BP203T · B.PHARM THEORY

BP203T Human Anatomy, Physiology and Pathophysiology II

Unit V — Reproductive System & Cancer

Pills & Python Notes

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

Syllabus coverage: Unit V (12 hours).

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UNIT V — REPRODUCTIVE SYSTEM AND CANCER (12 hours)

Unit V overview

- **Unit Va:** Anatomy of the male and female reproductive systems; functions of the male and female reproductive systems; sex hormones; physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition.
- **Unit Vb:** Pathophysiology of sexually transmitted diseases — AIDS, syphilis, gonorrhea.
- **Unit Vc:** Etiology and pathogenesis of cancer.
- **Unit objectives:** By the end of this unit you can (1) describe the anatomy and functions of the male and female reproductive systems; (2) explain the sex hormones and gamete formation; (3) describe menstruation, fertilization, pregnancy and parturition; (4) describe AIDS, syphilis and gonorrhea factually and sensitively; (5) explain what cancer is, its causes and how it develops.

> *A note on tone:* this unit deals with the human body factually, the way any anatomy chapter does. There is nothing embarrassing about learning how the body works — doctors and pharmacists must know this to care for patients.

Infographic concept — "From Cell to Baby to Health"

> **A left-to-right strip: (1) testes/ovaries making tiny gametes (sperm, egg) → (2) monthly cycle wheel (28-day clock with 4 phases) → (3) fertilization (two cells merging) → (4) pregnancy (growing baby, 9 months) → (5) birth. Below the strip, three shield icons for STD prevention (safe practices, testing, treatment) and a ribbon icon for cancer awareness (know the warning signs, avoid tobacco). One line under each icon.**

Chapter 21 — Anatomy of the Male Reproductive System

21.1 Learning objectives

After studying this chapter you will be able to: (1) list the organs of the male reproductive system; (2) describe the structure of the testes, epididymis, vas deferens, accessory glands, urethra and penis; (3) explain the function of each part in simple terms.

21.2 Definitions

Reproductive system. The body system that makes specialised cells (gametes) and enables the creation of a new human being.

Gamete. A reproductive cell — sperm in males, egg (ovum) in females. Each carries half the genetic material; together they make a complete set.

Testis (plural: testes). The male organ that makes sperm and the male hormone testosterone. Located outside the body in the scrotum.

Semen. The fluid released at ejaculation — sperm plus nourishing fluids from accessory glands.

KEY TAKEAWAY: Male system = makes sperm + testosterone, delivers them via semen.

21.3 The organs — a guided tour in order of sperm travel

1. Testes (2): oval organs in the **scrotum** — a skin pouch hanging outside the body. Why outside? Sperm form best slightly cooler than body temperature. Inside each testis are coiled tubes called **seminiferous tubules**, where sperm are made.

2. Epididymis: a long, coiled tube sitting on top of each testis — like a tightly wound hose. New sperm are immature; they mature and are stored here.

3. Vas deferens (sperm duct): a muscular tube carrying mature sperm from the epididymis up into the pelvis, looping toward the urethra. (This is the tube cut/tied in male sterilisation — vasectomy.)

4. Accessory glands — add fluids that nourish sperm and form semen:

- **Seminal vesicles:** make sugary fluid (fructose) — food for sperm.
- **Prostate gland:** a chestnut-sized gland below the bladder, around the urethra; adds milky fluid. It often enlarges in older men (benign prostate enlargement), causing urinary difficulty.
- **Bulbourethral glands:** add slippery lubricating fluid.

5. Urethra: the tube through the penis that carries both urine and semen (not at the same time).

6. Penis: the external organ that delivers semen into the female reproductive tract.

> **Flowchart — the sperm's journey:** Seminiferous tubules (made) → epididymis (matured, stored) → vas deferens (transport) → joins urethra, mixes with gland fluids (semen formed) → urethra → released (ejaculation)

Sketch guide: Side view of the male pelvis. Draw the bladder (balloon). Below it, the chestnut (prostate) wrapped around the urethra tube. Draw the scrotum pouch below with two ovals (testes); on each oval draw a comma-shaped cap (epididymis). Draw a tube from the epididymis looping up over the bladder (vas deferens). Draw two small sacs behind the bladder (seminal vesicles). Label the penis and urethra.

Example: Like a factory line — testes manufacture, epididymis is the warehouse, vas deferens is the delivery truck, accessory glands add packaging (fluid), urethra is the dispatch gate.

KEY TAKEAWAY: Sperm path: testis → epididymis → vas deferens → urethra; glands add the fluid that makes semen.

21.4 Functions of the male reproductive system (summary)

1. **Produce sperm** (in seminiferous tubules).
2. **Produce testosterone** (in Leydig cells between the tubules) — gives male features: deeper voice, facial hair, muscle mass.
3. **Deliver sperm** into the female tract via semen.

21.5 PHARMACY RELEVANCE

- Pharmacists counsel on medicines affecting male fertility or prostate (e.g., finasteride for prostate enlargement — also used for hair loss).
- Understanding vasectomy helps pharmacists answer family-planning queries accurately.

