

# IMPACT OF INFECTIOUS DISEASE ON HUMANS AND OUR ORIGINS

## Glossary

**Actin:** A protein that forms the internal skeleton of animal cells, including red blood cells (RBCs).

**Acute Respiratory Distress Syndrome (ARDS):** A serious type of respiratory failure characterized by rapid onset of widespread fluid buildup in the lungs, which limits oxygen uptake and causes shortness of breath, rapid breathing, and bluish skin coloration.

**Adhesin:** Proteins produced by bacteria and protozoa that mediate binding to molecules on host cells.

Malarial adhesins can be transferred to the surface of red blood cells (RBCs) causing them to become sticky and adhere to other RBCs and vessel walls, resulting in microvascular inflammation.

**Adjuvant:** A pharmacological or immunological agent that modifies the effect of other agents. Adjuvants may be added to a vaccine to boost the immune response to produce more antibodies and longer-lasting immunity, thus minimizing the dose of antigen needed.

**Aedes Mosquitos:** A genus of mosquito found on all continents except Antarctica. Species in this genus are vectors for numerous viral infections, including Dengue Fever, Yellow Fever, West Nile Fever, Chikungunya, Eastern Equine Encephalitis, and Zika virus.

**Allele:** Alternative DNA sequence at the same locus (location on the chromosome).

**Allosomes:** Chromosomes that determine sex (XY, with Y-Chromosome inherited paternally).

**Alphavirus:** A genus of RNA viruses that affect humans, rodents, fish, birds, and larger animals such as horses, and invertebrates. Transmission occurs via mosquitos. Diseases caused by Alphaviruses are numerous and include Eastern Equine Encephalitis and Chikungunya.

**Amino Acid:** Organic compounds that are the building blocks of proteins and participate in a number of processes such as neurotransmitter transport and biosynthesis. Amino acids are encoded by the genome as different three letter codes.

**Anopheles Mosquitos:** A genus of mosquito with ~460 species, ~100 of which can transmit malaria to humans.

**Anthroponosis:** A disease spread from humans to non-human animals.

**Antibody:** A Y-shaped glycoprotein produced by B-cells and used by the immune system to neutralize pathogens such as bacteria and viruses. The tips of the "Y" can recognize specific antigens and lead to a successful immune response, while the bottom of the "y" regulates immune cell responses. Also known as immunoglobulin.

**Antigen:** A molecule or molecular structure that can trigger an immune response and can be specifically recognized by an antibody.

**Autoimmunity:** An organism's aberrant immune response against its own healthy cells and tissues. Low-level autoimmunity is usually harmless and potentially beneficial, high-level autoimmunity can cause a broad range of deleterious illnesses known as autoimmune diseases (e.g. lupus).

**Bacteria:** A type of prokaryotic microorganism. Unlike eukaryotes, bacterial cells do not contain a nucleus and rarely harbour membrane-bound organelles. Bacteria were among the first life forms to evolve on Earth, and can be found in most every habitat, including soil, water, acidic hot springs, radioactive waste, the deep biosphere of the earth's crust, and in and on other living organisms as symbionts and parasites. Bacteria can be beneficial, such as those comprising the gut flora, or pathogenic and cause infectious disease. However, the vast majority of the bacteria in the body are rendered harmless by the protective effects of the immune system.

**Bacteremia:** The presence of bacteria in the blood, a normally sterile environment.

**Bacterial Vaginosis (BV):** A type of vaginal inflammation characterized by the presence of exfoliated epithelial cells with attached bacteria, abnormally thin mucus secretions, a sharp amine odor, vaginal pH, and overgrowth of the *Coccobacillus*, *Gardnerella vaginalis*. BV seems to be part of the spectrum of normal for many women, and evidence from non-human primates seems to suggest that a diverse vaginal microbiome is the ancestral state. The condition is nevertheless associated with a wide range of reproductive health complications that endanger fertility and limit reproductive success.

**B-cell (B lymphocyte):** A type of white blood cell whose function in the adaptive immune system is to secrete antibodies. Additionally, B-cells present antigens and secrete cytokines. In mammals, B-cells mature in the bone marrow. B-cells express B cell receptors (BCRs) on their cell membrane, which allow the B-cell to bind to a specific antigen, against which it will initiate an antibody response. These cells can create and almost infinite repertoire through recombination and shuffling.

**B-cell receptors (BCRs):** Immunoglobulin molecules that form a receptor protein on the outer surface of B-cells. BCRs allow the B-cell to bind to a specific antigen, against which it will initiate an antibody response. BCRs also control B-cell activation by biochemical signaling and by physical acquisition of antigens from immune synapses with antigen-presenting cells.

