets."** Never — in RA it is weekly; daily dosing is a classic fatal medication error.
- **"Osteoarthritis is only caused by old age."** Age is a risk factor, but obesity, joint injury, and genetics matter; young people with injuries can develop OA.
- **"Biologics are just stronger painkillers."** They are targeted immune therapies that slow disease, given by injection/infusion, with infection risk — not analgesics.

16. Common Mistakes (Exam Traps)

- Writing that NSAIDs are DMARDs — they are symptom-relievers, not disease-modifiers.
- Mixing up Heberden's (DIP, fingertip) and Bouchard's (PIP, middle) nodes — remember "Heberden's is at the Head (tip)".
- Stating morning stiffness duration backwards — RA = prolonged (hours), OA = brief (minutes).
- Forgetting that RA is symmetric and polyarticular while OA is often asymmetric and targets weight-bearing joints.
- Omitting the "window of opportunity" — early DMARD therapy prevents irreversible damage.
- Listing methotrexate monitoring incorrectly — blood counts and liver function, plus folic acid co-prescription and pregnancy avoidance.
- Suggesting DMARDs for OA — they have no role in OA.
- Confusing pannus (RA's destructive overgrown synovium) with osteophytes (OA's bony spurs).

17. Mnemonics

- **RA features — "RA SID": S**ymmetric, **S**mall joints first, **S**tiffness prolonged (morning), **I**nflammatory markers raised, **D**eformities late (swan-neck, boutonnière). (Read as "RA's SID".)
- **OA X-ray — "LOSS": L**oss of joint space, **O**steophytes, **S**ubchondral **S**clerosis.
- **DMARD ladder — "M-B-J": M**ethotrexate first, then **B**iologics, then **J**AK inhibitors (targeted synthetic).
- **Methotrexate weekly — "Monday Methotrexate":** pick one weekday and never take it daily.
- **RA vs OA stiffness — "Long = inflamed (RA), Short = worn (OA)".**

18. Exam Summary

Rheumatoid arthritis is a chronic systemic autoimmune disease causing symmetric inflammatory polyarthritis, beginning in small joints of hands/feet, with prolonged morning stiffness, raised ESR/CRP, RF/anti-CCP positivity, and X-ray erosions; pannus destroys cartilage and bone, so early DMARD therapy (methotrexate anchor, then biologics or JAK inhibitors for inadequate response) is essential, with NSAIDs and short corticosteroid courses for symptoms. Osteoarthritis is a degenerative disease of cartilage wear and failed repair affecting weight-bearing joints and hands, with brief morning stiffness, activity-related pain, normal blood tests, and X-ray osteophytes with joint space narrowing; management rests on weight loss, exercise, physiotherapy, topical/oral analgesics, intra-articular steroids for flares, and joint

replacement for end-stage disease. Pharmacists ensure weekly methotrexate safety, NSAID stewardship, DMARD monitoring, infection vigilance on biologics, and OA lifestyle counselling.

19. One-Minute Revision

- RA = autoimmune attack on synovium → pannus → erosions; symmetric small joints; stiffness for hours; RF/anti-CCP+, ESR/CRP up.
- OA = cartilage wear + failed repair; knees/hips/hands; stiffness for minutes; pain with activity; bloods normal; osteophytes on X-ray.
- RA treatment: early DMARDs (methotrexate weekly anchor → biologics → JAK inhibitors); NSAIDs/steroids for symptoms only.
- OA treatment: weight loss + exercise + physio first; topical NSAID; oral analgesics short-term; steroid injection for flares; replacement at end stage.
- Pharmacist: weekly methotrexate check, folic acid, blood monitoring, TB screen before biologics, NSAID safety, OA lifestyle coaching.

20. MCQs

1 The primary pathological target in rheumatoid arthritis is the:

a) Articular cartilage b) Synovium c) Meniscus d) Periosteum

1 Which antibody is more specific for rheumatoid arthritis?

a) ANA b) Anti-CCP c) Anti-dsDNA d) ASLO

1 Prolonged morning stiffness lasting more than an hour is characteristic of:

a) Osteoarthritis b) Rheumatoid arthritis c) Gout d) Fibromyalgia

1 Heberden's nodes are seen in:

a) RA of the wrist b) OA of the DIP joints of the hand c) Septic arthritis d) Psoriatic arthritis

1 Pannus refers to:

a) Bony spurs in OA b) Thickened inflamed synovium that destroys cartilage and bone in RA c) Crystal deposits in gout d) Cartilage softening in OA

1 The anchor conventional synthetic DMARD in RA is:

a) Paracetamol b) Methotrexate c) Ibuprofen d) Tramadol

1 Methotrexate in RA is dosed:

a) Daily b) Weekly c) Monthly d) Twice daily

1 Which is a TNF inhibitor biologic DMARD?

a) Metformin b) Adalimumab c) Amlodipine d) Atorvastatin

1 Typical X-ray finding in OA is:

a) Bone erosions b) Osteophytes with joint space narrowing c) Periarticular osteopenia only d) Soft tissue calcification

1 First-line foundation of knee OA management is:

a) Immediate joint replacement b) Weight loss, exercise, and physiotherapy c) Long-term oral corticosteroids d) Biologic DMARDs

Answer Key: 1-b, 2-b, 3-b, 4-b, 5-b, 6-b, 7-b, 8-b, 9-b, 10-b

21. Viva / Application Questions

1 **Q: How do you clinically differentiate RA from OA in 30 seconds?**

A: Ask about morning stiffness duration (hours = RA, minutes = OA), symmetry (symmetric small joints = RA), pain timing (worse at rest = RA, worse with activity = OA), and check bloods/X-ray (inflammatory markers and erosions = RA; normal bloods with osteophytes = OA).

1 **Q: Why must DMARD therapy start early in RA?**

A: Because pannus causes irreversible cartilage and bone destruction; early DMARDs suppress inflammation during the "window of opportunity" and prevent permanent deformity, while NSAIDs only relieve symptoms.

1 **Q: A prescription reads "methotrexate 15 mg daily" for RA. What do you do?**

A: Do not dispense; contact the prescriber immediately — RA dosing is weekly, and daily dosing causes fatal bone marrow and liver toxicity. Counsel the patient on the correct weekday schedule and folic acid.

1 **Q: Why is weight loss the most powerful intervention in knee OA?**

A: Each kilogram of body weight multiplies the load across the knee with every step; losing weight directly reduces mechanical stress, pain, and disease progression without drugs.

1 **Q: What screening is needed before starting a biologic DMARD?**

A: Screen for latent tuberculosis and hepatitis B/C (as per current guidelines — confirm latest edition), update vaccinations where advised, and counsel the patient to report fever or signs of infection promptly during therapy.

22. References

- Standard pharmacotherapeutics and clinical pharmacy textbooks (consult latest editions).
- Rheumatology standard textbooks for RA/OA pathogenesis and classification (consult latest editions).
- Current national/international rheumatology society guidelines for RA and OA management — as per current guidelines, confirm latest edition.
- Standard pharmacology textbooks for NSAID, DMARD, biologic, and corticosteroid drug classes (consult latest editions).

CHAPTER 12: Tuberculosis, Pneumonia and Urinary Tract Infection

1. Learning Objectives

After studying this chapter, the student will be able to:

- Define tuberculosis (TB), pneumonia, and urinary tract infection (UTI).
- Distinguish latent TB from active TB, and pulmonary from extrapulmonary TB.
- Explain the DOTS concept and India's NTEP programme in the management of TB.
- Name first-line anti-TB drug CLASSES (rifamycins, isoniazid class, pyrazinamide, ethambutol, fluoroquinolones, injectable agents as categories) and define MDR/XDR-TB conceptually.
- Distinguish community-acquired from hospital-acquired pneumonia, and typical from atypical pneumonia; describe CURB-65 conceptually (qualitative).
- Outline pneumonia management by drug class (beta-lactams, macrolides, fluoroquinolones as classes).
- Distinguish cystitis from pyelonephritis and uncomplicated from complicated UTI; outline UTI management by drug class.
- Describe the pharmacist's role in adherence counselling (TB), antimicrobial stewardship, and patient education.

2. Definitions

- **Infection** — invasion of the body by a microorganism (germ) that multiplies and causes illness. **Colonisation** is when germs sit on a surface without causing illness — not the same as infection.
- **Tuberculosis (TB)** — a chronic infectious disease caused by the bacterium *Mycobacterium tuberculosis*, spread through the air when a person with infectious pulmonary TB coughs or sneezes. It most often affects the lungs (pulmonary TB) but can affect almost any organ (extrapulmonary TB).
- **Latent TB infection (LTBI)** — the person carries TB bacteria in the body but the bacteria are dormant (sleeping); the person has no symptoms and cannot spread TB to others. Treatment may be given to prevent activation.
- **Active TB disease** — the bacteria are multiplying and causing illness; the person has symptoms and (if pulmonary) can spread TB to others.
- **Pulmonary TB** — TB of the lungs. **Extrapulmonary TB** — TB outside the lungs (lymph nodes, pleura, bones/joints, meninges/brain, abdomen, kidneys).
- **DOTS** — Directly Observed Treatment, Short-course: a strategy in which a trained observer watches the patient swallow each dose of anti-TB medicine, ensuring complete treatment and preventing drug resistance.

