Agents that cause infectious diseases range in size from the 20-nm poliovirus to the 10-m tapeworm. The infectious agents include many categories the most important are:-

I-Prions
Prions are abnormal forms of a normal host prion protein (PrP) found in high levels in neurons; the function of PrP is unknown. They cause transmissible spongiform encephalopathies, including Creutzfeldt-Jakob disease (CJD; associated with corneal transplants) Bovine spongiform encephalopathy (BSE; popularly known as "mad cow disease")
The spongiform encephalopathies occur when a PrP undergoes a conformational (folding) change that confers protease resistance. The protease-resistant PrP then promotes conversion of the normal protease-sensitive PrP to the abnormal form, explaining the "infectious" nature of these diseases. Accumulation of abnormal PrP leads to neuronal damage and distinctive foamy "spongiform" changes in the brain. Spontaneous or inherited PrP mutations that make PrP intrinsically protease resistant have been observed in the sporadic and familial forms of CJD, respectively.

II-Viruses
Viruses are obligate intracellular organisms that commandeer the host cell's biosynthetic and replicative apparatus for their own proliferation. They consist of a nucleic acid genome surrounded by a protein coat (called a capsid) & occasionally, a host-derived lipid membrane.
Classification:-
1-according to their nucleic acid genome (DNA or ribonucleic acid [RNA], but not both).
2-the shape of the capsid (icosahedral or helical),
3-The presence or absence of a lipid envelope,
4-The mode of replication.
5-The preferred host cell type (called tropism).
6- The type of pathology they cause.
Viruses are best visualized by electron microscopy. However, certain viruses have the propensity to aggregate within the cells they infect and form characteristic inclusion bodies; these may be visualized by light microscopy and may be diagnostically helpful. e.g. CMV-infected cells are markedly enlarged & have characteristic inclusion bodies-both eosinophilic nuclear inclusions and smaller basophilic cytoplasmic inclusions. In comparison, herpesviruses can form a large nuclear inclusion surrounded by a clear halo.
and in chronic hepatitis B virus (HBV) infections, accumulated hepatitis B surface antigen (HBsAg) forms so-called ground-glass hepatocytes. Different species of viruses can produce the same clinical picture (e.g., upper respiratory infection); conversely, a single virus can cause different clinical manifestations depending on host age or immune status (e.g., CMV). While many viruses cause transient illnesses (e.g., the common cold and influenza), others can persist within cells of the host for years, either continuing to multiply (e.g., chronic HBV) or surviving in some nonreplicating form with potential for reactivation (latent infection) e.g. the herpes varicella-zoster (chickenpox) virus, establishes latency in the dorsal root ganglia; later reactivation results in shingles, an extremely painful cutaneous lesion. Some viruses also have the nasty capacity to transform host cells into neoplastic cells.

III- Bacteriophages, Plasmids, and Transposons
These are mobile genetic elements that infect bacteria and can indirectly spread human disease by encoding bacterial virulence factors (e.g., adhesins, toxins, or enzymes). Exchange of these elements between bacteria often providing the recipient with a survival advantage (e.g., antibiotic resistance), and/or converts otherwise nonpathogenic bacteria into virulent ones.

IV-Bacteria
Bacterial infections are common causes of disease. Bacterial cells are prokaryotes: they have a cell membrane but lack membrane-bound nuclei and other membrane-enclosed organelles. They are also bound by a cell wall usually consisting of a mixture of sugars and amino acids; many antibiotics function by inhibiting cell wall synthesis (e.g., penicillin). Bacterial cell walls generally occur in one of two varieties: a thick wall surrounding the cell membrane that retains crystal violet stain (Gram-positive) or a thin cell wall sandwiched between two phospholipid bilayer membranes (these do not retain crystal violet stain and are thus Gram-negative).

Classification
1-Bacteria are classified by Gram staining (positive or negative).
2-Shape (e.g., spherical ones are cocci; rod-shaped ones are bacilli),
3-Form of respiration (aerobic or anaerobic).
Many bacteria have flagella that permit movement; others possess pili that allow attachment to host cells. Most bacteria synthesize their own DNA, RNA & proteins, but look to the host for their nutrition. Most bacteria remain extracellular, while some can grow only within host cells (obligate intracellular bacteria); still others can survive and replicate either outside or inside of host cells (facultative intracellular bacteria). Normal healthy people are colonized by as many as $10^{10}$ bacteria in the mouth, $10^{12}$ bacteria on the skin, and $10^{14}$ bacteria in the gastrointestinal (GI) tract. Aerobic and anaerobic bacteria in the mouth, particularly Streptococcus mutans, contribute to dental
plaque, a major cause of tooth decay. Bacteria colonizing the skin include Staphylococcus epidermidis and Propionibacterium acnes, the cause of acne. In the colon, 99.9% of bacteria are anaerobic.