**Catarrh:** A build-up of mucus in an airway or body cavity caused by inflammation such as that associated with respiratory illnesses.

**Chikungunya:** An infection caused by the Chikungunya virus, which is spread between people by *Aedes albopictus* and *Aedes aegypti* mosquitos. Symptoms include fever and joint pain. Chikungunya typically occurs in Africa and Asia, but recent outbreaks have been reported in Europe and the Americas.

**Chikungunya Virus (CHIKV):** A RNA virus that belongs to the **genus *Alphavirus*** that is primarily transmitted by two species of ***Aedes*** mosquitoes, although the **virus** can also be transmitted from mother to child during delivery. Before 2013, the **virus** was found only in Africa, Asia, Europe, and the Indian and Pacific islands. In late 2013, outbreaks occurred for the first time in the Americas in the Caribbean Islands. Chikungunya (pronounced "chik-en-gun-ye") comes from the Kimadonde verb meaning "bent over in pain" or "contorted."

**Chromatin:** A complex of **DNA** and **proteins** (histone and adaptor **proteins**) forming **chromosomes**.

**Chromosomes:** Discrete strands of tightly packaged **chromatin**.

**Clotting (Blood):** The process by which blood changes from liquid to a gel, forming a clot. Also known as **coagulation**.

**Coccobacillus:** A type of short rod-shaped **Gram-negative bacteria**. Some species of coccobacillus cause disease in humans.

**Communicable (Disease):** An illnesses that is **transmittable** from an infected person or animal to another person or animal through direct contact or indirectly via contaminated food, water, or a **vector**.

**Contagious (Disease):** **Infectious** diseases that can be spread from organism to organism by direct or indirect contact. Contagious disease is a subset of **communicable**, **infectious**, and **transmissible**.

**Control Group:** A group of individuals in a medical study who receive either no treatment or the standard treatment, which is compared against a group who receive the treatment being studied.

**Coronavirus:** A member of the large, single-stranded **RNA virus** family (*Coronaviridae*) named for their ring, or corona, shape. They are also characterized by a fatty outer lining that is covered with club-shaped spike **proteins**. Coronaviruses are known to infect many mammals (including us humans) and birds. Different coronaviruses are responsible for causing **MERS**, **SARS**, and **COVID-19**.

**Coronavirus Disease 2019 (COVID-19):** An **infectious** disease caused by **severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)** that was first identified in December 2019 in Wuhan, China, and then spread globally, resulting in a **pandemic**. Common symptoms include fever, cough, fatigue, shortness of breath, loss of appetite, sputum production, and muscle and joint pains, and loss of smell and taste. Severe cases may progress to **acute respiratory distress syndrome (ARDS)**, multi-organ failure, septic shock, and blood **clots**. Spread of the **virus** occurs between people during close contact, most often via small droplets produced by coughing, sneezing, and talking. Less commonly, people may become infected by touching a contaminated surface and then touching their face.

**Cytidine monophospho-N-acetylneuraminic acid hydroxylase (Cmah):** An enzyme that is encoded by the *CMAH* gene. In most mammals, this enzyme modifies **sialic acids** [it modifies N-acetylneuraminic acid (Neu5Ac) into N-glycolylneuraminic acid (Neu5Gc)]. The human lineage

lost the function of the *CMAH* gene over 2 million years ago causing human cells to lack Neu5Gc and be coated with an excess of Neu5Ac.

**Cytokines:** A broad and loose category of small **proteins** secreted by certain cells of the immune system and are important in cell signaling and have an effect on other cells.

**Cytokine "Storm":** A severe immune reaction in which the body releases too many **cytokines** into the blood too quickly. Signs and symptoms include high fever, **inflammation**, severe fatigue, and nausea. This may be severe or even life-threatening, leading to multiple organ failure.

**Dengue Fever:** A tropical disease caused by the **Dengue virus** and spread several species of female ***Aedes* mosquitos**, especially *A. aegypti*. Symptoms may include a high fever, headache, vomiting, muscle and joint pains, and a characteristic skin rash. Severe **infections** may develop into **Dengue Hemorrhagic Fever** or **Dengue Shock Syndrome**.

**Dengue Hemorrhagic Fever:** A severe form of **Dengue Fever**, which includes bleeding and blood platelet and blood plasma leakage.

**Dengue Shock Syndrome:** A severe form of **Dengue Fever** in which dangerously low blood pressure occurs.

**Dengue Virus:** The cause of **Dengue Fever**. It is a mosquito-borne, single positive-stranded **RNA virus** of the **genus, *Flavivirus***. Origin: Africa and Asia.