- **MDR-TB (multidrug-resistant TB)** — TB resistant to at least the two most powerful first-line drugs (isoniazid and rifampicin). **XDR-TB (extensively drug-resistant TB)** — MDR-TB plus resistance to additional key second-line drug classes. Both need longer, specialised regimens.
- **Pneumonia** — infection of the lung tissue (alveoli — the tiny air sacs where oxygen enters blood), causing them to fill with pus/fluid instead of air.
- **Community-acquired pneumonia (CAP)** — pneumonia caught outside a hospital (in the community). **Hospital-acquired pneumonia (HAP)** — pneumonia developing 48 hours or more after hospital admission, usually caused by tougher, drug-resistant germs.
- **Typical pneumonia** — classic bacterial pneumonia (e.g., pneumococcus) with high fever, productive cough, and lobar consolidation. **Atypical pneumonia** — pneumonia caused by organisms like *Mycoplasma* or viruses, with milder onset, dry cough, and patchy X-ray changes.
- **CURB-65** — a simple clinical score (Confusion, Urea, Respiratory rate, Blood pressure, age ≥65) used to judge how severe CAP is and whether the patient can be treated at home or needs hospital admission. Each factor adds one point; higher score = sicker patient.
- **Urinary tract infection (UTI)** — infection anywhere in the urinary system (kidneys, ureters, bladder, urethra).
- **Cystitis** — infection of the bladder (lower UTI): burning on urination, frequent urge, lower abdominal pain, usually no fever.
- **Pyelonephritis** — infection of the kidney (upper UTI): fever, flank/back pain, nausea/vomiting — more serious than cystitis.
- **Uncomplicated UTI** — UTI in a healthy non-pregnant woman with a normal urinary tract. **Complicated UTI** — UTI with complicating factors: male sex, pregnancy, urinary obstruction, stones, catheters, diabetes, kidney disease, or resistant organisms.
- **Bacteriuria** — bacteria in the urine. **Asymptomatic bacteriuria** — bacteria in urine without symptoms; usually needs treatment only in pregnancy or before urological procedures.
- **Empirical therapy** — starting antibiotics based on the likely germ before lab results arrive. **Definitive (targeted) therapy** — antibiotics chosen after culture/sensitivity results identify the exact germ and its drug susceptibilities.

3. Terminology Table

Term	Simple Meaning
Acid-fast bacilli (AFB)	TB bacteria seen under the microscope with a special stain; "sputum AFB positive" means infectious TB likely
Sputum	Mucus coughed up from the lungs, tested to diagnose TB/pneumonia
CBNAAT / GeneXpert	A rapid molecular test that detects TB bacteria and rifampicin resistance within hours
Consolidation	Lung tissue filled with fluid/pus instead of air (seen on X-ray in pneumonia)
Pleural effusion	Fluid collected around the lung (can occur in TB or pneumonia)
Dysuria	Pain or burning during urination

Term	Simple Meaning
Frequency / urgency	Needing to pass urine very often / suddenly and urgently
Haematuria	Blood in the urine
Flank pain	Pain in the side of the back below the ribs (kidney area)
Catheter-associated UTI	UTI linked to a urinary catheter tube; a common hospital infection
Culture and sensitivity	Lab test growing the germ from a sample and checking which antibiotics kill it
Adherence	Taking medicines exactly as prescribed for the full duration
Default / treatment interruption	Stopping TB treatment before completion — a major cause of drug resistance

4. Detailed Explanation

4.1 Tuberculosis

The germ and spread. *Mycobacterium tuberculosis* is a slow-growing bacterium with a waxy coat that makes it "acid-fast" and hard to kill. It spreads through airborne droplets: when a person with infectious pulmonary TB coughs, sneezes, or talks, tiny droplets carrying bacteria float in the air and can be inhaled by others. Prolonged close contact matters most — family members and crowded settings carry the highest risk. TB is NOT spread by sharing food, utensils, or touch.

Latent vs active. Most people who inhale TB bacteria control the infection with their immune system: bacteria are walled off in small scars (granulomas) and go dormant — this is latent TB. The person feels fine and is not infectious. But if immunity weakens (HIV, diabetes, malnutrition, smoking, immunosuppressive drugs), dormant bacteria can wake up and cause active TB disease. This is why treating latent TB in high-risk people prevents future disease.

Pulmonary vs extrapulmonary. Pulmonary TB is the commonest form: persistent cough (more than 2 weeks), evening low-grade fever, night sweats, weight loss, loss of appetite, and sometimes blood in sputum (haemoptysis). Extrapulmonary TB can affect lymph nodes (most common extrapulmonary site — painless neck swelling), pleura (fluid around lung), spine (Pott's disease — back pain, deformity), meninges (TB meningitis — headache, neck stiffness, altered consciousness; a medical emergency), abdomen, and genitourinary tract.

Diagnosis (conceptual). Sputum examination for AFB (microscopy), rapid molecular test (CBNAAT/GeneXpert — also detects rifampicin resistance), chest X-ray (cavities, infiltrates), and culture (slow but definitive). HIV testing is offered to every TB patient because the two diseases worsen each other.

Treatment principles. TB is treated with a COMBINATION of several drugs for MANY MONTHS — never a single drug, because single-drug treatment breeds resistance. The standard drug-sensitive regimen has two phases: an **intensive phase** (more drugs, shorter) to kill rapidly multiplying bacteria and make the patient non-infectious quickly, followed by a **continuation phase** (fewer drugs, longer) to kill dormant bacteria and prevent relapse. First-line drug classes include: **rifamycins** (e.g., rifampicin — the backbone; makes body fluids orange-red), **isoniazid**, **pyrazinamide**, and **ethambutol**. Pyridoxine (vitamin B6) is co-given with isoniazid to prevent nerve damage (peripheral neuropathy). Exact regimen composition and durations follow current national guidelines — confirm latest edition.

DOTS and NTEP. Because TB treatment lasts months, patients often feel better early and stop medicines — producing drug-resistant TB. **DOTS** solves this: every dose is observed by a trained worker (now supported by digital adherence tools in many areas). In India, TB care is delivered through the **NTEP (National TB Elimination Programme)** — the renamed and strengthened successor of RNTCP (Revised National TB Control Programme) — which provides free diagnosis and free anti-TB drugs, Nikshay notification of every case, and adherence support. India's stated goal is TB elimination, ahead of global targets.

Drug-resistant TB. MDR-TB (resistant to isoniazid + rifampicin) and XDR-TB (broader resistance) arise mainly from interrupted or inadequate treatment. They are treated with longer regimens built from second-line classes: **fluoroquinolones** (e.g., levofloxacin/moxifloxacin class), **bedaquiline** (a diarylquinoline), **linezolid** (oxazolidinone), **clofazimine**, **cycloserine**, and injectable agents where still used — strictly under programmatic guidance (as per current guidelines — confirm latest edition). Never improvise regimens for drug-resistant TB.

4.2 Pneumonia

What happens. Germs reach the alveoli (air sacs); the immune system floods the area with white cells and fluid; the sacs fill with pus instead of air, so oxygen transfer falls — causing breathlessness, and in severe cases bluish lips and confusion.

CAP vs HAP. Community-acquired pneumonia is usually caused by *Streptococcus pneumoniae* (pneumococcus), *Haemophilus influenzae*, atypical organisms (*Mycoplasma*, *Chlamydophila*, *Legionella*), or respiratory viruses. Hospital-acquired pneumonia (≥48 hours after admission, including ventilator-associated pneumonia) is usually caused by tougher gram-negative bacteria or MRSA — hence broader, stronger empirical antibiotics.

Typical vs atypical. Typical (pneumococcal): sudden high fever, shaking chills, productive rusty cough, chest pain on breathing, lobar consolidation on X-ray. Atypical: gradual onset, dry persistent cough, headache and muscle aches, low-grade fever, patchy X-ray shadows; often affects younger people and spreads in close-contact settings.

Severity assessment — CURB-65 (qualitative). Each of Confusion, raised Urea, fast Respiratory rate, low Blood pressure, and age ≥65 scores one point. Low scores may be managed at home with oral antibiotics; higher scores need hospital assessment and possibly ICU care. It is a triage aid, not a substitute for clinical judgement.

Treatment by class. Mild CAP: a **beta-lactam** (e.g., amoxicillin class) covers typical bacteria; a **macrolide** (e.g., azithromycin class) is added or used alone when atypical organisms are suspected. Moderate–severe CAP or HAP: broader combinations — a beta-lactam plus macrolide, or a respiratory **fluoroquinolone** — chosen per severity, local resistance, and guidelines (as per current guidelines — confirm latest edition). Supportive care: oxygen, fluids, fever control, and treatment of complications (pleural effusion, sepsis).

Prevention. Pneumococcal and influenza vaccines reduce pneumonia risk in the elderly and high-risk groups; smoking cessation; hand hygiene.

4.3 Urinary Tract Infection

Why UTIs are common. The urethra is short in women, so bacteria (usually *E. coli* from the bowel) reach the bladder easily. Anything that blocks urine flow (stones, enlarged prostate, catheters) or weakens immunity (diabetes) raises risk.

Cystitis vs pyelonephritis. Cystitis (bladder): burning urination, frequency, urgency, lower abdominal discomfort; usually NO fever or back pain. Pyelonephritis (kidney): fever with chills, flank pain,

nausea/vomiting, feeling very ill — needs prompt treatment because kidney infection can progress to bloodstream infection (urosepsis).

Uncomplicated vs complicated. Uncomplicated cystitis in a healthy non-pregnant woman is treated with a short course of an appropriate oral antibiotic class (e.g., **nitrofurantoin**, **fosfomycin** single-dose class, or **trimethoprim-sulfamethoxazole** — choice depends on local resistance and guidelines). Complicated UTI, pyelonephritis, or UTI in pregnancy/men needs urine culture first, broader or longer therapy, and evaluation of the underlying cause (stones, obstruction, prostate). Asymptomatic bacteriuria is generally NOT treated except in pregnancy and before urological surgery.

Diagnosis. Urine routine (pus cells, red cells, nitrites) plus urine culture and sensitivity for complicated, recurrent, or severe cases.