21.6 COMMON CONFUSIONS

- **Sperm vs semen:** sperm = the cells; semen = sperm + fluids.
- **Testis vs scrotum:** testis = the organ; scrotum = the pouch holding it.
- **Urethra's double duty:** carries urine and semen, but never both at once (a muscle valve prevents mixing).

21.7 COMMON MISTAKES

- Saying sperm are made in the epididymis — they are made in the testes (seminiferous tubules); the epididymis only matures and stores them.
- Saying the prostate makes sperm — it only adds fluid.

21.8 ONE-MINUTE REVISION

Two testes in the scrotum make sperm (seminiferous tubules) and testosterone (Leydig cells). Sperm mature in the epididymis, travel via the vas deferens, mix with fluids from seminal vesicles, prostate and bulbourethral glands to form semen, and leave through the urethra. Cooler scrotal temperature suits sperm formation.

21.9 Practice questions

MCQs

1. Sperm are produced in the: (a) epididymis (b) seminiferous tubules (c) prostate (d) vas deferens
2. Testosterone is produced by: (a) Sertoli cells (b) Leydig cells (c) prostate cells (d) bladder cells
3. The fluid part of semen mainly comes from: (a) testes (b) accessory glands (c) kidneys (d) urethra

Short answers

4. Trace the path of sperm from production to ejaculation.
5. List the male accessory glands and their secretions.

Long answer

6. Describe the anatomy of the male reproductive system with a labelled sketch plan.

Application-based

7. A patient asks why the testes are located outside the body. Give a simple, factual explanation.

Viva

8. What is the difference between sperm and semen?

Chapter 22 — Anatomy of the Female Reproductive System

22.1 Learning objectives

After studying this chapter you will be able to: (1) list the organs of the female reproductive system; (2) describe ovaries, fallopian tubes, uterus, cervix and vagina; (3) explain the function of each part; (4) describe the mammary glands briefly.

22.2 Definitions

Ovary (plural: ovaries). Two almond-sized organs in the pelvis that make eggs (ova) and the female hormones oestrogen and progesterone.

Fallopian tube (uterine tube). The tube that carries the released egg from the ovary toward the uterus; fertilization usually happens here.

Uterus (womb). The hollow, muscular, pear-shaped organ where the baby grows during pregnancy.

Cervix. The narrow neck of the uterus opening into the vagina.

Vagina. The muscular canal from the cervix to the outside; receives semen and is the birth canal.

KEY TAKEAWAY: Ovaries make eggs + hormones; tubes transport; uterus houses pregnancy; cervix is the doorway; vagina is the passage.

22.3 The organs — front view

1. Ovaries (2): almond-sized, on either side of the uterus, held by ligaments. Each contains thousands of tiny sacs called **follicles**, each holding one immature egg. Every month, one follicle matures and releases its egg (**ovulation**).

2. Fallopian tubes (2): about 10 cm long, with finger-like ends (**fimbriae**) that hover near the ovary and sweep the released egg inside. The tube's inner lining has tiny hairs (cilia) wafting the egg toward the uterus. Fertilization — sperm meeting egg — usually happens in the tube's outer third.

3. Uterus: a hollow, muscular, upside-down-pear-shaped organ. Its inner lining, the **endometrium**, thickens each month to receive a fertilized egg — and sheds as menstrual bleeding if pregnancy doesn't occur. Its thick muscle wall (**myometrium**) contracts powerfully in labour.

4. Cervix: the lower narrow neck of the uterus, opening into the vagina. It makes mucus that changes through the cycle (thin and slippery near ovulation, helping sperm pass).

5. Vagina: a muscular, stretchable canal — receives semen, and stretches enormously during childbirth (the birth canal).

6. External genitalia (vulva): the outer parts, including protective folds (labia) and the clitoris.

7. Mammary glands (breasts): not strictly reproductive organs, but they produce milk after childbirth under prolactin and oxytocin control.

Sketch guide: Front view of the female pelvis. Draw an upside-down pear (uterus) in the centre. Draw two arms reaching out from its top (fallopian tubes) ending in fringed fingers (fimbriae). Place an almond at each tube's end (ovary). Below the pear, draw a narrow neck (cervix) and a canal below it (vagina). Shade the pear's inner lining (endometrium). Label everything.

Flowchart — the egg's journey: Follicle in ovary → ovulation (egg released) → swept into fallopian tube by fimbriae → travels toward uterus (fertilization may occur here) → reaches uterus → implants in endometrium if fertilized

KEY TAKEAWAY: Egg path: ovary → fallopian tube → uterus; fertilization happens in the tube, implantation in the uterus.

22.4 Functions of the female reproductive system (summary)

1. **Produce eggs** (ova) — one usually released each month.
2. **Produce oestrogen and progesterone** — control the menstrual cycle and pregnancy.
3. **Receive sperm and enable fertilization** (in the fallopian tube).
4. **House and nourish the growing baby** (uterus, ~9 months).
5. **Deliver the baby** (vagina as birth canal) and **feed it** (breasts make milk).