**de Novo:** A Latin adverb meaning "from the new." A new genetic variant that is the result of a mutation in a germ cell (egg or sperm) of one of the parents, or a variant that arises in the fertilized egg during embryogenesis. (See **Novel**)

**Diploid:** Organisms with two sets of each **chromosome** except for XY sex **chromosomes** in male mammals.

**DNA:** Deoxyribonucleic acid. The molecule of inheritance, which consists of sequences of the four **nucleotide** bases: Adenine, Thymine, Guanine, and Cytosine.

**DNA Sequence:** The specific order of the **nucleotide** bases Adenine, Thymine, Guanine, and Cytosine.

**Eastern Equine Encephalitis (EEE):** A rare but serious and often fatal infection of **Togavirus** that causes encephalitis (inflammation of the brain). The **virus** is maintained via a bird-to-mosquito cycle, primarily by mosquitos that feed on the blood of birds. Transmission of EEE to mammals (including horses and humans) occurs via "bridge vectors," mosquito (including those from the ***Aedes* genus**) that feed on the blood of both birds and mammals and transfer the **virus**. Origin: Americas.

**Endemic:** In **epidemiology**, an **infection** that is constantly maintained at a baseline level in a population in a geographic area without external inputs.

**Epidemic:** The rapid spread of a disease to a significant percent of a given population.

**Epidemiology:** The branch of medicine that studies and analyzes the incidence, distribution, patterns, determinants, and possible control of diseases and other health factors.

**Eukaryotes:** Organisms whose cells have a nucleus enclosed within membranes. (see **Prokaryotes**)

**Falciparum Malaria:** Human-specific (malignant) malaria caused by the protozoan parasite, *Plasmodium falciparum*.

**Fomite:** Inanimate objects (clothes, furniture, door handles, etc.) that when contaminated can transfer disease.

**Gardnerella:** A genus of Gram-variable-staining facultative anaerobic bacteria of which *Gardnerella vaginalis* is the only species.

**Gardnerella vaginalis:** A facultatively anaerobic Gram-variable rod that is involved, together with many other bacteria, in **bacterial vaginosis** in some women as a result of a disruption in the normal vaginal microflora.

**Gastroenteritis: Inflammation** of the stomach and small intestine typically caused by a **virus**, but can also be caused by **bacteria**, **parasites**, and **fungi**. Symptoms may include diarrhea, vomiting, and abdominal pain.

**Gene:** DNA sequence which encodes a specific function.

**Gene-Culture Co-Evolution Theory:** A branch of theoretical population genetics that models the transmission of **genes** and cultural traits from one generation to the next, exploring how they interact. Also known as "biocultural evolution."

**Gene Flow:** Movement of **alleles** between populations as is achieved by mating.

**Genetic Drift:** Change in **allele** frequencies, including fixation and loss, by chance.

**Genome:** All DNA in a cell. Also refers to the DNA sequence that typifies an individual or **species**.

**Genomics:** The study of **genome** structure/function.

**Genotype:** The two **alleles** at one or more diploid loci.

**Genus:** A taxonomic rank used in biological classification of living and fossil organisms to group closely related **species**. In binomial nomenclature, the genus name plus **species** name forms the binomial **species** name (e.g. *Homo sapiens*).

**Glycans:** One of the four classes of major biomolecules. Glycans consist of varying numbers of sugars (monosaccharides) attached to **proteins** or **lipids** or secreted as free glycans. Glycans are essential biomolecules whose functions can be divided into three broad categories: structural and modulatory properties (including nutrient storage and sequestration), specific recognition by other molecules, and molecular mimicry of host glycans

**Glycolipids:** A type of a **lipid** (fat) with an attached **glycan** that functions to maintain the stability of the cell membrane and to facilitate cellular recognition. Glycolipids are crucial in immune response and tissue formation.

**Glycoprotein:** A class of **proteins** with covalently attached **glycans**. Glycoproteins play a part in important cellular functions like embryonic development, cell-to-cell recognition, cell adhesion, and immune functions.

**Gram-Negative and Gram-Positive Staining:** A characterization of **bacteria** based on how they differentially react with a chemical stain (crystal violet) based on their cell wall constituents.

**Guillain-Barré Syndrome (GBS):** A rapid-onset muscle weakness caused by an **autoimmune** response in which the body's **immune system** mistakenly attacks and damages the peripheral nervous system. Initial symptoms typically begin in the feet and hands with changes in sensation, pain, and muscle weakness, which then spreads to the arms and upper body of both sides. Sometimes this immune dysfunction is triggered by an **infection** or, less commonly by surgery, and rarely by vaccination.