5. Classifications

Table 5.1 — TB classification

Basis	Types	Notes
Infection status	Latent TB infection / Active TB disease	Latent: no symptoms, not infectious; Active: symptomatic, may be infectious
Site	Pulmonary / Extrapulmonary	Pulmonary most common; extrapulmonary: nodes, pleura, spine, meninges, abdomen
Drug susceptibility	Drug-sensitive / MDR / XDR	Determined by molecular testing and culture
Treatment history	New / previously treated / relapse / defaulter	Guides regimen choice under NTEP

Table 5.2 — First-line anti-TB drug classes

Class	Example member (for identification)	Key property / watch-point
Rifamycins	Rifampicin	Backbone; colours urine/tears orange-red; strong inducer of liver enzymes (many interactions, including oral contraceptives)
Hydrazides	Isoniazid	Kills rapidly dividing TB bacteria; pyridoxine (B6) co-given to prevent neuropathy; liver monitoring
Pyrazinamides	Pyrazinamide	Works in acidic areas (inside macrophages); mainly intensive phase
Ethambutol	Ethambutol	Protects against resistance; can affect vision (optic neuritis) — report visual changes

Table 5.3 — Pneumonia classification

Basis	Types	Typical germs (conceptual)
Place of acquisition	Community-acquired (CAP) / Hospital-acquired (HAP, incl. ventilator-associated)	CAP: pneumococcus, atypicals, viruses; HAP: resistant gram-negatives, MRSA
Clinical pattern	Typical / Atypical	Typical: pneumococcus-like; Atypical: Mycoplasma, Chlamydophila, Legionella, viruses

Basis	Types	Typical germs (conceptual)
Severity (CAP)	Mild (outpatient) / Moderate–severe (inpatient) / ICU-level	Guided by CURB-65 and clinical judgement

Table 5.4 — UTI classification

Basis	Types	Clinical clue
Level	Cystitis (lower) / Pyelonephritis (upper)	Burning + frequency without fever = cystitis; fever + flank pain = pyelonephritis
Complexity	Uncomplicated / Complicated	Complicated: male, pregnant, catheter, stone, obstruction, diabetes, resistant organism
Course	First episode / Recurrent / Asymptomatic bacteriuria	Recurrent needs evaluation; asymptomatic bacteriuria treated only in specific groups

6. Mechanisms / Pathophysiology Flow

Flow 6.1 — TB: from inhalation to disease

```
Person with infectious pulmonary TB coughs --> droplet nuclei float in air
        |
        v
Susceptible person inhales droplets --> bacteria reach alveoli
        |
        v
Macrophages engulf bacteria BUT waxy coat resists killing
        |
        +---> Immune system walls off bacteria in GRANULOMA --> LATENT TB
        |       (dormant, no symptoms, not infectious)
        |
        +---> Immunity fails to contain --> ACTIVE TB
                |
                v
        Caseation (cheese-like necrosis) --> cavity formation in lung
                |
                v
        Cough, fever, night sweats, weight loss; sputum AFB positive --> infectious
                |
        (If immunity weak: bacteria spread via blood --> miliary/extrapulmonary TB)
```

Flow 6.2 — How DOTS prevents drug resistance

```
Patient feels better after 2-3 weeks of treatment
        |
        +---> WITHOUT observation: stops medicines early
        |       --> surviving bacteria = the toughest ones --> DRUG-RESISTANT TB
        |
        +---> WITH DOTS (observed every dose): completes full course
                --> all bacteria (active + dormant) killed --> CURE, no resistance
```

Flow 6.3 — Pneumonia: alveoli fill up

```
Germs inhaled/aspirated into alveoli
        |
        v
Immune response: white cells + fluid flood the air sacs
        |
        v
Alveoli fill with pus/fluid (CONSOLIDATION) instead of air
        |
        v
Oxygen cannot cross into blood --> breathlessness, fast breathing
        |
        v
Severe: low oxygen, low BP, confusion --> needs hospital/ICU care
```

Flow 6.4 — UTI: ascent of bacteria

```
Bacteria (usually E. coli) from bowel/skin enter urethra
        |
        v
Travel up to bladder --> CYSTITIS (burning, frequency, urgency)
        |
        +---> treated promptly: infection cleared
        |
        +---> ascends via ureter to kidney --> PYELONEPHRITIS (fever, flank pain)
                |
                +---> may enter blood --> UROSEPSIS (emergency)
```

Flow 6.5 — How beta-lactam antibiotics work (concept)

```
Bacteria build cell walls using enzymes (penicillin-binding proteins)
        |
        v
Beta-lactam antibiotic binds these enzymes --> wall building stops
        |
        v
Weak wall + cell's own turgor pressure --> bacterium bursts and dies (bactericidal)
```

7. Diagrams / Flowcharts

Diagram 7.1 — TB management pathway (programmatic)

```
Cough > 2 weeks / weight loss / night sweats --> suspect TB
        |
        v
Sputum test (microscopy + CBNAAT/GeneXpert) + chest X-ray + HIV test
        |
        +---> Drug-sensitive TB --> NTEP regimen (intensive + continuation phases)
        |       with DOTS/adherence support --> cure, follow-up sputum checks
        |
        +---> Rifampicin-resistant / MDR / XDR --> specialised longer regimen
                at designated centre (as per current guidelines — confirm latest edition)
```

Diagram 7.2 — CAP severity triage (CURB-65 concept)

```
Score 0-1 (no confusion, normal vitals, younger)
   --> consider home treatment, oral antibiotics, review plan
Score 2
   --> hospital assessment usually needed
Score 3+
   --> urgent hospital/ICU-level care; broad empirical antibiotics + oxygen
(Always combine with clinical judgement — frailty and comorbidity matter)
```

Diagram 7.3 — UTI decision flow

```
Burning urination + frequency, NO fever/flank pain --> likely CYSTITIS
   --> uncomplicated woman: short oral antibiotic course (per guidelines)
   --> complicated/pregnant/man: urine culture + tailored therapy + find cause
Fever + flank pain + nausea --> likely PYELONEPHRITIS
   --> prompt medical care; culture; broader/longer antibiotics; watch for sepsis
```

8. Infographic Concepts (Text Boxes)

```
+-----------------------------------------------------------+
| TB: THE 3 GOLDEN RULES                                    |
| 1. COMBINATION — never one drug alone (breeds             |
|    resistance).                                           |
| 2. DURATION — months, not days; finish every dose.        |
| 3. OBSERVED — DOTS makes sure no dose is missed.          |
| Break any rule --> drug-resistant TB.                     |
+-----------------------------------------------------------+

+-----------------------------------------------------------+
| COUGH > 2 WEEKS? THINK TB                                 |
| Persistent cough + evening fever + night sweats +         |
| weight loss = get a sputum test. Early diagnosis          |
| protects the whole family. TB treatment under NTEP        |
| is FREE.                                                  |
+-----------------------------------------------------------+

+-----------------------------------------------------------+
| PNEUMONIA: HOME OR HOSPITAL?                              |
| CURB-65 = Confusion, Urea, breathing Rate, Blood          |
| pressure, age 65+. More points = sicker patient =         |
| hospital. Confusion or bluish lips = emergency.           |
+-----------------------------------------------------------+

+-----------------------------------------------------------+
| UTI: BLADDER OR KIDNEY?                                   |
| Burning + going often, no fever --> bladder (cystitis).   |
| Fever + back/side pain + vomiting --> kidney              |
| (pyelonephritis) --> see a doctor promptly.               |
| Drink water, don't hold urine, wipe front-to-back.        |
+-----------------------------------------------------------+
```

9. Tables (Comparisons, Summaries)

Table 9.1 — Latent vs active TB

Feature	Latent TB	Active TB
Symptoms	None	Cough, fever, night sweats, weight loss
Infectious	No	Yes, if pulmonary

Feature	Latent TB	Active TB
Chest X-ray	Usually normal	Abnormal (infiltrates, cavities)
Sputum AFB	Negative	May be positive
Treatment aim	Prevent activation	Cure disease, stop spread

Table 9.2 — CAP vs HAP

Feature	CAP	HAP
Where acquired	Community	Hospital, ≥48 h after admission
Usual germs	Pneumococcus, atypicals, viruses	Resistant gram-negatives, MRSA
Empirical antibiotics	Narrower (beta-lactam ± macrolide)	Broader, anti-resistant coverage
Prevention	Vaccines, smoking cessation	Hand hygiene, ventilator bundles, early mobilisation

Table 9.3 — Typical vs atypical pneumonia

Feature	Typical	Atypical
Onset	Sudden	Gradual
Fever	High with chills	Low-grade
Cough	Productive (rusty sputum)	Dry, persistent
Chest pain	Common (pleuritic)	Less common
X-ray	Lobar consolidation	Patchy infiltrates
Classic antibiotic class	Beta-lactam	Macrolide

Table 9.4 — Cystitis vs pyelonephritis

Feature	Cystitis	Pyelonephritis
Site	Bladder	Kidney
Fever	Usually absent	Present, often with chills
Flank pain	Absent	Present
Nausea/vomiting	Absent	May be present
Severity	Mild–moderate	Moderate–severe; can lead to sepsis
Workup	Urine routine ± culture	Urine culture; assess for obstruction

Table 9.5 — Antibiotic classes by infection (overview)

Infection	First-line classes (conceptual)	Notes
Drug-sensitive TB	Rifamycin + isoniazid-class + pyrazinamide + ethambutol	Combination for months; DOTS; free under NTEP
Drug-resistant TB	Fluoroquinolones, bedaquiline class, linezolid class, clofazimine, cycloserine	Long specialised regimens at designated centres
Mild CAP (typical)	Beta-lactams (amoxicillin class)	Add/switch to macrolide if atypical suspected
Moderate–severe CAP/HAP	Beta-lactam + macrolide, or respiratory fluoroquinolone	Broader for HAP; de-escalate on culture

Infection	First-line classes (conceptual)	Notes
Uncomplicated cystitis	Nitrofurantoin, fosfomycin class, TMP-SMX	Short courses; follow local resistance patterns
Pyelonephritis/complicated UTI	Broader beta-lactams, fluoroquinolones (per culture)	Culture-guided; longer duration; evaluate cause

10. Worked Examples (Patient-Case Vignettes)

Case 1 — Pulmonary TB. A 28-year-old man has had cough for 3 weeks, evening fever, night sweats, and 5 kg weight loss. He smokes and lives in a crowded household. Sputum CBNAAT is positive for *M. tuberculosis* without rifampicin resistance; HIV test negative. Interpretation: drug-sensitive pulmonary TB. Management principles: notify under Nikshay/NTEP; start the standard multi-drug regimen (intensive + continuation phases, as per current guidelines — confirm latest edition) with DOTS/adherence support; counsel that treatment is free, lasts months, every dose matters, and orange-red urine from rifampicin is harmless; screen household contacts; advise cough hygiene and ventilation; warn about liver symptoms and visual changes (ethambutol) and to report them.