22.5 PHARMACY RELEVANCE

- Pharmacists dispense oral contraceptives, emergency contraception and hormone therapies — understanding this anatomy makes counselling accurate.
- Iron–folic acid tablets for pregnant women (anaemia prevention) are a major pharmacy item in India.
- Pharmacists guide on menstrual hygiene products and when to refer (very heavy bleeding, severe pain).

22.6 India context

- Government programmes supply free iron–folic acid to pregnant women; pharmacists support adherence.
- Menstrual health awareness is growing; pharmacists can be approachable, stigma-free counsellors.

22.7 COMMON CONFUSIONS

- **Ovary vs uterus:** ovary makes eggs; uterus houses the baby. Different organs!
- **Cervix vs vagina:** cervix = neck of the uterus; vagina = canal below it.
- **Fertilization vs implantation:** fertilization (sperm + egg) happens in the tube; implantation (embedding in the wall) happens in the uterus days later.

22.8 COMMON MISTAKES

- Saying fertilization happens in the uterus — it usually happens in the fallopian tube.
- Saying the ovaries "store babies" — they store eggs; the uterus carries the pregnancy.

22.9 ONE-MINUTE REVISION

Almond-sized ovaries release one egg monthly (ovulation). Fringed fallopian tubes sweep it up; fertilization occurs in the tube. The pear-shaped uterus, lined by endometrium, receives the fertilized egg; its muscle powers labour. The cervix is the doorway, the vagina the passage and birth canal, breasts make milk after birth.

22.10 Practice questions

MCQs

1. Fertilization usually occurs in the: (a) uterus (b) fallopian tube (c) ovary (d) vagina
2. The inner lining of the uterus is called: (a) myometrium (b) endometrium (c) perimetrium (d) cervix
3. Ovulation is: (a) release of semen (b) release of an egg from the ovary (c) thickening of the uterus (d) milk production

Short answers

4. List the female reproductive organs and one function each.
5. Trace the path of an egg from ovary to uterus.

Long answer

6. Describe the anatomy of the female reproductive system with a labelled sketch plan.

Application-based

7. A student asks, "If the egg is released from the ovary, how does it get into the tube when they are not directly joined?" Explain simply.

Viva

8. What is the difference between fertilization and implantation?

Chapter 23 — Sex Hormones, Spermatogenesis and Oogenesis

23.1 Learning objectives

After studying this chapter you will be able to: (1) name the male and female sex hormones and their functions; (2) explain how the pituitary controls the gonads; (3) describe spermatogenesis and oogenesis simply; (4) compare the two processes in a table.

23.2 Definitions

Sex hormones. Steroid hormones that develop reproductive organs and secondary sexual features — testosterone (male), oestrogen and progesterone (female).

Gonads. The primary reproductive organs — testes in males, ovaries in females. They make both gametes and sex hormones.

Spermatogenesis. The process of making sperm in the testes — takes about two to three months from start to finish.

Oogenesis. The process of making eggs in the ovaries — begins before birth and completes one egg at a time after puberty.

Secondary sexual characteristics. Body features that appear at puberty but aren't directly part of reproduction — e.g., facial hair and deep voice in males; breast development and wider hips in females.

KEY TAKEAWAY: Gonads = testes/ovaries; they make gametes (sperm/eggs) AND sex hormones.

23.3 The sex hormones

Hormone	Made in	Main actions
Testosterone	Testes (Leydig cells)	Sperm production; male features at puberty (voice, hair, muscle); sex drive
Oestrogen	Ovaries (follicles)	Female features at puberty (breasts, hips); builds up the uterine lining each month
Progesterone	Ovaries (corpus luteum), placenta	Maintains the uterine lining; supports pregnancy ("pro-gestation" = for pregnancy)

Mnemonic: Progesterone = **P**regnancy protector.

Pituitary control (the command chain): Hypothalamus → GnRH → pituitary releases FSH + LH → gonads make gametes + sex hormones → sex hormones feed back to slow the pituitary (negative feedback).

- In males: FSH → sperm production; LH → testosterone production.
- In females: FSH → follicle growth; LH → ovulation + progesterone production.

KEY TAKEAWAY: Brain (FSH/LH) commands gonads; gonads' hormones report back — the same negative-feedback pattern as other endocrine axes.

23.4 Spermatogenesis — making sperm

- **Where:** seminiferous tubules of the testes, helped by Sertoli (nurse) cells.
- **How (simple version):** unspecialised germ cells divide and transform over ~64–72 days into tadpole-shaped sperm, each with a head (carries genetic material), a middle piece (energy motor — mitochondria), and a long tail (swimming).
- **Scale:** millions made daily from puberty onwards, continuously through life.
- **Needs:** slightly cool temperature (hence the scrotum), FSH and testosterone.

> **Analogy:** A factory production line running 24×7 — raw cells enter one end, finished "tadpoles" exit the other, millions per day.

23.5 Oogenesis — making eggs

- **Where:** ovaries, inside follicles.
- **How (simple version):** a girl is born with all her immature eggs already formed (about a million follicles at birth, fewer by puberty). From puberty, each month usually ONE follicle matures and releases its egg (ovulation). The rest of that month's starter follicles degenerate.
- **Key differences from sperm:** eggs are few (one per month), large (visible as a dot), made before birth, and production stops at menopause.