**Herd Immunity:** Sometimes also called "herd protection" or "indirect immunity," this is when most of a population is immune to a specific contagious disease, which slows its spread to others that are not immune. However, because the level needed to reach this kind of immunity is so high (about 80-90% of the population), it invariably means that a lot of individuals must be infected (and often can die) before herd immunity can be achieved.

**Haplogroup:** A set of similar **haplotypes** that share a common ancestor.

**Haplotype:** A set of **alleles** along neighboring positions on a **chromosome** that are inherited together.

**Hemoglobin:** A **protein** complex within **red blood cells (RBCs)** that binds to oxygen molecules in the lungs for delivery to tissues throughout the body. The same complex also binds carbon dioxide (CO<sub>2</sub>) and carries it back to the lungs.

**Hemoglobin S:** The abnormal **hemoglobin protein** in **red blood cells (RBCs)** that causes **RBCs** to assume a sickle, or crescent shape.

**Hemoglobin Subunit Beta Gene (HBB):** A gene that provides instructions for making beta-globin, a protein component of **hemoglobin**. **Sickle Cell Anemia** is a disorder caused by a **mutation** in the **HBB gene**.

**Host:** A living organism on or in which a **parasite**, **pathogen**, commensal or **symbiont** lives (see **Parasitism**).

**Hybridization:** Breeding among recognized **species**.

**Immune Cells:** Cells that are part of the **immune system**. Most develop from stem cells in the bone marrow and become different types of white blood cells (the microglia of the brain originate in the yolk sack during embryonic development). Immune cells are broadly classified into innate and adaptive immune cells. Innate immune cells include neutrophils, basophils, mast cells, monocytes and eosinophils, dendritic cells, and macrophages. Adaptive immune cells include **B-cells** and T-cells. T-Cells and Natural Killer T-cells mediate important dialogues between innate (rapid) and adaptive (slower) immune responses. **B-cells** and T-cells can form long-term immunological memory.

**Immune System:** The biological defense system of an organism that protects against disease.

**Immunity:** The capability of multicellular organisms to resist

harmful microorganisms from entering it and compromising its biological systems. The balanced state of adequate biological defenses to fight infection, disease, or other unwanted biological invasion, while having adequate tolerance to avoid allergy, and autoimmune diseases. It critically relies on recognition of both self and non-self.

**Immunoglobulin:** A class of **glycoproteins** present in the serum and on cells of the **immune system**. (see **Antibody**)

**Immunology:** The branch of biology and biomedicine concerned with the study of **immune systems**.

**Infection:** The invasion of an organism's organs or tissues by **pathogens**, their multiplication, and the reaction of the **host** tissues to the **pathogens**.

**Infectious (Disease):** The capability of producing **infection** or spreading disease to others. Synonymous with **communicable** and **transmissible**.

**Inflammation:** An often-painful localized redness, swelling, and heat that is the body's response to an injury or infection. While uncomfortable, it indicates that your body is working hard to repair itself or to defend against infection.

**Influenza:** Often referred to as "flu," this is a highly **contagious** viral **respiratory** illness. Symptoms include fever, severe body aches, and **catarrh**. Because it is so contagious, influenza often produces **epidemics**. There are several influenza viruses that affect humans (A, B, C).

**Introgression:** Transfer of **alleles** between **species**.

**Japanese Encephalitis:** An infection of the central **nervous system** caused by the **Japanese Encephalitis Virus**. Most infections are benign but occasionally can cause **inflammation** of the brain (**encephalitis**), headaches, vomiting, fever, confusion and seizures.

**Japanese Encephalitis Virus (JEV):** A RNA virus of the genus *Flavivirus* that causes **Japanese Encephalitis** and is generally spread by mosquitoes, such as *Aedes* mosquitoes. JEV is prevalent in much of Asia and the Western Pacific. Pigs and wild birds serve as a **reservoir** for the **virus**.

**Jaundice:** A yellowing of the eyes and skin due to rapid breakdown of **red blood cells (RBCs)** and release of degraded **hemoglobin**.

**Lactobacillus:** A genus of **Gram-positive**, rod-shaped **bacteria** that convert sugars to lactic acid. In humans, they are a significant component of the **microbiome** and can survive in the harsh pH conditions of the digestive and genital systems. *Lactobacillus* species are normally a major part of the **vaginal microbiota**. While receiving nutrients from their human host, *Lactobacilli* protect the host against certain **pathogens**, even helping to treat diarrhea, vaginal **infections**, and skin disorders such as eczema. *Lactobacillus* is the most common probiotic, perhaps most notable for its use in yogurt.

**Lactobacillus crispatus:** A common **genus** of beneficial *Lactobacillus* **bacteria** that produces hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) and is found in the vagina and gastrointestinal system.