**V-Chlamydiae, Rickettsias, and Mycoplasmas**
Like bacteria, these organisms divide by binary fission and are sensitive to antibiotics. However, they are considered separately here because they lack certain structures (e.g., Mycoplasma lack a cell wall) or metabolic capabilities, Chlamydia cannot synthesize ATP that distinguish them from bacteria. Chlamydia and Rickettsia species are obligate intracellular organisms that replicate in membrane-bound vacuoles in epithelial cells and the cytoplasm of endothelial cells, respectively. Rickettsiae are notable for their transmission by arthropod vectors, including lice, ticks, and mites. Chlamydia trachomatis is the most frequent infectious cause of female sterility (by scarring fallopian tubes) and blindness (causing conjunctival inflammation that eventually scars and opacifies the cornea). By injuring endothelial cells, rickettsiae cause hemorrhagic vasculitis (often presenting as a rash), but they can also cause pneumonia or hepatitis (Q fever) or injure the central nervous system and cause death (Rocky Mountain spotted fever). Mycoplasma is the tiniest free-living organism known; it can causes an atypical pneumonia characterized by peribronchiolar infiltrates of lymphocytes and plasma cells.

**VI-Fungi**
Fungi are eukaryotes grow either as budding yeast forms or as slender filamentous hyphae. Hyphae may be septate (cell walls separate individual cells) or aseptate, a distinction important in clinical diagnosis. Many pathogenic fungi show thermal dimorphism; that is, they grow as hyphae at room temperature but as yeast at body temperature.
Fungi may cause superficial or deep infections. Superficial infections typically involve the skin, hair, or nails while deep fungal infections usually remain latent in normal hosts; they can invade tissues, destroying vital organs. Many fungi that cause deep infections in immunocompromised hosts (opportunistic fungi such as Candida, Aspergillus, Mucor, and Cryptococcus) are colonizing normal human epithelia without causing illness. In immunocompromised individuals these opportunistic fungi result in life-threatening infections characterized by tissue necrosis, hemorrhage, and vascular occlusion. e.g. AIDS patients are frequent victims of the opportunistic fungus Pneumocystis jiroveci (formerly called P. carinii).

**VII-Protozoa**
Parasitic protozoa can replicate intracellularly in many cell types (e.g., malaria in erythrocytes, Leishmania in macrophages) or extracellularly in the urogenital system,
intestine, or blood. Trichomonas vaginalis is a sexually transmitted protozoan that can colonize the vagina and male urethra. The most prevalent intestinal protozoans, Entamoeba histolytica & Giardia lamblia, have two forms: (1) nonmotile cysts that are resistant to stomach acids and are infectious when ingested, (2) motile trophozoites that multiply in the intestinal lumen. Blood-borne protozoa (e.g., Plasmodium, Trypanosoma, and Leishmania) replicate within insect vectors before transmission to new human hosts.

**VIII-Helminths**
Parasitic worms are highly differentiated multicellular organisms with complex life cycles; most alternate between sexual reproduction in the definitive host and asexual multiplication in an intermediary host or vector. Thus, depending on the species, humans may harbor adult worms (e.g., Ascaris lumbricoides), immature forms (e.g., Toxocara canis), or asexual larval forms (e.g., Echinococcus species). Once adult worms take up residence in humans, they generate eggs or larvae destined for the next phase of the cycle. pathology related to helminth infections is usually due to inflammatory responses to the eggs or larvae rather than to the adult forms (e.g., the granulomatous inflammation in schistosomiasis).

Helminths comprise 3 classes:
1. Roundworms (nematodes) have a non-segmented structure. These include Ascaris species, hookworms, and Strongyloides.
2. Flatworms (cestodes) are gutless worms whose head (scolex) sprouts a ribbon of flat segments (proglottids) covered by an absorptive tegument. They include the pork, beef, and fish tapeworms and the cystic tapeworm larvae (hydatid cysts).
3. Flukes (trematodes) are primitive, leaflike worms they include the Asian liver and lung flukes and the blood-dwelling schistosomes.

**IX-Ectoparasites**
Ectoparasites are insects (lice, bedbugs, fleas) or arachnids (mites, ticks, spiders) that attach to and live on or in the skin. Arthropods may produce disease by direct tissue damage or indirectly by serving as the vectors for transmission of infectious agents. Some arthropods induce itching and excoriations (e.g., pediculosis caused by lice attached to hair shafts, or scabies caused by mites burrowing into the stratum corneum).