Feature	Spermatogenesis	Oogenesis
Where	Testes (seminiferous tubules)	Ovaries (follicles)
When starts	At puberty	Before birth
How many	Millions daily, continuous	~One per month
Size	Tiny, with tail	Large, no tail
Stops when	Continues lifelong (declines with age)	At menopause

KEY TAKEAWAY: Sperm = millions, continuous, from puberty; eggs = one per month, stock made before birth, ending at menopause.

23.6 PHARMACY RELEVANCE

- Testosterone replacement and oestrogen/progesterone therapies (HRT, contraceptives) are common pharmacy items — counselling on benefits and risks is essential.
- Drugs like finasteride (blocks testosterone's active form) need careful counselling.

23.7 COMMON CONFUSIONS

- **Oestrogen vs progesterone:** oestrogen builds the lining up; progesterone maintains it for pregnancy.
- **FSH vs LH:** FSH grows the gamete-makers (follicles/sperm); LH triggers the key events (ovulation/testosterone surge).

23.8 COMMON MISTAKES

- Saying eggs are "made fresh each month like sperm" — the egg stock is present from birth; one matures per month.
- Saying testosterone is only in males — females make small amounts too (and males make tiny amounts of oestrogen); it's the balance that differs.

23.9 ONE-MINUTE REVISION

Testes make testosterone (male features, sperm); ovaries make oestrogen (female features, builds uterine lining) and progesterone (protects pregnancy). Pituitary FSH/LH command the gonads with negative feedback. Spermatogenesis = millions of sperm continuously from puberty in the testes; oogenesis = one egg per month from a pre-birth stock, ending at menopause.

23.10 Practice questions

MCQs

1. Progesterone's main role is: (a) sperm production (b) maintaining pregnancy (c) milk ejection (d) sleep
2. Spermatogenesis occurs in the: (a) ovaries (b) seminiferous tubules (c) prostate (d) epididymis
3. Which pituitary hormones control the gonads? (a) GH and prolactin (b) FSH and LH (c) TSH and ACTH (d) ADH and oxytocin

Short answers

4. Name the sex hormones and one function each.
5. Compare spermatogenesis and oogenesis.

Long answer

6. Describe the sex hormones and explain pituitary control of the gonads with a flowchart.

Application-based

7. Explain in one paragraph why a male contraceptive pill is harder to design than a female one, using sperm numbers from this chapter. (General reasoning, no product claims.)

Viva

8. Why does the male body keep making sperm lifelong while egg supply runs out?

Chapter 24 — Menstruation, Fertilization, Pregnancy and Parturition

24.1 Learning objectives

After studying this chapter you will be able to: (1) describe the phases of the menstrual cycle; (2) explain fertilization simply; (3) describe the main events of pregnancy; (4) explain parturition (labour) and the role of oxytocin.

24.2 Definitions

Menstrual cycle. The roughly monthly cycle in which the uterus prepares for pregnancy and sheds its lining (menstruation) if pregnancy doesn't occur. Counted from day 1 of one period to day 1 of the next — often about 28 days, but 21–35 days is a normal range.

Menstruation (period). Bleeding for a few days when the built-up uterine lining sheds.

Ovulation. Release of a mature egg from the ovary, around the middle of the cycle.

Fertilization. Fusion of sperm and egg, usually in the fallopian tube.

Pregnancy (gestation). The ~9 months (about 40 weeks) during which the baby develops in the uterus.

Parturition. Childbirth — labour and delivery of the baby.

KEY TAKEAWAY: Cycle prepares → ovulation releases egg → fertilization may occur → pregnancy grows baby → parturition delivers.

24.3 The menstrual cycle — four phases

Phase	Approx. days (28-day cycle)	What happens
Menstrual phase	Days 1–5	Endometrium sheds → bleeding; a new follicle starts growing
Follicular phase	Days 1–13	FSH grows the follicle; oestrogen rebuilds the lining
Ovulation	~Day 14	LH surge → egg released from the ovary
Luteal phase	Days 15–28	Empty follicle becomes corpus luteum → makes progesterone → lining maintained; if no pregnancy, corpus luteum dies → lining sheds → next cycle

Memory clock: draw a circle like a clock. Mark 1–5 (bleeding), 14 (egg released — mark with a star), 15–28 (waiting). Write "oestrogen builds, progesterone maintains."

Example: If day 1 is the first day of bleeding, ovulation is roughly two weeks later — this is why the "fertile window" sits mid-cycle.

Flowchart: **Day 1: bleeding starts → FSH rises → follicle grows, oestrogen rebuilds lining → LH surge ~day 14 → ovulation → corpus luteum makes progesterone → lining ready → no fertilization → corpus luteum fades → lining sheds → day 1 again**

KEY TAKEAWAY: Oestrogen builds the lining, ovulation releases the egg (~day 14), progesterone maintains the lining; no pregnancy → shedding → repeat.