**Lactobacillus iners:** A common **genus** of beneficial

*Lactobacillus* **bacteria** that normally inhabits the lower reproductive system and vagina of healthy women.

**Lipid:** One of the four classes of major biomolecules. A fatty or waxy organic compound involved in important cellular activities like storing energy, as a component of the cell membrane, and signaling within and between other cells.

**Malaria:** An **infectious** disease that affects humans and other animals and caused by single-celled organisms belonging to genus *Plasmodium* and transmitted by mosquitos (commonly female *Anopheles* mosquitos). Initial symptoms are flu-like and may include headache, fever, shivering, joint pain, vomiting, anemia, **jaundice**, **hemoglobin** in the urine, retinal damage, and convulsions. The classic symptom of malaria is a cyclical occurrence of sudden coldness and shivering and then fever and sweating. The disease is widespread in tropical and subtropical regions of the equator. In 2018, there were 228 million cases of malaria worldwide resulting in an estimated 405,000 deaths. The high levels of mortality caused by malaria has repeatedly placed selective pressure on the human **genome**, resulting in several genetic factors (including **Sickle Cell Trait**) that mediate its effect to some degree.

**Middle East Respiratory Syndrome (MERS):** A **contagious** and sometimes fatal viral **respiratory** sickness that can produce severe symptoms such as fever, cough, shortness of breath and in some cases death. The MERS virus originated in bats and was first reported affecting other species, camels and humans, in Saudi Arabia in 2012. Since then, it has been identified in many other countries, including the United States.

**Microbiome:** The totality of all organisms (microbes) that live on and in the body.

**Mitochondrial DNA:** Maternally inherited **DNA** found only in the mitochondria, the energy producing organelles of **eukaryotic** cells. Mitochondria are thought to descend from symbiotic **bacteria** that have become part of **eukaryotic** cells.

**Molecular Mimicry:** The phenomenon whereby one organism produces molecules that are identical or very similar to those of another organism (such as its **host**). **Parasites** and **pathogens** repeatedly evolve molecular mimicry for host manipulation and immune evasion.

**Morbidity:** The rate of disease in a population (as opposed to mortality, which is death rate).

**Morphology (Biology):** Shape or form (outward appearance) of an organism. The branch of biology interested in the form and structure of organisms and their specific structural features.

**Mucus:** A slimy or gooeey substance (hydrated bio-gel) produced by mucous membranes and glands for to lubricate or protect the body. The substance we refer to as "snot" or "boogers" are the mucus inside your nose that traps dirt and germs before they can enter further into your body and do you harm. Sneezing expels these invaders from your body but also propels them out towards other unsuspecting victims.

**Mutation:** Change in a **DNA** or **RNA** sequence.

**Nervous System:** The network of nerve cells and fibers that transmits nerve impulses between parts of the body.

**"Non-typhoidal" *Salmonella*:** A serovar of *Salmonella* and the causative pathogen of salmonellosis. "Non-typhoidal" *Salmonella* can be transferred from animals to humans and humans to humans.

**Novel (Disease):** A new strain of a disease that has not been previously identified in a species. (See **de Novo**)

**Nucleic Acids:** One of the four classes of major biomolecules. The overall name for DNA and RNA, which are composed of nucleotides.

**Nucleotides:** Molecular building blocks for DNA and RNA. Specifically, they consist of three components: a 5-carbon sugar, a phosphate group, and a nitrogenous base. The type of sugar, either deoxyribose or ribose, determines if the resulting nucleic acid is DNA or RNA.

**Pandemic:** An epidemic that has spread across regions, including multiple continents or worldwide.

**Parasite:** An organism that lives on or in a host organism at the expense of the host.

**Parasitism (Biology):** A close relationship between two organisms where one benefits at the expense of the other.

**Pathogen:** A bacterium, virus, or other microorganism that can cause disease.

**Pathogenesis:** The biological mechanism (or mechanisms) that leads to a disease state and can also refer to the origin and development of a disease, and whether it is acute, chronic, or recurrent.

**Pathogenicity:** The absolute ability of an infectious agent to cause disease or damage in a host.

**Peer Review (Academic Publishing):** The professional critique by other scholars or scientists from the same field that normally takes place before scholarly or scientific papers are accepted for publication.

**Phenotype:** Observable traits of an organism that result from interactions between genes and environment during development.

**Phylogenetic Tree:** A branching diagram showing the evolutionary relationships among biological species, or other entities, based on their physical or genetic characteristics.

**Plasmodium:** A genus of single-celled organisms that are obligate parasites of vertebrates and insects. In humans, malaria is caused by multiple species of *Plasmodium* and transmitted by mosquitos (commonly female *Anopheles* mosquitos).