Case 2 — CAP. A 68-year-old woman develops sudden high fever with chills, productive cough, and sharp chest pain on breathing, 3 days after a cold. She is confused, breathing fast, with low blood pressure. Interpretation: severe community-acquired (typical) pneumonia — CURB-65 high. Management principles: urgent hospital care; oxygen; empirical broad antibiotics (beta-lactam + macrolide class per guidelines) before cultures; blood cultures and chest X-ray; fluids and monitoring; de-escalate antibiotics once culture results arrive; consider pneumococcal/influenza vaccination after recovery.

Case 3 — UTI. A 24-year-old woman has 2 days of burning urination, frequency, and urgency, no fever or back pain. Interpretation: uncomplicated cystitis. Management principles: short course of an appropriate oral antibiotic class per current guidelines and local resistance; advise plenty of fluids, not holding urine, and completing the course; urine culture if recurrent. Contrast: if she had fever with flank pain, manage as pyelonephritis — urgent care, culture, broader therapy.

Case 4 — MDR-TB counselling. A patient interrupted TB treatment after 2 months ("I felt fine") and now has recurrent symptoms; testing shows rifampicin resistance. Pharmacist's role: explain without blame that stopping early let the toughest bacteria survive; refer immediately to the drug-resistant TB centre; stress that the new regimen is longer and must be completed fully with adherence support; reinforce that irregular treatment endangers the family and community.

11. Analogies

- **Latent vs active TB:** latent TB is like embers buried under ash (present but not burning); active TB is the fire blazing.
- **Why TB needs 4 drugs for months:** like attacking a fortress with infantry, artillery, air force, and siege engineers together — one army alone lets the enemy adapt; TB's waxy coat and dormancy mean you need every weapon, for the full siege.
- **DOTS:** like a teacher watching students finish homework — not from distrust, but because unfinished homework (missed doses) creates super-germs.
- **Drug resistance:** like weeds surviving a half-sprayed field — the survivors are the toughest, and they seed the next crop.

- **Pneumonia:** alveoli are like tiny balloons; pneumonia fills them with water so they cannot inflate — breathlessness follows.
- **CURB-65:** like a cricket umpire's checklist — each warning sign is a run against the patient; too many runs and the patient needs the hospital "pavilion".
- **Cystitis vs pyelonephritis:** a fire in the courtyard (bladder) versus a fire inside the house's main rooms (kidney) — the deeper the fire, the more urgent the response.

12. Pharmacy Relevance (What the Pharmacist Does)

- **TB case-finding:** ask every patient with cough >2 weeks about fever, night sweats, weight loss — and refer for sputum testing. This single habit saves lives.
- **Adherence champion:** explain that TB drugs must be taken for months even after feeling better; support DOTS/digital adherence; trace and re-engage patients who miss doses (inform the NTEP treatment supporter).
- **Counselling on side effects:** orange-red urine/tears with rifampicin (harmless — warn contact-lens wearers); take isoniazid-related pyridoxine as prescribed; report yellow eyes, vomiting (liver), or visual blurring (ethambutol) immediately; rifampicin reduces oral contraceptive effectiveness — advise alternative contraception.
- **Never dispense anti-TB drugs casually:** single-drug or incomplete regimens breed MDR-TB; always align with the programme regimen.
- **Pneumonia:** ensure antibiotics start promptly in suspected severe CAP; counsel on completing the course; promote pneumococcal/influenza vaccination in the elderly and high-risk.
- **UTI:** discourage self-medication with leftover antibiotics; insist on urine culture for recurrent/complicated cases; counsel on hydration, hygiene, and completing prescribed courses; flag pregnancy, fever, or flank pain for urgent medical review.
- **Antimicrobial stewardship:** dispense antibiotics only on prescription, educate against demanding antibiotics for viral colds, and support culture-guided de-escalation.

13. India Context

- India carries one of the world's largest TB burdens; TB remains a major public health priority. Care is delivered through the **NTEP (National TB Elimination Programme)**, successor to **RNTCP**, which provides **free diagnosis (including CBNAAT) and free anti-TB drugs**, mandatory **Nikshay notification** of every TB case, and adherence support including DOTS and digital tools. The national goal is TB elimination ahead of global timelines.
- Drug-resistant TB (MDR/XDR) is a growing concern, driven largely by treatment interruption — making the pharmacist's adherence role nationally important.
- The **National Malaria Programme** is separate (see Chapter 13); for pneumonia, national immunisation and the Ayushman Bharat health infrastructure support vaccine delivery and hospital care access.
- For HIV-associated TB, **NACO (National AIDS Control Organisation)** coordinates HIV care; every TB patient is offered HIV testing and vice versa, because co-infection worsens both diseases.

- UTIs are among the commonest bacterial infections seen in Indian outpatient practice; rising antibiotic resistance (including to fluoroquinolones and TMP-SMX in many regions) makes urine culture and local antibiograms essential — empirical choices must follow current local guidance.
- Over-the-counter antibiotic sale without prescription remains a driver of resistance; pharmacists are frontline stewards under Schedule H/H1 rules.

14. Key Points

- TB spreads through air; latent TB is dormant and non-infectious, active pulmonary TB is infectious.
- Diagnose with sputum tests (microscopy, CBNAAT/GeneXpert), chest X-ray, and HIV testing.
- Treat drug-sensitive TB with multi-drug combination therapy (rifamycin + isoniazid-class + pyrazinamide + ethambutol) in intensive + continuation phases for months, under DOTS — free via NTEP.
- MDR-TB = resistant to isoniazid + rifampicin; XDR-TB = broader resistance; both need long specialised regimens at designated centres.
- CAP vs HAP differ in germs and antibiotic breadth; typical vs atypical differ in onset and drug class (beta-lactam vs macrolide).
- CURB-65 (Confusion, Urea, Respiratory rate, Blood pressure, age ≥65) triages CAP severity qualitatively.
- Cystitis = bladder (burning, frequency, no fever); pyelonephritis = kidney (fever, flank pain) — more urgent.
- Uncomplicated cystitis gets short oral therapy; complicated UTI/pyelonephritis needs culture and broader/longer treatment.
- Pharmacists drive TB adherence, counsel on side effects and interactions, and practise antibiotic stewardship.

15. Common Confusions (with Clarifications)

- **"Latent TB spreads to others."** No — latent TB has dormant bacteria, no symptoms, and is not infectious; only active pulmonary TB spreads.
- **"One strong antibiotic can cure TB."** Never — single-drug TB treatment rapidly breeds resistance; combination therapy for months is mandatory.
- **"I feel better, so I can stop TB medicines."** The most dangerous belief in TB care — stopping early causes relapse and MDR-TB; DOTS exists precisely to prevent this.
- **"Orange urine means kidney damage from TB drugs."** It is the harmless colouring effect of rifampicin — but warn patients in advance so they do not panic or stop treatment.
- **"All pneumonias need the same antibiotic."** CAP and HAP involve different germs; typical and atypical need different classes; severity changes the regimen.
- **"UTI antibiotics can be shared with family."** No — wrong drug, wrong duration, and pregnancy/complicated cases need different management; culture guides therapy.

- **"Asymptomatic bacteriuria always needs antibiotics."** Usually not — except in pregnancy and before urological procedures.

16. Common Mistakes (Exam Traps)

- Writing DOTS as only "directly observed" without the "short-course" chemotherapy concept and its purpose (adherence → preventing resistance).
- Confusing MDR (isoniazid + rifampicin resistance) with XDR (MDR plus further second-line resistance) — state both precisely.
- Prescribing-style answers with specific doses or durations — keep to drug classes and phases; cite "as per current guidelines — confirm latest edition".
- Mixing up cystitis (no fever) and pyelonephritis (fever + flank pain) features.
- Forgetting HIV testing in TB workup and TB screening in HIV care (NACO/NTEP linkage).
- Listing CBNAAT/GeneXpert only as a TB test without noting it also detects rifampicin resistance rapidly.
- Omitting pyridoxine (vitamin B6) with isoniazid, or the rifampicin–oral contraceptive interaction.
- Treating asymptomatic bacteriuria routinely — know the two exceptions.

17. Mnemonics

- **TB symptoms — "Cough FEVER": Cough** >2 weeks, **F**ever (evening), **E**vening sweats (night), **V**ery tired/appetite loss, **E**maciation (weight loss), **R**usty/bloody sputum.
- **First-line TB classes — "RIPE": R**ifamycin, **I**soniazid-class, **P**yrazinamide, **E**thambutol.
- **MDR vs XDR — "MDR = Minus two Drugs Resistant (isoniazid + rifampicin); XDR = eXtremely Drug Resistant (MDR plus more)".**
- **CURB-65 — "Confusion, Urea, Respiratory rate, Blood pressure, 65+ years".**
- **Cystitis vs pyelonephritis — "Bladder Burns, Kidney Burns with Fever"** (burning alone = bladder; burning + fever + flank pain = kidney).
- **UTI complicated factors — "SCAMP D": S**tone, **C**atheter, **A**natomical obstruction, **M**ale sex, **P**regnancy, **D**iabetes/immunosuppression.

18. Exam Summary

Tuberculosis, caused by *Mycobacterium tuberculosis* and spread airborne, presents as latent (dormant, non-infectious) or active disease, pulmonary (cough >2 weeks, evening fever, night sweats, weight loss) or extrapulmonary; diagnosis uses sputum microscopy, CBNAAT/GeneXpert (also detecting rifampicin resistance), chest X-ray, and HIV testing. Drug-sensitive TB is treated with combination therapy (rifamycin, isoniazid-class, pyrazinamide, ethambutol) in intensive and continuation phases for months under DOTS through India's NTEP, which provides free diagnosis and drugs; MDR-TB (isoniazid + rifampicin resistance) and XDR-TB need long specialised regimens. Pneumonia is classified as community- versus hospital-acquired and typical versus atypical, severity triaged by CURB-65, and treated by class (beta-lactams ± macrolides for CAP; broader regimens for HAP). UTI presents as cystitis (burning,

frequency, no fever) or pyelonephritis (fever, flank pain); uncomplicated cystitis receives short oral therapy while complicated cases need culture-guided broader treatment. Pharmacists ensure TB adherence, counsel on drug effects and interactions, and uphold antibiotic stewardship.