24.4 Fertilization — simply

- Millions of sperm are deposited in the vagina; they swim through the cervix and uterus into the tubes.
- Usually ONE sperm fuses with the egg in the outer part of the fallopian tube.
- The fused cell (zygote) starts dividing as it travels to the uterus (3–4 days), then embeds in the endometrium — **implantation**, about a week after fertilization.

> **Analogy:** The egg is a guest arriving at a station (tube); one sperm meets it there; the couple then travels to a prepared hotel room (uterus lining) and checks in (implantation).

24.5 Pregnancy — the main events

- **First 3 months (first trimester):** organs form from the tiny embryo; the placenta develops — the organ connecting baby to mother, exchanging food, oxygen and waste through the umbilical cord. Pregnancy hormones (hCG, oestrogen, progesterone) maintain it. Morning sickness is common.
- **Middle 3 months:** baby grows rapidly; mother often feels movement.
- **Last 3 months:** baby gains weight, lungs mature, head usually turns downward.
- **The placenta's jobs:** feeds the baby, removes waste, makes hormones that maintain pregnancy, and partly shields the baby (but alcohol, smoking and many drugs cross it — pharmacists warn pregnant women about medicines).

KEY TAKEAWAY: Placenta = baby's food, oxygen, waste and hormone manager via the umbilical cord.

24.6 Parturition — labour and delivery

- Near term, the baby's head presses on the cervix → nerve signals + hormones trigger **oxytocin** release from the posterior pituitary.
- Oxytocin makes the uterus contract rhythmically; each contraction pushes the baby down, which releases MORE oxytocin — **positive feedback** (like the example in Chapter 15).
- **Stages in simple words:** (1) cervix opens (dilates) with regular contractions; (2) baby is pushed out through the vagina; (3) placenta is delivered.
- After birth, oxytocin also squeezes the uterus to prevent excess bleeding and ejects milk during breastfeeding.

> **Flowchart (positive feedback of labour): Baby's head presses cervix → oxytocin released → uterus contracts → baby pushed further down → more oxytocin → stronger contractions → baby born → cycle stops**

24.7 PHARMACY RELEVANCE

- **Oxytocin injections** induce/augment labour and control postpartum bleeding — an essential medicine pharmacists must stock correctly.
- **Folic acid** before and during early pregnancy prevents neural tube defects — key counselling point.
- Pharmacists must check every prescription for pregnant women — many drugs are unsafe in pregnancy; when in doubt, refer to the doctor.
- Emergency contraception counselling needs accurate cycle knowledge.

24.8 India context

- Anaemia in pregnancy is common in India; iron–folic acid adherence counselling by pharmacists saves lives.
- Institutional (hospital) delivery is promoted to make childbirth safer; pharmacists support antenatal care messaging.

24.9 COMMON CONFUSIONS

- **Ovulation vs menstruation:** ovulation (~day 14) releases the egg; menstruation (days 1–5) sheds the lining — opposite ends of the cycle.
- **Fertilization vs implantation:** fusion in the tube vs embedding in the uterus, days apart.
- **Oxytocin vs prolactin:** oxytocin ejects milk and contracts the uterus; prolactin makes the milk.

24.10 COMMON MISTAKES

- Saying pregnancy lasts "9 calendar months exactly" — about 40 weeks from the last period.
- Saying fertilization happens in the uterus — it's the fallopian tube.
- Forgetting the placenta's hormone role — it maintains the pregnancy.

24.11 ONE-MINUTE REVISION

28-day cycle: days 1–5 bleeding, follicle grows under FSH, oestrogen rebuilds lining, LH surge ~day 14 causes ovulation, corpus luteum's progesterone maintains the lining; no fertilization → shedding. Fertilization in the tube → zygote → implantation in the uterus ~1 week later. Pregnancy ~40 weeks; placenta feeds baby via cord and makes hormones. Labour = oxytocin-driven positive feedback: contractions → baby descends → more oxytocin → delivery.

24.12 Practice questions

MCQs

1. Ovulation occurs around day ___ of a 28-day cycle: (a) 1 (b) 7 (c) 14 (d) 28
2. Fertilization usually occurs in the: (a) uterus (b) fallopian tube (c) ovary (d) cervix
3. The hormone driving uterine contractions in labour is: (a) progesterone (b) oxytocin (c) prolactin (d) oestrogen
4. The corpus luteum mainly secretes: (a) FSH (b) LH (c) progesterone (d) testosterone

Short answers

5. Describe the four phases of the menstrual cycle.
6. What is implantation? How does it differ from fertilization?
7. List the functions of the placenta.

Long answer

8. Describe the menstrual cycle with a flowchart. Explain fertilization, pregnancy and parturition briefly.

Application-based

9. A woman with a regular 28-day cycle asks which days pregnancy is most likely if she has unprotected intercourse. Using ovulation timing and sperm/egg survival (sperm ~3–5 days, egg ~1 day), explain the fertile window simply.

Viva

10. Why is labour an example of positive feedback?

Chapter 25 — Sexually Transmitted Diseases: AIDS, Syphilis and Gonorrhea

25.1 Learning objectives

After studying this chapter you will be able to: (1) define sexually transmitted disease; (2) describe the cause, transmission and general features of AIDS, syphilis and gonorrhea; (3) explain prevention in factual terms; (4) describe the pharmacist's role with sensitivity and without stigma.

