Factors that enhance the ability of a pathogen to infect a host:

1. Adhesion factors: assist attachment to host cells e.g. a capsule around a virus.

2. Invasive factors: assist pathogens in penetrating anatomic barriers and host tissues
   e.g. Plasmodium (malaria) invades RBCs; and viruses invade cells to reproduce.

3. Evasive factors: allow a pathogen to evade components of the Immune system

4. Toxins: alter or destroy normal host cell function 2) Exotoxins and Endotoxins.

Exotoxins: proteins released from bacterial cells during growth-cell death or dysfunction

Endotoxins: lipid molecules activate human regulatory systems e.g. can trigger fever.
Modes of transmission

. a) Direct person to person contact e.g. hands, touching, kissing, sex

. b) Direct contact with infected animals carrying infection e.g. swine flu

. c) Airborne transmission of particles.

. d) Ingestion of contaminated food or water.

. e) Contact with contaminated objects e.g. non-living objects where microbes reside

. f) Injection.

Stopping the chain of infection

➢ Aseptic technique - gloves, masks, hand washing (reduces transmission) ➢ Clean, disinfect, and sterilise fomites. ➢ Limit aerosols: damp mopping, rolling sheets.
➢ Dispose of contaminated material safely and effectively.

Control of microbial growth

. a) Asepsis: The state of being free of living pathogenic microorganisms.

. b) Antiseptic: A chemical disinfectant that can safely be used on the skin.

. c) Disinfection: Destruction or reduction in numbers of harmful micro-organisms.

. d) Sterilisation: Process designed to kill all living organisms, including spores.

Process of controlling microbial growth

A. Autoclaving- uses moist heat & pressure e.g. steam 121 degrees for 15 mins. E.g. used for glass

B.Dry heating- hot air ovens used for glass & metal objects.

C. Incineration- destructs contaminated waste & disposable equipment.

D. Ionising radiation- gamma rays sterilise heat sensitive material e.g. plastic

The Lymphatic system

Responsible for defending the body, manages the fluid levels in the body, maintains homeostasis by returning most of fluid through blood. The system includes the cells, tissues & organs responsible for defending the body against disease causing organisms (pathogens). Primary function is to produce, maintain & distribute lymphocytes that provide defence against infections & environmental hazards. Functions of lymphatic system:

. a) Fat absorption- from digestive tract

. b) Fluid balance- excess fluid enters lymphatic capillaries & becomes lymph which returns to CVS.

. c) Defence- microorganisms are filtered from lymph.

Lymphatic systems consist of lymphatic vessels, lymphocytes, lymphoid tissues & lymphoid organs, which function in body defences: lymph is a fluid that resembles plasma. Lymph starts out as blood plasm then goes through capillaries where the leakage helps with the exchange of nutrients & gases. Blood capillaries re-absorb some fluids but some gets left behind. Lymphatic vessels & nodes help re-absorb lymph & cleanse it.

A. Lymphatic vessels- carry lymph from peripheral tissues to the venous system. Smallest lymphatic vessels=lymphatic capillaries (carry lymph in and out of lymph nodes). Lymph drainage-thoracic duct carries lymph from tissue under diaphragm.

B.Lymphocytes- Lymphocytes are the primary cells of the lymphatic system, that aid in

overcoming infection & disease by eliminating the threat or rendering invading pathogens, abnormal body cells & foreign proteins harmless (produce cellular immunity). They account for 20-30% of circulating WBC in body. 3 classes include:

- Type 1: T cells: Thymus dependent- defend against foreign cells & tissues, coordinate immune response. T cells incl cytotoxic T cells, helper T cells etc. Cytotoxic T cells are involved in direct cellular attack. These lymphocytes are the primary cells involved in the production of cell- mediated immunity.

- Type 2: B cells: Bone-marrow derived-produce & secrete antibodies in response to toxins that attack the foreign antigens. B-cells responsible for antibody-mediated immunity. Antibodies bind to antigens, which stimulate the immune response.

- Type 3: NK cells: Natural killer cells-provide innate (nonspecific) immunity. They attack foreign cells, cells infected with viruses & cancer cells, without previous sensitisation. (immune surveillance)

C. Lymphoid tissues- Connective tissues dominated by lymphocytes. Primary lymphoid tissues & organs are sites where lymphocytes are formed & mature incl. red bone marrow & the thymus gland. Secondary lymphoid tissues & organs are where lymphocytes are activated & cloned. In a lymphoid nodule, the lymphocytes are densely packed in an area of areolar tissue. E.g. tonsils and malt (mucosa- associated lymphoid tissue).

D. Lymphoid organs- fibrous connective tissue separates the following organs: - Lymph nodes- small organs that defend us against bacteria & other invaders by purifying

lymph before it reaches the veins. 2 lymphatic vessels: (1) afferent- brings lymph to the lymph node from peripheral tissues, (2) efferent- carry lymph away from the lymph node, towards the venous circulation.

- The Thymus-produces hormones that are important in developing normal immunological defences. E.g. thymosin is an extract from the thymus that promotes the development of lymphocytes.