19. One-Minute Revision

- TB: airborne; latent = dormant/non-infectious; active pulmonary = cough >2 weeks + evening fever + night sweats + weight loss.
- Diagnosis: sputum AFB, CBNAAT (also rifampicin resistance), X-ray, HIV test.
- Treatment: RIPE classes, intensive + continuation phases, months, DOTS, free under NTEP; MDR = INH+RIF resistance, XDR = broader.
- Pneumonia: CAP vs HAP; typical (beta-lactam) vs atypical (macrolide); CURB-65 triage.
- UTI: cystitis (bladder, no fever) vs pyelonephritis (kidney, fever + flank pain); uncomplicated = short course; complicated = culture + broader therapy.
- Pharmacist: adherence, side-effect counselling, stewardship, referral.

20. MCQs

1 The causative organism of tuberculosis is:

a) *Streptococcus pneumoniae* b) *Mycobacterium tuberculosis* c) *Escherichia coli* d) *Mycoplasma pneumoniae*

1 A person with latent TB infection is:

a) Highly infectious b) Symptomatic with cavitary disease c) Asymptomatic and non-infectious d) Always sputum AFB positive

1 DOTS in TB control primarily ensures:

a) Single-drug therapy b) Observed adherence to complete multi-drug treatment c) Surgical treatment d) Vaccination of contacts

1 MDR-TB is defined as resistance to at least:

a) Pyrazinamide and ethambutol b) Isoniazid and rifampicin c) Streptomycin and ethambutol d) All second-line drugs

1 Orange-red discolouration of urine in a TB patient is caused by:

a) Isoniazid b) Rifampicin c) Pyrazinamide d) Ethambutol

1 Hospital-acquired pneumonia is defined as pneumonia developing:

a) Before admission b) ≥48 hours after hospital admission c) Only in ICU patients d) Within 24 hours of discharge

1 In CURB-65, the "R" stands for:

a) Renal failure b) Respiratory rate c) Rhonchi d) Relapse

1 Atypical pneumonia is classically treated with which antibiotic class?

a) Aminoglycosides b) Macrolides c) Glycopeptides d) Carbapenems

1 Fever with flank pain and burning urination most suggests:

a) Uncomplicated cystitis b) Pyelonephritis c) Asymptomatic bacteriuria d) Urethritis only

1 Asymptomatic bacteriuria generally requires treatment in:

a) All healthy adults b) Pregnancy and before urological procedures c) Elderly men routinely d) No situation ever

Answer Key: 1-b, 2-c, 3-b, 4-b, 5-b, 6-b, 7-b, 8-b, 9-b, 10-b

21. Viva / Application Questions

1 **Q: Why is TB treated with four drugs for months instead of one drug for two weeks?**

A: TB bacteria grow slowly, hide inside cells, and go dormant; a single drug kills only susceptible bacteria and selects resistant mutants. Combination therapy attacks through multiple mechanisms at once, and the long continuation phase kills dormant bacteria, preventing relapse and resistance.

1 **Q: A TB patient wants to stop medicines after one month because he feels fine. How do you counsel?**

A: Explain that feeling better means the active bacteria are dying, but dormant ones survive; stopping now causes relapse with drug-resistant TB that is harder to treat and endangers the family. Reinforce DOTS support and that treatment under NTEP is free.

1 **Q: How does CBNAAT/GeneXpert change TB diagnosis?**

A: It detects TB bacteria and rifampicin resistance from sputum within hours, unlike culture which takes weeks — allowing same-day diagnosis and immediate identification of drug-resistant cases for correct regimen selection.

1 **Q: A 70-year-old with CAP is confused, breathing 32/min, BP 90/60. What does CURB-65 suggest?**

A: At least 4 points (confusion, fast respiratory rate, low BP, age ≥65) — severe pneumonia needing urgent hospital/ICU-level care with broad empirical antibiotics and oxygen, not home treatment.

1 **Q: Why is urine culture essential before treating pyelonephritis but often skipped in simple cystitis?**

A: Pyelonephritis is more serious, often involves resistant organisms, and needs longer/broader therapy — culture guides the exact drug. Uncomplicated cystitis in healthy women follows predictable patterns, so short empirical therapy per guidelines is acceptable, with culture reserved for recurrence or complications.

22. References

- Standard pharmacotherapeutics and clinical pharmacy textbooks (consult latest editions).

- Standard microbiology textbooks for *Mycobacterium tuberculosis*, pneumonia pathogens, and uropathogens (consult latest editions).
- India's National TB Elimination Programme (NTEP) guidelines and technical documents — as per current guidelines, confirm latest edition.
- NACO guidelines for HIV-TB co-infection — as per current guidelines, confirm latest edition.
- Current national/international guidelines for community-acquired pneumonia and urinary tract infection — as per current guidelines, confirm latest edition.
- Standard pharmacology textbooks for anti-TB, beta-lactam, macrolide, fluoroquinolone, and urinary antiseptic drug classes (consult latest editions).

CHAPTER 13: Malaria and HIV

1. Learning Objectives

After studying this chapter, the student will be able to:

- Define malaria and HIV/AIDS and name the causative organisms.
- Compare the four main *Plasmodium* species affecting humans in a table.
- Describe the malaria life cycle (mosquito → human liver → human blood) with a flow diagram.
- List clinical features of malaria and recognise severe malaria conceptually.
- Outline antimalarial management by drug class, including artemisinin-based combination therapy (ACT) as a class concept, and prophylaxis principles.
- Describe HIV structure and life cycle, stages of HIV infection, and common opportunistic infections.
- Name antiretroviral (ART) drug classes — NRTI, NNRTI, PI, INSTI — and explain what step of the viral life cycle each blocks.
- Explain PEP and PrEP concepts.
- Describe the pharmacist's role in adherence, counselling, and India's national programmes for malaria and HIV.

2. Definitions

- **Malaria** — a mosquito-borne infectious disease caused by *Plasmodium* parasites, transmitted to humans through the bite of an infected female *Anopheles* mosquito. Its hallmark is periodic fever with chills and sweating.
- **Plasmodium** — the genus (group) of single-celled parasites that cause malaria. The species infecting humans are *P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, and *P. knowlesi*.

- **Vector** — a living carrier that transmits a germ from one host to another. The *Anopheles* mosquito is the vector of malaria.
- **Parasitaemia** — the presence (and amount) of malaria parasites in the blood.
- **Relapse** — return of malaria from dormant liver forms (**hypnozoites**) of *P. vivax*/*P. ovale*, weeks or months after the first attack. **Recrudescence** is different: return of blood-stage parasites because treatment did not fully clear them.
- **Artemisinin-based combination therapy (ACT)** — treatment combining a fast-acting artemisinin-class drug (which rapidly kills blood parasites) with a longer-acting partner drug (which clears remaining parasites and prevents resistance). The current standard for uncomplicated falciparum malaria.
- **Chemoprophylaxis** — taking medicines to PREVENT malaria while travelling in or living in endemic areas.
- **HIV** — Human Immunodeficiency Virus: a virus that attacks the immune system, mainly CD4 T-lymphocytes (helper T cells), progressively weakening immunity.
- **AIDS** — Acquired Immunodeficiency Syndrome: the late stage of HIV infection when immunity is severely damaged (CD4 count very low) and opportunistic infections or certain cancers appear.
- **CD4 count** — the number of CD4 helper T cells in blood; the main marker of immune strength in HIV. Falling CD4 = weakening immunity.
- **Viral load** — the amount of HIV in the blood; the goal of ART is an undetectable viral load.
- **Opportunistic infection (OI)** — an infection caused by germs that healthy immune systems control easily, but which cause serious disease when immunity is weak (e.g., TB, PCP pneumonia, cryptococcal meningitis, toxoplasmosis).
- **Antiretroviral therapy (ART)** — combination treatment with several anti-HIV drug classes that suppresses viral replication for life; it does not cure HIV but makes it a manageable chronic condition.
- **PEP (post-exposure prophylaxis)** — a short course of antiretroviral medicines started urgently AFTER a possible HIV exposure (needlestick injury, unprotected exposure) to prevent infection.
- **PrEP (pre-exposure prophylaxis)** — antiretroviral medicines taken BEFORE potential exposure by HIV-negative people at substantial ongoing risk, to prevent infection.
- **Serodiscordant couple** — a couple in which one partner has HIV and the other does not.

3. Terminology Table

Term	Simple Meaning
Anopheles	The mosquito genus that transmits malaria (bites mainly at night)
Sporozoite	The malaria parasite form injected by the mosquito bite
Hypnozoite	Dormant liver form of *P. vivax*/*P. ovale* that causes relapses
Merozoite	The parasite form released from the liver that invades red blood cells
Gametocyte	The sexual parasite form in blood that infects mosquitoes

Term	Simple Meaning
Schizont	The multiplying stage inside red blood cells
Cerebral malaria	Severe falciparum malaria affecting the brain (confusion, seizures, coma)
Blackwater fever	Dark/red urine from massive red cell destruction in severe malaria
Retrovirus	A virus (like HIV) that copies its RNA into DNA and inserts it into host DNA
Reverse transcriptase	The viral enzyme that converts HIV RNA into DNA
Integrase	The viral enzyme that inserts HIV DNA into human DNA
Protease	The viral enzyme that cuts new viral proteins into working parts
Window period	The early weeks after HIV infection when antibody tests may still be negative
Adherence (ART)	Taking every ART dose on time, every day — missing doses breeds resistance

4. Detailed Explanation

4.1 Malaria

The parasite and the bite. When an infected female *Anopheles* mosquito bites, it injects **sporozoites** into the blood. These travel to the **liver**, multiply silently for 1–2 weeks, then burst out as **merozoites** that invade **red blood cells**. Inside red cells the parasites multiply (schizonts), burst the cells, and invade new ones in synchronised cycles — each bursting wave causes the classic fever spike with chills followed by sweating. Some parasites become **gametocytes**, which a new mosquito picks up, completing the cycle.

Species differences (the key exam table). *P. falciparum* is the most dangerous — it infects red cells of all ages, reaches high parasite loads, makes red cells sticky (causing blockage of small blood vessels → cerebral malaria, organ damage), and causes severe, potentially fatal disease. *P. vivax* is the commonest cause of malaria in India; it forms dormant **hypnozoites** in the liver causing **relapses** months later, so treatment must include a drug that kills liver hypnozoites (a "radical cure" class, e.g., primaquine-class drugs — with G6PD testing first, see Chapter 14 concepts). *P. ovale* behaves like vivax (relapses, milder). *P. malariae* causes milder, long-lasting infection. *P. knowlesi* (monkey malaria, Southeast Asia) can be severe.