> *A note on tone:* these are infections like any other — they deserve the same factual, non-judgmental study as tuberculosis or typhoid. Stigma stops people seeking treatment; as future pharmacists, your job is facts, confidentiality and referral.

25.2 Definitions

Sexually transmitted disease (STD) / sexually transmitted infection (STI). An infection passed mainly through sexual contact. ("Disease" and "infection" are both used; STI is the newer term.)

Pathogen. Any germ that causes disease — virus, bacterium, fungus or parasite.

AIDS (Acquired Immunodeficiency Syndrome). The late stage of infection with HIV (Human Immunodeficiency Virus), which destroys the body's immune cells (CD4 T-cells), leaving the person open to other infections.

Syphilis. A bacterial STD caused by *Treponema pallidum*, which progresses in stages if untreated.

Gonorrhea. A bacterial STD caused by *Neisseria gonorrhoeae*, mainly infecting the urethra, cervix and throat.

KEY TAKEAWAY: AIDS = viral (HIV), attacks immunity; syphilis and gonorrhea = bacterial, curable with antibiotics.

25.3 Concept first — how STDs spread and how they are stopped

STDs spread through unprotected sexual contact; HIV also spreads through infected blood (shared needles, unscreened transfusions) and from mother to baby during birth/breastfeeding. They do NOT spread through hugging, sharing food, toilets or mosquito bites — a common myth worth correcting.

Prevention (factual): safe sexual practices (condoms reduce transmission), never sharing needles, screened blood transfusions, testing and early treatment of partners.

> **Analogy:** Treating only one partner for a bacterial STD is like mopping the floor while the tap is still running — both partners need treatment, or reinfection occurs ("ping-pong infection").

25.4 AIDS — the viral STD

- **Cause:** HIV, a virus that infects CD4 T-lymphocytes (the immune system's commander cells).
- **Course (simple):** after infection there may be a brief flu-like illness, then a long silent period (years) with no symptoms while the virus slowly destroys CD4 cells. When immunity falls low, **AIDS** develops — the person gets unusual infections and certain cancers that a healthy immune system would fight off.
- **General features of AIDS stage:** persistent fever, major weight loss, long-lasting diarrhoea, repeated infections (e.g., tuberculosis, fungal mouth infections).
- **Diagnosis (general):** blood tests detect HIV antibodies/antigens; CD4 counts track immune damage. (No cutoffs memorised here — labs report them.)
- **Management (general):** antiretroviral therapy (ART) — combinations of medicines that suppress the virus, taken lifelong; with ART, people live long healthy lives and transmission risk falls greatly. There is no complete cure yet, but treatment is highly effective.
- **Pharmacist's role:** dispense ART with strict adherence counselling (missing doses lets the virus rebound), maintain absolute confidentiality, correct myths, refer for testing.

25.5 Syphilis — the staged bacterial STD

- **Cause:** the bacterium *Treponema pallidum*.
- **Stages (simple):**

1. **Primary:** a single painless sore (chancre) where the germ entered, healing by itself in weeks — but the infection remains. 2. **Secondary:** weeks later — rash (often on palms and soles), fever, swollen glands. 3. **Latent:** no symptoms, but infection persists for years. 4. **Tertiary (late):** after years untreated — damage to heart, brain, nerves.

- **Key point:** curable with antibiotics (penicillin is the classic treatment) especially in early stages — which is why early testing matters.
- **In pregnancy:** can pass to the baby (congenital syphilis) — another reason antenatal screening matters.

25.6 Gonorrhea — the discharge-causing bacterial STD

- **Cause:** the bacterium *Neisseria gonorrhoeae*.
- **General features:** in men — burning pain while passing urine and discharge from the penis; in women — often mild or no symptoms (which is why it spreads silently), sometimes vaginal discharge or pelvic pain. Can also infect the throat and eyes (newborns can get eye infection during birth — prevented with eye care at delivery).
- **Key point:** curable with antibiotics, but drug resistance is a growing concern worldwide — treatment follows current medical guidelines.
- **Complication if untreated:** can spread upward causing pelvic inflammatory disease and infertility.

25.7 Comparison table

Feature	AIDS (HIV)	Syphilis	Gonorrhea
Germ type	Virus	Bacterium	Bacterium
Curable?	No cure; controllable with lifelong ART	Yes, with antibiotics	Yes, with antibiotics (resistance a concern)
Main target	Immune system (CD4 cells)	Whole body in stages	Urethra, cervix, throat
Silent spread?	Years without symptoms	Latent stage for years	Often silent in women
Prevention	Safe practices, no shared needles, screened blood	Safe practices, early testing/treatment	Safe practices, early testing/treatment

KEY TAKEAWAY: Two are bacterial and curable (treat both partners); HIV is viral and lifelong but controllable — all need testing, confidentiality and no stigma.