- Spleen-remove abnormal blood cells, stores iron recycled from RBC and initiates immune responses by B cells & T cells in response to antigens in circulating blood.

Immunity is the ability to resist infection & disease. INVADERS (antigens) like viruses,

bacteria, fungi, toxins and parasites; attack our body. Antigens are substances that the immune system perceives as being foreign & induces an immune response in the body. The human body has multiple defence mechanisms that together provide resistance (the natural or acquired ability to maintain immunity). Our 2 body defence systems are:

1) Innate (nonspecific) defences- you're born with these defences e.g. surface barriers prevent or slow the entry of infectious organisms. They're nonspecific as they don't distinguish one threat from another (response is same regardless of the invader). The 7 defences are:

- ·Physicalbarriers-epithelialcoveringtheskinprotectsunderlyingtissues,hair,mucous,cilia
- ·Phagocytes-1st line of cellular defence that remove cellular debris incl: microphages & macrophages. E.g. a macrophage might engulf a pathogen with lysosomal enzymes to respond to a pathogen.
- ·Immunesurveillance-thedestructionofabnormalcellsbyNKcellsinperipheraltissues.
- ·Interferons-chemicalmessengersthatcoordinatethedefencesagainstviralinfections.
- ·Complementsystem-circulatingproteinsthatassistantibodiesinthedestructionofpathogens.
- ·Inflammation-limitsspreadofinjury/infection.Aimstodestroy/dilutetheinjuriousagents.Itlocalisesthe infection, removes the pathogen then promotes repair & wound healing. Step 1: increase bood flow to site, swelling occurs. Step 2: WBC leave blood vessels and enter tissues, then phagocytes engulf & destroy bacteria. Signs of inflammation: redness, heat, swelling, pain and loss of function.
- ·Fever-elevationofbodytempthataccelerates Cells involved are: Neutrophils, macrophages, NK cells, mast cells. Neutrophils- easily deformable cells, first to move out of blood vessels. They phagocytose bacteria release their contents to kill it and eventually form pus. Macrophages are blood monocytes, they follow the neutrophils and they ingest bacteria, viruses, dead cells & foreign matter. Function as Antigen Presenting Cells (APC) & present the antigen of the invaders to other cells. Cellular response-migration & phagocytosis

o Chemotaxis – bacterial product that attract phagocytic cells o Margination – phagocytic cells align themselves at endothelial surface o Diapedesis – phagocytic cells deform and squeeze out through openings in the blood

vessels. o Phagocytosis- next step is to engulf (phagocytose) and killing the invaders

Nk cells are 1st line of defence against tumour & viral infection.

2) Adaptive (specific) defences- lymphocytes respond specifically (focused), providing an adaptive long- term defence against individual threats, resulting from the coordinated activities of T cells & B cells. Adaptive immunity isn't present at birth. You develop immunity to a specific antigen only when you've been exposed to it. It can be active or passive:

o Active- develops after exposure to an antigen. Exposure can be naturally acquired (after birth) or artificially induced active immunity (stimulates body to produce antibodies under controlled conditions).

o Passive-produced by transferring antibodies from other source e.g. baby receives antibodies from mum

Adaptive immunity has 4 properties:

. a) Specificity- results from the activation of appropriate lymphocytes & the production of antibodies with targeted effects.

. b) Versatility- body contains a small num of different kinds of lymphocytes. When an antigen arrives, lymphocytes sensitive to it are 'selected'. These lymphocytes divide to generate a large num of additional lymphocytes of the same type.

. c) Memory- repeated cycles of cell division enable immune system to remember an antigen it has previously encountered.

. d) Tolerance-the immune response targets foreign cells & compounds, but normal tissues are ignored.

The integumentary system-16% of body weight, 1st line of defence to protect body against external environment, protects tissues and organs against impact and abrasion, excretes salts, water & organic wastes through glands, maintains normal body temp through insulation/evaporation, produces melanin- pigment (which protects tissues from UV radiation), produces keratin which protects against abrasion & serves as a water repellent, coordinates immune response to pathogens and detection of touch,

pressure and pain (through thermoreceptors, fine touch receptors, pressure receptors & nociceptors) and then relays this info to the nervous system.

Two components: (1) Cutaneous membrane- Epidermis and dermis (2) Accessory structures-incl hair, exocrine glands, nails.

1) Epidermis- A stratified squamous epithelium which provides physical protection & helps keep microorganisms outside the body, it is avascular (lacks blood vessels). Epidermis contains: Keratinocytes- cells that form several layers. Keratinization is the formation of protective, superficial layers of cells filled with keratin. Thin skin covers most of the body surface, thick skin is found on the palms of the hands and the soles of feet. Epidermis has 5 layers: mitosis provides continuous replacement of dead cells.