Clinical features. Incubation is roughly 1–4 weeks depending on species. Classic attack: cold stage (shivering, chills), hot stage (high fever, headache, body ache), sweating stage (fever breaks with profuse sweating) — repeating every 48 hours (vivax/ovale) or 72 hours (malariae); falciparum fever is often irregular. Between attacks the patient may feel relatively well early in the illness.

Severe malaria (mostly falciparum) — recognise urgently: impaired consciousness/cerebral malaria, seizures, severe anaemia, breathing difficulty (acidosis/ARDS-like), very low blood sugar, kidney failure, shock, jaundice, dark urine (blackwater fever), high parasite load, bleeding. Severe malaria is a medical emergency needing parenteral (injectable) treatment and hospital care.

Diagnosis. Demonstration of parasites: peripheral blood smear (thick and thin films — the gold standard, also identifies species), rapid diagnostic test (RDT — detects parasite antigens within minutes, vital in field settings), and clinical assessment. Species identification matters because vivax needs anti-relapse treatment and falciparum needs ACT.

Treatment by class (overview, not doses). Uncomplicated *P. falciparum*: **artemisinin-based combination therapy (ACT)** — an artemisinin-class drug (rapid parasite killing) plus a longer-acting partner drug class (e.g., lumefantrine-class or similar partner), as per current guidelines — confirm latest edition. Uncomplicated *P. vivax*: a blood-stage drug class (e.g., chloroquine-class, where still effective) PLUS a hypnozoite-killing drug class (e.g., primaquine-class) for radical cure to prevent relapses — after checking G6PD status because primaquine-class drugs can cause haemolysis in G6PD deficiency. Severe malaria: parenteral **artesunate-class** therapy urgently, then complete with oral ACT. Drug resistance (notably chloroquine resistance in falciparum) is why combinations and programme guidance are essential.

Prophylaxis principles. For travellers to endemic areas and select high-risk groups: chemoprophylaxis with an appropriate drug class (e.g., doxycycline-class, atovaquone-proguanil-class, or mefloquine-class — choice depends on destination resistance, duration, and patient factors, as per current travel-medicine guidance), started before entry, continued during stay, and for a defined period after leaving. PLUS mosquito protection always: insecticide-treated bed nets, repellents, screened windows, long clothing at night. No drug replaces bite prevention.

4.2 HIV

Structure (simple). HIV is a small spherical **retrovirus**: an outer envelope (with gp120/gp41 spikes that grip CD4 cells), inside a protein capsid containing two copies of RNA and three key enzymes — **reverse transcriptase**, **integrase**, and **protease**.

Life cycle and drug targets (the heart of ART).

```
1. ATTACHMENT & ENTRY: gp120 spike grips CD4 receptor (+ co-receptor) on helper T cell
        |
2. REVERSE TRANSCRIPTION: reverse transcriptase converts viral RNA --> DNA
        |   <-- blocked by NRTIs and NNRTIs
3. INTEGRATION: integrase inserts viral DNA into human DNA (now a permanent "provirus")
        |   <-- blocked by INSTIs (integrase strand transfer inhibitors)
4. TRANSCRIPTION & TRANSLATION: cell machinery makes long viral protein chains
        |
5. ASSEMBLY & BUDDING: new virus particles pinch off from the cell
        |
6. MATURATION: protease cuts protein chains into working parts --> infectious virus
            <-- blocked by PIs (protease inhibitors)
```

Stages of HIV infection. Acute infection (2–4 weeks after exposure): flu-like illness (fever, rash, sore throat, swollen glands); very high viral load and infectiousness; antibody tests may still be negative (window period). **Chronic/asymptomatic stage**: years with no symptoms while CD4 slowly falls; the person feels well but can transmit HIV. **AIDS**: CD4 severely depleted; opportunistic infections and AIDS-defining cancers appear (TB, *Pneumocystis* pneumonia/PCP, cryptococcal meningitis, toxoplasmosis of brain, oesophageal candidiasis, Kaposi sarcoma, certain lymphomas).

Opportunistic infections to know. TB is the commonest serious OI in India and the leading killer of people with HIV — every HIV patient is screened for TB and vice versa (see Chapter 12). Others: PCP (*Pneumocystis jirovecii* pneumonia — dry cough, breathlessness, low oxygen), cryptococcal meningitis (headache, neck stiffness, raised intracranial pressure), cerebral toxoplasmosis (focal brain lesions, seizures), severe candidiasis, chronic diarrhoea from cryptosporidium.

ART classes overview. ART always uses a COMBINATION (usually 3 drugs from ≥2 classes) to suppress the virus fully and prevent resistance — single-drug HIV treatment is never used.

Class	What it blocks	Example members (for identification)
NRTI (nucleoside/nucleotide reverse transcriptase inhibitors)	Faulty building blocks: viral DNA chain stops growing	Tenofovir, lamivudine, emtricitabine, zidovudine, abacavir
NNRTI (non-nucleoside RTIs)	Jams the reverse transcriptase enzyme directly	Efavirenz, nevirapine, doravirine
PI (protease inhibitors)	Stops maturation of new virus particles	Lopinavir/ritonavir, atazanavir/ritonavir, darunavir (ritonavir or cobicistat "boosts" levels)
INSTI (integrase strand transfer inhibitors)	Blocks viral DNA insertion into human DNA	Dolutegravir, raltegravir, bictegravir
Entry/fusion inhibitors	Block viral entry into the cell	Maraviroc, enfuvirtide (specialised use)

Modern first-line regimens in most guidelines are **INSTI-based** (e.g., dolutegravir-based) with two NRTIs as the backbone — as per current guidelines, confirm latest edition. ART is lifelong; the goals are undetectable viral load, CD4 recovery, no OIs, and zero transmission ("undetectable = untransmittable", U=U).

PEP and PrEP. PEP: after a significant exposure (needlestick, sexual exposure), start a full ART combination URGENTLY — ideally within hours, no later than 72 hours — and continue for 28 days. Every hour counts; the exposed person is counselled, tested, and followed up. **PrEP**: HIV-negative people at ongoing substantial risk take antiretrovirals regularly (daily oral, or long-acting injectable where available) to prevent infection; requires HIV testing before starting (PrEP must never be given to someone already HIV-positive, as partial treatment breeds resistance), plus regular follow-up.

5. Classifications

Table 5.1 — *Plasmodium* species comparison

Feature	*P. falciparum*	*P. vivax*	*P. ovale*	*P. malariae*
Danger	Most dangerous, can be fatal	Moderate; relapses	Mild; relapses	Mild, chronic
Red cells infected	All ages	Young (reticulocytes)	Young	Old
Hypnozoites (liver dormancy)	No	YES — relapses	YES — relapses	No
Fever pattern	Irregular	Every 48 h (tertian)	Every 48 h	Every 72 h (quartan)
Severe disease	Cerebral malaria, organ failure	Rare	Rare	Rare (nephrotic syndrome reported)
Key treatment note	ACT	Blood drug + anti-hypnozoite (radical cure)	Like vivax	Blood-stage drug

Table 5.2 — Malaria by severity

Category	Features	Management level
Uncomplicated	Fever with parasites, no danger signs, patient can swallow	Outpatient oral therapy (ACT for falciparum; blood drug + radical cure for vivax)

Category	Features	Management level
Severe	Impaired consciousness, seizures, severe anaemia, respiratory distress, hypoglycaemia, renal failure, shock, hyperparasitaemia	Emergency: parenteral artesunate-class + hospital supportive care

Table 5.3 — HIV infection stages

Stage	CD4 trend	Clinical picture
Acute infection	Transient dip	Flu-like illness 2–4 weeks post-exposure; highly infectious
Chronic asymptomatic	Slow decline over years	Well; transmissible
Symptomatic (non-AIDS)	Falling	Persistent fever, weight loss, thrush, shingles, TB
AIDS	Severely low	OIs (PCP, cryptococcal meningitis, toxoplasmosis), wasting, AIDS-defining cancers

Table 5.4 — ART classes and life-cycle step blocked

Class	Step blocked	Backbone or anchor role
NRTI	Reverse transcription (chain termination)	Backbone — usually 2 NRTIs in every regimen
NNRTI	Reverse transcription (enzyme jamming)	Alternative anchor
INSTI	Integration	Preferred anchor in current guidelines
PI (boosted)	Maturation	Anchor, especially with resistance or TB co-treatment considerations
Entry inhibitors	Attachment/entry	Specialised/rescue use

6. Mechanisms / Pathophysiology Flow

Flow 6.1 — Malaria life cycle (mosquito → human → mosquito)

```
Infected female Anopheles bites --> injects SPOROZOITES
        |
        v
Sporozoites travel to LIVER --> multiply silently (1-2 weeks)
        |
        +---> P. vivax/ovale: some become dormant HYPNOZOITES (future relapses)
        |
        v
MEROZOITES burst from liver --> invade RED BLOOD CELLS
        |
        v
Multiply inside RBCs (schizonts) --> RBC bursts --> fever spike + chills
        |
        v
New merozoites invade fresh RBCs --> cycles repeat (48h/72h/irregular)
        |
        v
Some parasites become GAMETOCYTES --> mosquito bites patient
        |
        v
Parasites mature inside mosquito --> mosquito infective --> bites next person
```

Flow 6.2 — Why falciparum turns severe

```
P. falciparum infects RBCs of ALL ages --> very high parasite load
        |
        v
Infected RBCs become STICKY --> cling to walls of tiny blood vessels
        |
        v
Microvessels blocked in brain, lungs, kidneys, placenta
        |
        v
Cerebral malaria (coma/seizures) + organ failure + severe anaemia --> death if untreated
```