25.8 PHARMACY RELEVANCE

- Dispense antibiotics/ART exactly as prescribed; counsel on completing the full course.
- Never disclose a patient's STD/HIV status to anyone — confidentiality is legal and ethical duty.
- Stock and counsel on condoms without embarrassment — prevention is healthcare.
- Refer anyone with genital sores, discharge or burning urination for medical testing; don't guess.
- Correct myths (HIV doesn't spread by touch/sharing food) whenever you hear them.

25.9 India context

- Government programmes provide free HIV testing and ART; pharmacists can guide patients to these services.
- NACO (National AIDS Control Organisation) runs awareness programmes — pharmacists can display/distribute materials.

25.10 COMMON CONFUSIONS

- **HIV vs AIDS:** HIV is the virus/infection; AIDS is the late stage when immunity collapses.
- **Syphilis vs gonorrhea:** syphilis = painless sore then rash, staged over years; gonorrhea = burning urination/discharge, faster onset.
- **Curable vs controllable:** bacterial STDs are curable; HIV is controllable, not yet curable.

25.11 COMMON MISTAKES

- Saying HIV spreads by casual contact — it does not.
- Treating only one partner for bacterial STDs — both need treatment.
- Moralising about patients — unprofessional and drives people away from care.

25.12 ONE-MINUTE REVISION

STDs spread mainly through sexual contact (HIV also via blood/mother-to-baby). AIDS = HIV destroying CD4 immune cells; silent for years, then opportunistic infections; controlled by lifelong ART, no cure yet. Syphilis = *Treponema pallidum*, staged (painless chancre → rash → latent → late organ damage), curable with penicillin-type antibiotics. Gonorrhea = *Neisseria gonorrhoeae*, burning urination/discharge, often silent in women, curable but resistance is a concern. Treat both partners, keep confidentiality, correct myths.

25.13 Practice questions

MCQs

1. AIDS is caused by: (a) a bacterium (b) a virus (c) a fungus (d) a parasite
2. The causative agent of syphilis is: (a) *Neisseria gonorrhoeae* (b) *Treponema pallidum* (c) HIV (d) *E. coli*
3. Which statement is TRUE? (a) HIV spreads by sharing food (b) Bacterial STDs are curable with antibiotics (c) Only one partner needs treatment (d) Syphilis has no stages
4. HIV mainly destroys: (a) red blood cells (b) CD4 T-cells (c) platelets (d) bone cells

Short answers

5. Define STD. How do STDs spread, and how are they prevented?
6. Describe the stages of syphilis.
7. Write the general features of gonorrhea.

Long answer

8. Describe AIDS: cause, course, general features and the pharmacist's role. Handle the topic without stigma.

Application-based

9. A young man asks the pharmacist for "something for burning while urinating" and seems embarrassed. What should the pharmacist do and say? (Focus on referral, confidentiality and not guessing the diagnosis.)

Viva

10. Why must both partners be treated in bacterial STDs?

Chapter 26 — Cancer: Etiology and Pathogenesis

26.1 Learning objectives

After studying this chapter you will be able to: (1) define cancer, tumour, benign and malignant; (2) list the causes (etiology) of cancer; (3) explain how cancer develops (pathogenesis) in simple steps; (4) list general warning signs; (5) describe the pharmacist's role.

26.2 Definitions

Cancer. A disease in which some body cells divide uncontrollably, ignore normal stop signals, and can invade nearby tissues and spread to distant parts.

Tumour (neoplasm). An abnormal mass of tissue from uncontrolled cell growth — "new growth."

Benign tumour. Grows slowly, stays in one place, does not spread; usually less dangerous (e.g., a simple lipoma — fatty lump).

Malignant tumour. The true cancer — grows fast, invades neighbours, and spreads (metastasis) through blood or lymph to distant organs.

Metastasis. Spread of cancer cells from the original site to distant organs — what makes cancer deadly.

Carcinogen. Any agent that can cause cancer — e.g., tobacco smoke, certain chemicals, some viruses, radiation.

KEY TAKEAWAY: Benign = stays put; malignant = invades + spreads (metastasis). Only malignant tumours are called cancer.

26.3 Concept first — normal vs cancer cell

Normal cells divide only when told, stop when neighbours touch them, stay in their tissue, and die on schedule (**apoptosis** — programmed cell death). Cancer cells break all four rules: they divide without permission, ignore stop signals, invade neighbours, and refuse to die.

> **Analogy:** Normal cells are disciplined citizens obeying traffic rules; cancer cells are reckless drivers who ignore signals, crash through barriers and speed to other cities (metastasis).

26.4 Etiology — what causes cancer

Cancer starts with damage to the genes controlling cell division (mutations). Causes:

1. **Tobacco** — the single biggest preventable cause (mouth, lung, throat cancers); includes chewing tobacco/gutka.
2. **Alcohol** — especially with tobacco, raises risk of mouth, throat, liver cancers.
3. **Infections** — some viruses: HPV (cervical cancer), hepatitis B/C (liver cancer), H. pylori bacterium (stomach cancer).
4. **Radiation** — excessive UV sunlight (skin cancer); ionising radiation.
5. **Chemicals** — asbestos, certain industrial dyes and solvents.
6. **Diet and lifestyle** — very low fruit/vegetable intake, obesity linked with several cancers.
7. **Heredity** — a small fraction runs in families (e.g., certain breast/ovarian cancers).
8. **Chronic irritation/inflammation** — long-standing tissue injury can precede cancer.