**Polygenic:** Relating to a trait determined by two or more genes. Most traits of organisms are polygenic.

**Polymerase chain reaction (PCR):** A method of copying a specified locus.

**Preprint (Academic Publishing):** A version of a scholarly or scientific paper that has not yet been formally peer reviewed. It is freely available before it is published as a finished product in a peer-reviewed scholarly or scientific journal, which often

include costly paywalls. It is generally not good practice for news outlets to report on preprinted results because they have not been peer-reviewed.

**Prokaryotes:** Unicellular organisms that lack a membrane-bound nucleus, mitochondria, or any other membrane-bound organelle. (see **Eukaryotes**)

**Proteins:** One of the four classes of major biomolecules. Proteins are molecules encoded by DNA sequences and composed of amino acids connected by peptide bonds. These range in size from a few amino acids (short peptides) to large molecules (long polypeptides) comprised of hundreds of amino acids.

**Protozoa:** An informal term for unicellular (single celled) eukaryotes, either free-living or parasitic.

**Pulmonary Hypertension:** High blood pressure in the blood vessels that supply the lungs. Also affects the right side of the heart.

**Receptor:** A molecule on the surface of host cells used by pathogens for attachment and/or invasion. Examples: angiotensin-converting-enzyme 2 (ACE2) used by **SARS-CoV-2**; Sialic acid used by **influenza A**.

**Red Blood Cells (RBCs):** The most common type of blood cell and the vertebrate's principal means of oxygen delivery from lungs or gills to all tissues of the body. RBCs of most mammals do not contain a nucleus with chromosomes. RBCs are also called "erythrocytes."

**Reproductive Tract (Human Female):** The external (labia, clitoris, and vaginal opening) and internal (clitoris, uterus, fallopian tubes, and ovaries) sex organs that function in reproduction.

**Reservoir (Medicine):** A population that is chronically infested with the causative agent of a disease and can act as a source of further infection.

**Respiratory:** Associated with the act of respiration or breathing.

**RNA: Ribonucleic Acid.** A molecule essential in gene coding, decoding, regulation, and expression. Consists of sequences of the four nucleotide bases: Adenine, Uracil, Guanine, and Cytosine. Types of RNA include messenger RNA (mRNA), transfer RNA (tRNA), ribosomal RNA (rRNA), small nuclear RNA (snRNA), and other non-coding RNAs. Some viruses including Influenza A and Sars-Cov-2 have RNA genomes.

**RNA virus:** A virus that has RNA (ribonucleic acid) as its genetic material. This nucleic acid is usually single-stranded RNA (ssRNA) but may be double-stranded RNA (dsRNA).

**Salmonella:** A genus of rod-shaped Gram-negative bacteria of the family *Enterobacteriaceae* and is divided by serovar type as either "non-typhoidal" *Salmonella* or "typhoidal" *Salmonella*. *Salmonella* enter the body through ingestion, often through consumption of contaminated meat, eggs, milk, or other foods that have come into contact with animal fecal matter. Its niche is in the intestines.

**Salmonella enterica:** A bacterium species of the genus

*Salmonella*. Most cases of **salmonellosis** in humans is caused by *S. enterica*, often via infected cattle or poultry, including eggs. *S. enterica* can be divided in six subspecies and comprise over 2,000 serovars.

***Salmonella enterica typhi***: A serovar of *Salmonella enterica* whose **reservoir** is the human body. It is usually contracted by ingestion of food or water that is contaminated by the feces of those carrying the organism.

**Salmonellosis**: An intestinal infection caused by *Salmonella* bacteria. Common symptoms include diarrhea, fever, abdominal cramps, and vomiting.

**Serovar**: A subdivision within a species **bacteria** or **viruses**, or among immune cells of different individuals grouped together based on cell surface **antigens**.

**Severe Acute Respiratory Syndrome (SARS)**: A contagious and sometimes fatal respiratory illness caused by the **Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV or SARS-CoV-1)**. SARS was first reported in China in November 2002 and was rapidly spread worldwide by international travelers. Symptoms first appear flu-like with a fever, chills, muscle aches, headache and sometimes diarrhea. This can progress to a dry cough and shortness of breath. A massive global response helped to contain the spread of the disease and no new cases of the original SARS have been reported since 2004.

**Severe Acute Respiratory Syndrome Coronavirus 1 (SARS-CoV or SARS-CoV-1)**: A strain of **coronavirus** that causes **Severe Acute Respiratory Syndrome (SARS)**. It is a single-stranded **RNA virus** that infects the epithelial cells within the lungs and can infect humans, bats, and palm civets.

**Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)**: A **novel** strain of **coronavirus** closely related to **SARS-CoV** that causes **coronavirus disease 2019 (COVID-19)**, which resulted in a **pandemic**. It is a naturally evolving **virus** that crossed to humans from another animal, mostly likely a bat. SARS CoV-2 is completely different from the family that includes **influenza viruses** though both can cause **respiratory** symptoms.

**Sialic Acids**: Acidic sugar molecules prominently found at the outermost fringes of the forest of sugar chains (**glycans**) that cover all vertebrate cells. The two most common sialic acids in mammals are N-acetylneuraminic acid (Neu5Ac) into N-glycolylneuraminic acid (Neu5Gc). The human lineage ceased the ability to produce Neu5Gc over 2 million years ago causing human cells to be coated with an excess of Neu5Ac.

**Sialidase**: An enzyme that cleaves sialic acid, an abundant sugar that coats most vertebrate cells.

**Sickle Cell Anemia**: An inherited **red blood cell (RBC)** disorder and one of the group of disorders of **Sickle Cell Disease**. In Sickle Cell Anemia, **RBCs** assume a sickle, or crescent shape, and degrade prematurely, causing a lack of red blood cells (anemia) to perform gas exchange. Shortness of breath, fatigue, and delayed growth and development in children are common conditions.

**Sickle Cell Disease**: A group of inherited **red blood cell** disorders caused by the production of **hemoglobin S**, a

**protein in red blood cells (RBCs)** that causes **RBCs** to assume a sickle, or crescent, shape. Sickled **red blood cells** break down prematurely, which causes the group of disorders, including **Sickle Cell Anemia** (a lack of **red blood cells** causing shortness of breath, fatigue, and delayed growth and development in children), **jaundice** (yellowing of the eyes and skin due to rapid breakdown of **red blood cells**), **clotting** (sickled **red blood cells**, which are stiff and inflexible, get stuck in small blood vessels depriving tissues and organs of oxygen-rich blood and can lead to organ damage, especially in the lungs, kidneys, spleen, and brain), and **pulmonary hypertension** (high blood pressure in the blood vessels that supply the lungs). Repeated **infections**, and periodic episodes of pain are also common. The severity of symptoms varies from person to person.

**Sickle Cell Trait**: In humans, a condition in which a person is heterozygous for codominant **alleles** of the **hemoglobin subunit beta (HBB) gene** and produces both normal **hemoglobin** proteins (**hgb**) and abnormal **hemoglobin** proteins (**hemoglobin S**, which causes **red blood cells (RBCs)** to assume a sickle, or crescent, shape). In environments where **malaria is endemic**, humans with Sickle Cell Trait have a selective advantage as it confers some resistance to malaria. Sickle cells prevent the **malaria parasite** from stealing **actin** (a **protein** that maintains the pliable internal skeleton of **RBCs**). **Actin** is used by the parasite to transport another **protein**, **adhesin** (produced by the **parasite**), to the cell surface. **Adhesin** causes the infected **red blood cells** to adhere to each other and to vessel walls, resulting in **microvascular inflammation**. A person with Sickle Cell Trait does not display the severe symptoms of **Sickle Cell Disease**.

**Single Nucleotide Polymorphisms (SNPs)**: Single nucleotide differences (e.g. Adenine, Thymine).

**Species**: A biological population whose individuals can mate with one another to produce viable and fertile offspring. This is a debated definition and the concept is problematic for bacteria, which can exchange genetic material with distantly related groups.

**Spillover Infection**: also known as "pathogen spillover" and "spillover event," occurs when a **reservoir** population with a high pathogen prevalence comes into contact with a **novel host** population. The **pathogen** is transmitted from the reservoir population and may or may not be transmitted within the **host** population.

**Streptococcus**: A **genus of Gram-positive bacteria** with over 50 recognized species. **Streptococcus species** are responsible for "strep" throat, pink eye, meningitis, bacterial pneumonia, endocarditis, erysipelas, and necrotizing fasciitis (the "flesh-eating" bacterial infections). However, many streptococcal species are not **pathogenic** and form part of the commensal human **microbiota** of the mouth, skin, intestine, and upper respiratory tract. **Streptococci** are also a necessary ingredient in producing Emmentaler ("Swiss") cheese.

**Streptococcal Infection**: Any type of infection caused by the group of **Streptococcus bacteria**.

**Symbiont**: An organism that lives in a **symbiosis**.

**Symbiosis**: A close and long-term biological interaction

between two different biological organisms, be it mutualistic, commensalistic, or parasitic.