Flow 6.3 — HIV: from infection to AIDS

```
HIV exposure (unprotected sex, blood, mother-to-child)
        |
        v
Virus infects CD4 helper T cells --> replicates --> kills them
        |
        v
Acute illness (weeks) --> years of silent CD4 decline
        |
        v
CD4 severely depleted --> immune surveillance collapses
        |
        v
Opportunistic infections + AIDS-defining cancers --> AIDS
        |
  (ART at ANY stage halts this chain by suppressing replication)
```

Flow 6.4 — How ART combination prevents resistance

```
One drug alone: virus mutates around it --> resistant strain takes over
        |
Three drugs (2 classes): virus would need 3 simultaneous lucky mutations
        |
        v
Replication fully suppressed --> viral load undetectable --> no mutation --> no resistance
        |
  (This is why ART is always combination therapy, taken daily without gaps)
```

7. Diagrams / Flowcharts

Diagram 7.1 — Diagnosing and treating malaria (field logic)

```
Fever in endemic area / after travel --> suspect malaria
        |
        v
Test: RDT and/or blood smear --> identify species
        |
        +---> P. falciparum, uncomplicated --> ACT (oral), full course
        +---> P. vivax/ovale --> blood-stage drug + anti-hypnozoite radical cure
        |       (check G6PD first)
        +---> Severe (any species) --> URGENT parenteral artesunate-class + hospital care
        |
        v
Advise: complete every dose; sleep under treated nets; test fever again if recurs
```

Diagram 7.2 — HIV testing and treatment cascade

```
Possible exposure / symptoms / routine screening --> HIV test (with counselling)
        |
        +---> Negative --> prevention counselling; PrEP if ongoing risk; retest as advised
        |
        +---> Positive --> confirm; baseline CD4, viral load, TB screen, hepatitis screen
                |
                v
        Start ART promptly (INSTI-based combination per current guidelines)
                |
                v
        Adherence support --> viral load undetectable --> stays undetectable (U=U)
```

Diagram 7.3 — PEP timeline

```
Exposure (needlestick / high-risk contact)
        |
        v
Wash wound / assess risk IMMEDIATELY --> start PEP within HOURS (max 72 h)
        |
        v
Full 3-drug ART combination for 28 days --> HIV tests at baseline and follow-up
(Every hour of delay reduces effectiveness — treat as emergency)
```

8. Infographic Concepts (Text Boxes)

```
+-----------------------------------------------------------+
| MALARIA IN ONE BITE                                       |
| Mosquito injects sporozoites --> liver (silent) -->       |
| red blood cells (fever cycles) --> some become            |
| gametocytes --> next mosquito. Break the chain with       |
| nets + complete treatment + radical cure for vivax.       |
+-----------------------------------------------------------+

+-----------------------------------------------------------+
| FALCIPARUM = EMERGENCY SPECIES                            |
| Confusion, seizures, severe anaemia, breathing             |
| difficulty, dark urine, or inability to swallow =          |
| SEVERE malaria --> hospital NOW, injectable               |
| artesunate-class urgently.                                |
+-----------------------------------------------------------+

+-----------------------------------------------------------+
| VIVAX HIDES IN THE LIVER                                  |
| P. vivax sleeps in the liver as hypnozoites and wakes     |
| months later (relapse). Killing blood parasites is not    |
| enough — radical cure of the liver stage is essential.    |
| Check G6PD before primaquine-class drugs.                |
+-----------------------------------------------------------+

+-----------------------------------------------------------+
| ART: 3 DRUGS, EVERY DAY, FOR LIFE                         |
| HIV treatment = combination of drug classes, taken        |
| daily without gaps. Undetectable viral load =             |
| untransmittable (U=U). Missing doses breeds               |
| drug-resistant HIV.                                       |
+-----------------------------------------------------------+
```

9. Tables (Comparisons, Summaries)

Table 9.1 — Antimalarial drug classes (conceptual)

Class	Role	Example members (for identification)
Artemisinin class	Rapid blood-parasite killing (ACT component)	Artesunate, artemether
ACT partner drugs	Long-acting clearance, resistance prevention	Lumefantrine-class and similar partners
4-aminoquinolines	Blood-stage treatment (vivax where effective)	Chloroquine-class
8-aminoquinolines	Hypnozoite (liver) radical cure	Primaquine-class
Antifolates	Blood-stage (limited by resistance)	Sulfadoxine-pyrimethamine-class
Others (prophylaxis/treatment per guidance)	Prevention and selected treatment	Doxycycline-class, atovaquone-proguanil-class, mefloquine-class

Table 9.2 — Common opportunistic infections in AIDS (India-relevant)

Infection	Organ	Clue features
Tuberculosis	Lungs / disseminated	Cough, fever, weight loss; commonest killer
Pneumocystis pneumonia (PCP)	Lungs	Dry cough, breathlessness, low oxygen
Cryptococcal meningitis	Brain coverings	Headache, neck stiffness, raised pressure
Cerebral toxoplasmosis	Brain	Seizures, focal weakness
Oesophageal candidiasis	Food pipe	Painful swallowing, white patches
Chronic cryptosporidiosis	Gut	Prolonged watery diarrhoea

Table 9.3 — PEP vs PrEP

Feature	PEP	PrEP
Timing	AFTER exposure	BEFORE potential exposure
When to start	Within hours, max 72 h	When ongoing risk identified
Duration	28 days	Ongoing while at risk
Who	Exposed person (e.g., needlestick)	HIV-negative person at substantial risk
Precondition	Risk assessment + baseline HIV test	Confirmed HIV-negative + regular follow-up

10. Worked Examples (Patient-Case Vignettes)

Case 1 — Vivax malaria. A 30-year-old man from an endemic district has 5 days of fever with chills and sweating every alternate day, headache, and body ache. RDT/smear shows *P. vivax*. Interpretation: uncomplicated vivax malaria. Management principles: blood-stage drug class to clear parasites plus an anti-hypnozoite drug class for radical cure (as per current guidelines — confirm latest edition); check G6PD status before the primaquine-class drug; counsel to complete the full course even after fever settles; advise treated bed nets for the family; warn that fever returning weeks later needs retesting (possible relapse if radical cure missed).

Case 2 — Severe falciparum malaria. A 25-year-old woman returns from a forested area with high fever, confusion, and dark urine; smear shows heavy *P. falciparum* parasitaemia. Interpretation: severe malaria — emergency. Management principles: urgent hospital admission; parenteral artesunate-class therapy

immediately; supportive care (fluids, glucose monitoring, oxygen, transfusion if severe anaemia); complete with oral ACT once stable; monitor for complications.

Case 3 — New HIV diagnosis. A 32-year-old man tests HIV-positive during routine screening; he feels well. Baseline workup: CD4 low-normal, screen for TB (negative), hepatitis B/C, kidney function. Management principles: start ART promptly with an INSTI-based combination (as per current guidelines — confirm latest edition); counsel that ART is lifelong, daily, and makes viral load undetectable (U=U); screen and treat OIs; discuss partner testing, condom use, and that breastfeeding/pregnancy need specialist guidance; link to ART centre for free treatment.

Case 4 — Needlestick injury (PEP). A nurse sustains a needlestick from an HIV-positive patient's blood. Management principles: wash the wound immediately with soap and water (no squeezing/scrubbing); risk-assess urgently; start PEP within hours (never beyond 72 h) — a full 3-drug ART combination for 28 days; baseline and follow-up HIV testing with counselling; report through the facility's exposure protocol.

11. Analogies

- **Malaria life cycle:** like a terrorist sleeper cell — sporozoites infiltrate (bite), train silently in the liver camp, then launch coordinated attacks on red blood cells; vivax leaves sleeper agents (hypnozoites) behind for later attacks.
- **ACT:** like a one-two punch in boxing — artemisinin lands the fast knockout blow on parasites, the partner drug stays for the long rounds to finish stragglers and prevent comeback.
- **Radical cure:** mopping the floor (blood-stage drugs) is not enough if the tap is still running (liver hypnozoites) — primaquine-class drugs turn off the tap.
- **HIV vs immune system:** HIV is like a spy that assassinates the generals (CD4 helper cells) — the army (immune system) collapses not from lack of soldiers but from lack of command.
- **ART combination:** like a three-lock safe — the virus must pick all three locks at once, which is practically impossible, so it stays trapped.
- **U=U:** a silenced gun cannot fire — undetectable virus cannot be transmitted.
- **PEP:** like a morning-after intervention — it only works if taken urgently after exposure, not days later.

12. Pharmacy Relevance (What the Pharmacist Does)

- **Malaria:** suspect malaria in every fever from endemic areas or after travel — refer for RDT/smear rather than dispensing antipyretics alone; dispense the FULL ACT or vivax course with clear day-wise instructions; emphasise completing all doses; check G6PD testing before primaquine-class dispensing and counsel about dark urine/haemolysis warning signs; promote insecticide-treated nets and chemoprophylaxis for travellers.
- **HIV:** support ART adherence above all — missed doses breed resistance; use pill organisers, reminders, and non-judgemental counselling; never dispense single-drug "ART"; counsel on lifelong therapy, U=U, and that ART does not cure HIV; watch drug interactions (e.g., rifampicin with many antiretrovirals in TB-HIV co-treatment — coordinate with the ART centre); ensure PEP is started within hours for exposures.
- **Confidentiality:** HIV status is deeply sensitive — protect privacy in dispensing, labelling, and records without exception.

- **Linkage:** connect patients to free government services — malaria diagnosis/treatment under the national programme and ART centres under NACO.
- **Vaccination and OI prophylaxis:** remind eligible patients about co-trimoxazole prophylaxis and vaccinations as advised by their treating team.

13. India Context

- Malaria remains endemic in several Indian states, especially forested, tribal, and border districts; *P. vivax* is the predominant species nationally while *P. falciparum* dominates in high-burden pockets and causes most severe disease and deaths. India's **National Vector Borne Disease Control Programme (NVBDCP)** — which the task describes as the national malaria programme — drives surveillance, free diagnosis (RDT/smear), free ACT, indoor residual spraying, and treated-net distribution, working toward malaria elimination goals.
- Drug-resistant falciparum (notably chloroquine resistance) shaped India's shift to ACT for falciparum malaria; programme guidance determines first-line choices, which change with resistance data — always follow current national guidelines.
- India has one of the world's largest HIV burdens in absolute numbers, concentrated in high-risk groups and certain states. **NACO (National AIDS Control Organisation)** runs prevention, testing, and **free lifelong ART through ART centres** across the country, plus PPTCT (prevention of parent-to-child transmission) services and targeted interventions for high-risk groups.
- TB-HIV co-infection is a national priority: bidirectional screening (every TB patient offered HIV testing; every HIV patient screened for TB) is programme policy, and co-trimoxazole preventive therapy plus early ART are standard in co-infection.
- Stigma remains a barrier; pharmacists' confidential, respectful counselling directly supports testing and treatment uptake.