KEY TAKEAWAY: Most cancers come from avoidable exposures (tobacco first) plus some infections, radiation, chemicals and genes.

26.5 Pathogenesis — how cancer develops, step by step

1. **Initiation:** a carcinogen damages the DNA of a normal cell (mutation in growth-control genes).
2. **Promotion:** the damaged cell is repeatedly stimulated to divide (e.g., continued tobacco exposure) — a small abnormal clone grows.
3. **Progression:** more mutations accumulate; cells become increasingly abnormal, grow faster, and stop responding to controls.
4. **Invasion:** cancer cells break through the tissue boundary and invade neighbours.
5. **Metastasis:** cells enter blood/lymph vessels, travel, and start new tumours in distant organs (e.g., breast cancer spreading to bone).

> **Flowchart: Normal cell → DNA damage (initiation) → repeated growth signals (promotion) → more mutations (progression) → invades nearby tissue → spreads via blood/lymph (metastasis)**

Hallmarks of cancer (simple table):

Hallmark	Simple meaning
Uncontrolled division	Divides without permission
Ignores stop signals	Doesn't stop when crowded
Avoids cell death	Refuses apoptosis
Invades tissues	Breaks boundaries
Metastasises	Travels to distant organs
Grows its own blood supply	Builds vessels to feed itself (angiogenesis)

26.6 General warning signs (no statistics, just recognition)

Pharmacists and students should know the classic warning signs and refer promptly: a lump or swelling that doesn't go away, a sore that doesn't heal, unusual bleeding or discharge, a persistent cough or hoarseness, difficulty swallowing, change in a mole, unexplained weight loss, persistent indigestion. **Any of these needs a doctor's examination — pharmacists recognise and refer, never diagnose.**

26.7 PHARMACY RELEVANCE

- **Prevention counselling:** tobacco cessation is the highest-impact pharmacy intervention against cancer; pharmacists can offer quit support.
- **HPV vaccination** prevents cervical cancer — pharmacists can inform and encourage.
- **Anticancer drugs** (chemotherapy) are handled with strict safety protocols; pharmacists play roles in safe dispensing and counselling on side effects.
- **Early referral** of warning signs saves lives — the pharmacist is often the first health professional a worried person talks to.
- Pain relief and supportive care in advanced cancer involve pharmacists deeply.

26.8 India context

- Tobacco-related cancers (mouth, throat, lung) are a major burden in India — gutka and chewing tobacco are common culprits pharmacists see in the community.
- Cervical cancer screening and HPV vaccination awareness are growing; pharmacists can spread the word.
- Government cancer hospitals provide subsidised treatment; pharmacists can guide families to these centres.

26.9 COMMON CONFUSIONS

- **Benign vs malignant:** benign stays local; malignant invades and spreads.
- **Tumour vs cancer:** all cancers form tumours (mostly), but not all tumours are cancer.
- **Etiology vs pathogenesis:** etiology = the causes; pathogenesis = the step-by-step development.

26.10 COMMON MISTAKES

- Saying "all lumps are cancer" — most lumps are benign; but all persistent lumps need examination.
- Saying cancer is contagious — it is not (though some cancer-causing viruses spread).
- Listing only one cause — cancer usually results from accumulated damage over years.

26.11 ONE-MINUTE REVISION

Cancer = malignant cells dividing uncontrollably, invading and metastasising; benign tumours stay put. Causes: tobacco (biggest preventable), alcohol, cancer-causing infections (HPV, hepatitis), radiation, chemicals, diet/obesity, heredity, chronic irritation. Development: initiation (DNA damage) → promotion → progression → invasion → metastasis. Hallmarks: uncontrolled growth, no stop signals, no cell death, invasion, metastasis, new blood vessels. Know warning signs; recognise and refer; counsel tobacco quitting and HPV vaccination.

26.12 Practice questions

MCQs

1. Metastasis means: (a) tumour shrinking (b) spread of cancer to distant organs (c) benign growth (d) cell death
2. A benign tumour: (a) spreads rapidly (b) stays localised and does not spread (c) is always fatal (d) needs no examination
3. The biggest preventable cause of cancer is: (a) sunlight (b) tobacco (c) mobile phones (d) cold weather
4. Which virus is linked to cervical cancer? (a) HIV (b) HPV (c) Influenza (d) Rhinovirus

Short answers

5. Define cancer. Differentiate benign and malignant tumours.
6. List the causes (etiology) of cancer.
7. Describe the steps of cancer development (pathogenesis) with a flowchart.

Long answer

8. Explain the etiology and pathogenesis of cancer. Add the hallmarks of cancer and the pharmacist's role in prevention and early referral.

Application-based

9. A 45-year-old gutka chewer with a mouth ulcer that hasn't healed in two months asks the pharmacist for "a stronger mouth paint." What is the correct response?

Viva

10. Why is tobacco called the biggest preventable cause of cancer?

UNIT V — Combined references

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