- ·Stratum Basale- deepest layer of the epidermis
- ·Stratum Spinosum- contains cells (dendritic cells) that participate in the immune response- defend against microbes that penetrate skin, and superficial skin cancers.
- ·Stratum Granulosum- grainy layer consisting of 5 layers of keratinocytes. It's the basic structural component of hair & nails in humans.
- ·Stratum Lucidum- thick skin of palms of soles
- ·Stratum Corneum-at the exposed surface of thick skin and thin skin.

Epidermal pigmentation and dermal circulation are factors that influence skin color:

- Skin pigmentation- epidermis contains quantities of carotene and melanin. Carotene is an orange- yellow pigment (e.g. someone who eats a lot of carrots turn orange from an overabundance of carotene). Melanin is a pigment produced by melanocytes, located in stratum basale. A deficiency of melanin production leads to albinism.
- Dermal circulation- blood contains red blood cells filled with the pigment haemoglobin which transports oxygen in the bloodstream. Haemoglobin is bright red when exposed to oxygen, giving capillaries in the dermis a reddish tint. E.g. in Jaundice, the liver can't excrete bile, so a yellowish pigment accumulates in body fluids.

Sunlight causes epidermal cells to convert a steroid into cholecalciferol/ vitamin D. The liver then converts cholecalciferol into an intermediary product used by the kidneys to synthesize the hormone calcitriol which is essential for the normal absorption of calcium

& phosphorus in the small intestines. An inadequate supply leads to impaired bone maintenance and growth e.g. rickets (Degauls legs).

2) Dermis- the tissue layer that supports the epidermis. Collagen & elastic fibres give the dermis strength & elasticity. The elastic fibres provide flexibility, & the collagen fibres limit that flexibility to prevent damage to the tissue. 2 layers:

- Superficial papillary layer- consists of areolar tissue, capillaries, lymphatic vessels & sensory neurons that supply the surface of the skin. E.g. dermatitis is an inflammation of the skin.

- Deeper reticular layer-dense irregular connective tissue, collagen, elastin, blood vessels and sweat and sebaceous glands containing sensory receptors.

3)Hypodermis- (subcutaneous adipose layer) separates integument from the deep fascia & other organs. Consists of areolar tissue & adipose tissue/subcutaneous fat. Provides shock absorption.

Accessory structures:

- Hair- composed of keratinized dead cells pushed to the surface. Hairs are produced in hail follicles, beginning at the hair bulb. Hair bulb surrounds a small hair papilla (connective tissue containing capillaries & nerves).

- Exocrine glands-Sebaceous glands & sweat glands are exocrine glands found in the skin. Sebaceous glands/oil glands discharge an oily lipid secretion into the hair follicles. 2 types of sweat glands:

. 1) Aprocrine- pubic & axillary regions & around nipples, secrete sweat into hair follicles, produce a sticky odorous secretion because of bacteria growth.

. 2) Merocrine- coiled tubular glands discharge their secretions directly on the surface of the skin, palms & soles have highest number. Functions of merocrine sweat gland activity incl: colling the surface of skin to reduce body tem, excrete water, electrolytes and some drug metabolites; dilutes harmful chemicals on skin; discourages microbial growth

The Autonomic Nervous System controls the activation & deactivation of sebaceous and aprocrine glands at the subconscious levels. When the environmental temp is high, thermoregulation maintains temp homeostasis.

- Nails- keratinised epidermal cells that protect exposed dorsal surfaces of the tips of

the fingers & toes. ○ Ganglion- collection of nerve cell bodies outside the CNS. ○ Receptor- binding site ○ Synapse- junction between nerve cells

○ Neurotransmitter- chemical released at synapse The 2 main components of the PNS- Somatic AND Visceral (autonomic-involuntary nervous signalling). ANS is

controlled by hypothalamus & medulla oblongata.

The 3 sensory receptors in skin are (1) thermoreceptors- heat & cold, (2) mechanoreceptors- fine touch & pressure, (3) noniceptors- pain. Stimulation of these receptors activates sensory neurons which sends info to brain for interpretation.

Role in thermoregulation:

- When body is cold- hypodermis insulates, vasoconstriction of skin blood vessels leading to pale skin, piloerection (goose bumps).
- When body is hot- vasodilation of skin blood vessels (flushed skin), production & release of sweat. Homeostasis regulation is comprised of 3 parts:

. 1) Receptor- sensor that detects changes in the body's environment e.g. thermoreceptors, touch receptors

. 2) Control centre- processes info from receptor: sends commands to restore homeostasis e.g. brain cells.

. 3) Effector- cell/organ that responds or executes the commands by making changes. E.g. muscle cells, glands.

2 ways/mechanisms used to maintain homeostasis:

1. Autoregulation- a cell/tissue/organ automatically adjusts its activities in response to an environmental change to maintain equilibrium. E.g. oxygen levels decline in a tissue then local cells release chemical to dilate blood vessel then increases blood flow then increases oxygen levels for tissues.

2. Extrinsic regulation- nervous/endocrine system adjusts activities of lots of systems at once to maintain homeostasis. E.g. exercise, the nervous system sends signals to increase heart rate & rate of breathing, then skin increases heat loss.