14. Key Points

- Malaria = *Plasmodium* via female *Anopheles* bite; cycle: sporozoites → liver → red blood cells → (gametocytes → mosquito).
- *P. falciparum* is the killer (sticky red cells, cerebral malaria); *P. vivax*/*ovale* relapse from liver hypnozoites.
- Uncomplicated falciparum → ACT; vivax → blood drug + radical cure (check G6PD); severe → parenteral artesunate-class urgently.
- Prevention: treated nets, repellents + chemoprophylaxis for travellers (drug class per destination guidance).
- HIV attacks CD4 cells; stages: acute → chronic silent → AIDS with opportunistic infections (TB commonest in India).
- ART = lifelong combination (2 NRTIs + INSTI/NNRTI/PI anchor); goal: undetectable viral load (U=U).
- PEP: start within hours (max 72 h), 28 days; PrEP: for HIV-negative people at ongoing risk, confirmed negative first.

- Pharmacists: adherence support, confidentiality, interaction vigilance, linkage to free national programme services.

15. Common Confusions (with Clarifications)

- **"Malaria spreads from person to person like flu."** No — it needs the mosquito vector (or rarely blood transfusion/needles); you cannot catch it by touch or cough.
- **"Fever gone means malaria cured."** Blood parasites may be cleared while liver hypnozoites (vivax) survive — radical cure is needed, and the full course must be finished.
- **"Chloroquine cures all malaria."** Resistance is widespread in falciparum; species and programme guidance decide the drug — ACT for falciparum per current guidelines.
- **"HIV and AIDS are the same."** HIV is the virus; AIDS is its late stage after severe immune damage — ART prevents progression.
- **"ART cures HIV."** It suppresses the virus to undetectable levels but does not eliminate the integrated provirus; stopping ART lets the virus rebound.
- **"One anti-HIV tablet is enough."** Never — single-drug therapy rapidly breeds resistance; ART is always combination.
- **"PrEP can be started without an HIV test."** Dangerous — giving PrEP to someone already HIV-positive causes partial treatment and resistance; confirm negative status first.

16. Common Mistakes (Exam Traps)

- Forgetting hypnozoites/radical cure for vivax — the commonest reason exam answers on vivax treatment lose marks.
- Omitting G6PD testing before primaquine-class drugs (haemolysis risk).
- Mixing up relapse (vivax liver dormancy) with recrudescence (incomplete blood-stage clearance).
- Stating specific ACT doses or durations — keep to classes and "as per current guidelines — confirm latest edition".
- Confusing NRTI (chain terminators) with NNRTI (enzyme jammers) mechanisms.
- Listing PEP as effective any time after exposure — the 72-hour outer limit and "hours matter" urgency are essential.
- Forgetting TB screening in every new HIV diagnosis (and HIV testing in every TB case).
- Naming NACO/NVBDCP roles backwards — NACO = HIV/AIDS; the national malaria programme sits under the vector-borne disease programme.

17. Mnemonics

- **Species danger — "Fearful Falciparum, Vivacious Vivax relapses":** **F**alciparum = **F**atal/severe; **V**ivax = li**V**er hypnozoites (relapse).
- **Malaria cycle — "SLiM-RiG":** **S**porozoite → **Li**ver → **M**erozoite → **R**BC → **G**ametocyte.

- **ART classes — "N-N-P-I-E": N**RTI (faulty bricks), **N**NRTI (jam the machine), **P**I (no finishing cuts), **I**NSTI (no insertion), **E**ntry blockers (locked door).
- **PEP timing — "72 hours, 28 days":** start within 72 hours, take for 28 days.
- **Severe malaria signs — "CASH-GO": C**oma/confusion, **A**naemia severe, **S**eizures, **H**ypoglycaemia, **G**asping (respiratory distress), **O**liguria (kidney failure).
- **U=U — "Undetectable = Untransmittable".**

18. Exam Summary

Malaria, caused by *Plasmodium* species transmitted by female *Anopheles* mosquitoes, follows a sporozoite → liver → red-blood-cell → gametocyte cycle; *P. falciparum* causes severe disease through sticky infected red cells blocking microvessels (cerebral malaria, organ failure), while *P. vivax*/*P. ovale* form liver hypnozoites causing relapses. Uncomplicated falciparum malaria is treated with artemisinin-based combination therapy (ACT), vivax with a blood-stage drug plus radical cure of hypnozoites after G6PD testing, and severe malaria with urgent parenteral artesunate-class therapy; prevention combines treated nets, repellents, and chemoprophylaxis. HIV, a retrovirus attacking CD4 cells, progresses from acute infection through chronic silent disease to AIDS with opportunistic infections (TB commonest in India); ART uses lifelong combinations of NRTIs with an INSTI/NNRTI/PI anchor to achieve undetectable viral load (U=U). PEP must start within 72 hours for 28 days after exposure; PrEP protects HIV-negative people at ongoing risk. Pharmacists ensure adherence, confidentiality, and linkage to India's national malaria programme and NACO's free ART services.

19. One-Minute Revision

- Malaria: mosquito → sporozoite → liver → RBC cycles → fever/chills; falciparum = severe (sticky RBCs, cerebral); vivax = relapses (hypnozoites → radical cure, check G6PD).
- Treatment: falciparum = ACT; severe = injectable artesunate urgently; prevention = nets + prophylaxis.
- HIV: attacks CD4; acute → silent years → AIDS (OIs: TB, PCP, cryptococcal meningitis).
- ART: 2 NRTIs + INSTI/NNRTI/PI anchor, lifelong, daily; undetectable = untransmittable.
- PEP ≤72 h for 28 days; PrEP for at-risk HIV-negative, test first.
- India: national malaria programme (NVBDCP) + NACO free ART; TB-HIV bidirectional screening.

20. MCQs

1 Malaria is transmitted to humans by:

a) Male *Anopheles* mosquito b) Female *Anopheles* mosquito c) *Aedes* mosquito d) Housefly

1 Dormant liver forms causing vivax malaria relapses are called:

a) Sporozoites b) Hypnozoites c) Gametocytes d) Schizonts

1 The most dangerous *Plasmodium* species is:

a) *P. vivax* b) *P. ovale* c) *P. falciparum* d) *P. malariae*

1 ACT for falciparum malaria combines:

a) Two antibiotics b) A fast-acting artemisinin with a longer-acting partner drug c) Two vaccines d) An antipyretic with a vitamin

1 Before giving primaquine-class drugs, one must check:

a) Blood group b) G6PD status c) Eye pressure d) Thyroid function

1 HIV primarily attacks:

a) Red blood cells b) CD4 helper T-lymphocytes c) Platelets d) Neutrophils

1 Integrase inhibitors (INSTIs) block which step of the HIV life cycle?

a) Reverse transcription b) Integration of viral DNA into host DNA c) Protease maturation d) Viral attachment

1 NRTIs act by:

a) Jamming reverse transcriptase directly b) Acting as faulty building blocks that terminate viral DNA chain growth c) Cutting viral proteins d) Blocking CD4 receptors

1 PEP after HIV exposure must be started within:

a) 1 week b) 72 hours, ideally within hours c) 1 month d) 6 months

1 "U=U" in HIV care means:

a) Untreated = unsafe b) Undetectable viral load = untransmittable c) Universal vaccination = universal cure d) Urgent = uncomplicated

Answer Key: 1-b, 2-b, 3-c, 4-b, 5-b, 6-b, 7-b, 8-b, 9-b, 10-b

21. Viva / Application Questions

1 **Q: Why does vivax malaria need two types of drugs while falciparum needs ACT?**

A: Vivax hides dormant hypnozoites in the liver that blood-stage drugs cannot reach, so a second drug class is needed for radical cure to prevent relapses (after G6PD testing). Falciparum has no hypnozoites but is drug-resistant and rapidly fatal, so the fast-acting artemisinin plus a long-acting partner (ACT) clears parasites quickly and prevents resistance.

1 **Q: A traveller asks for "malaria tablets" for a 2-week trip to a forested endemic district. What do you advise?**

A: Recommend seeing a doctor for chemoprophylaxis suited to the destination's resistance pattern (drug class per current travel guidance), started before travel and continued after return — and stress that tablets never replace bite prevention: treated bed nets, repellents, and covered clothing at night.

1 **Q: How does combination ART prevent drug resistance?**

A: Each drug class blocks a different life-cycle step; the virus would need simultaneous mutations against all three drugs to survive, which is practically impossible when replication is fully suppressed — but only if every dose is taken daily.

1 **Q: A nurse has a needlestick injury from an HIV-positive source. Outline immediate steps.**

A: Wash with soap and water immediately (no squeezing), risk-assess urgently, start PEP within hours (outer limit 72 hours) — a 3-drug ART combination for 28 days — with baseline and follow-up HIV testing, counselling, and facility exposure reporting.

1 **Q: Why is TB screening mandatory in every new HIV diagnosis in India?**

A: TB is the commonest opportunistic infection and leading killer of people with HIV in India; the two diseases accelerate each other, and national policy (NACO/NTEP) requires bidirectional screening so both are treated together without delay.

22. References

- Standard pharmacotherapeutics and clinical pharmacy textbooks (consult latest editions).
- Standard parasitology and microbiology textbooks for *Plasmodium* species and HIV virology (consult latest editions).
- India's national malaria programme / NVBDCP guidelines — as per current guidelines, confirm latest edition.
- NACO guidelines for HIV testing, ART, PEP, and PrEP — as per current guidelines, confirm latest edition.
- Current international guidance on malaria treatment and HIV management (consult latest editions) — as per current guidelines, confirm latest edition.
- Standard pharmacology textbooks for antimalarial and antiretroviral drug classes (consult latest editions).