**Togavirus (Togaviridae):** The viral family comprising two genera, *Alphavirus* and *Rubivirus*. All togaviruses that are either animal pathogens or zoonoses belong to the *Alphavirus* genus. Humans can contract togaviruses via **vectored** transmission from domestic livestock.

**Transmissible (Disease):** Illnesses that are transmitted from one **host** to another through direct or indirect contact, via a **vector** or contaminated food and water. Synonymous with **communicable** and **infectious**.

**"Typhoidal" Salmonella:** A serovar of *Salmonella* and the causative pathogen of **Typhoid Fever**.

**Typhoid Fever:** A bacterial infection affecting only humans caused by *Salmonella typhi*. Symptoms include a gradual onset of a high fever, which is commonly accompanied by weakness, abdominal pain, constipation, headaches, and mild vomiting. Typhoid is spread by eating or drinking food or water contaminated with the feces of an infected person.

**Vaccine:** A biological preparation containing an agent that resembles a disease-causing microorganism, often a weakened or killed form of the microbe, its toxins, or one of its surface **glycoproteins** combined with an **adjuvant** (such as alum, an aluminum salt) which contributes to the immune response. Vaccines act by stimulating the body's **immune system** to recognize the agent as a threat, to destroy it, and to recognize it in the future, providing an acquired immunity to that **infectious** disease. (Synonym: immunization).

**Vaginal Microbiome:** The totality of all organisms (microbes) that colonize the vagina.

**Vector (Epidemiology):** Any agent which carries and transmits an **infectious pathogen** to another living organism. Most agents that act as vectors are living organisms.

**Viral (Biology):** Of or relating to viruses. (see **Virus**)

**Virulence:** The degree of damage caused by a **pathogen** or microbe to its **host**.

**Virus:** A submicroscopic **infectious** agent that relies on a living **host** cell for metabolic processes and replication. Like living organisms, viruses possess **genes** and evolve by natural selection. Unlike living organisms, viruses lack cellular structure, do not have their own metabolism, instead relying on a living **host** cell for production of materials, and replication through self-assembly inside a **host** cell.

**West Nile Virus (WNV):** A RNA virus that causes **West Nile Fever** and is a from the genus *Flavivirus*, which also contains the **Zika Virus**, **Dengue Virus**, and **Yellow Fever Virus**. WNV is primarily transmitted by mosquitoes with birds as the primary **hosts**.

**West Nile Fever:** An infection by the **West Nile virus**, which is typically spread by mosquitoes. Symptoms include fever, headache, vomiting, or a rash. In rare cases, encephalitis (swelling of the brain) or meningitis occurs, with associated neck stiffness, confusion, or seizures.

**White Blood Cell (WBC):** The cells of the **immune system** that are involved in protecting the body against both **infectious** disease and foreign invaders. WBCs are also called leukocytes.

**Y-Chromosome DNA:** In mammals, paternally inherited DNA. The Y-chromosome is one of two sex **chromosomes** (**allosomes**), and is the sex-determining **chromosome**. It is one of the fastest-evolving parts of the human genome.

**Yellow Fever:** A viral disease caused by **Yellow Fever Virus** and spread by female **Aedes mosquitos**. Typically, short in duration, symptoms include fever, chills, loss of appetite, nausea, muscle pains particularly in the back, and headaches. In some cases, a relapse of Yellow Fever will occur, causing abdominal pain and liver damage that results in yellow skin (see **Jaundice**).

**Yellow Fever Virus:** An RNA virus of the genus *Flavivirus* that causes **Yellow fever** and is spread by the bite of an infected female mosquito, primarily by female **Aedes mosquitos**. Origin: Africa.

**Zika Fever (Zika Virus Disease; Zika):** An **infectious** disease caused by the **Zika virus**. Symptoms resemble **Dengue Fever** and may include fever, red eyes, joint pain, headache, and a maculopapular rash but are typically mild. While Zika Fever is mainly spread via mosquitos, it can also be sexually transmitted and potentially spread by blood transfusions. Infections in pregnant women can spread to the baby which may cause microcephaly and other brain malformations. Infections in adults have been linked to **Guillain-Barré Syndrome (GBS)**.

**Zika Virus:** An RNA virus of the genus *Flavivirus* that causes **Zika Fever** and is spread by **Aedes mosquitos**. It was first identified in 1947 in the Zika Forest of Uganda, from which it was named. Zika virus is related to the **Dengue**, **Yellow Fever**, **Japanese Encephalitis**, and **West Nile Viruses**. Traditionally, Zika virus occurred within a narrow equatorial belt from Africa to Asia but spread to the Americas causing the 2015–2016 Zika virus **epidemic**. Origin: Africa.

**Zoonosis:** A disease which can be transmitted to humans from animals.