ITRC (Interstate Technology & Regulatory Council). 2023. *Contaminants of Emerging Concern Framework* CEC-1. Washington, D.C.: Interstate Technology & Regulatory Council, CEC Team. https://cec-1.itrcweb.org/.

A

Archaea

Archaea are single-celled microorganisms with a structure similar to bacteria. They are evolutionarily distinct from bacteria and eukaryotes and form the third domain of life. Archaea are obligate anaerobes living in environments low in oxygen (e.g., water, soil, sludge). They were originally defined as extremophiles. Archaea have been associated with various diseases of the human microbiome (e.g., periodontitis, endodontic infections, small intestinal bacterial overgrowth, urogenital tract infections), but they are generally considered non-pathogenic mainly due to our limited knowledge and methodological challenges associated with conducting clinical studies on the inflammatory potential and metabolism of these organisms (Duller and Moissl-Eichinger 2024 [X4GS6IYM] Duller, Stefanie, and Christine Moissl-Eichinger. 2024. “Archaea in the Human Microbiome and Potential Effects on Human Infectious Disease.” Emerging Infectious Diseases 30 (8). https://doi.org/10.3201/eid3008.240181.).

Aerosolization

A contaminant becomes suspended in air in fine soil particulates or in water droplets

Attenuation

When the virulence of lab strain cultures decreases over time or is completely lost resulting in biased laboratory results on infectious dose and virulence.

B

Biofilms

Biofilms are complex communities of attached microorganisms that are bound to biotic or abiotic surfaces by polysaccharides, proteins, and nucleic acids.

Biological Contaminant of Concern (BioCEC)

A microbial pathogenic agent that may pose newly identified risks to humans through the environment and is found in a vector, water, soil, waste, or air.

C

Capsule

A polymer coat consisting of a dense, well-defined layer surrounding the cell. These structures are not just important for attachment to the host but may also influence interactions with surfaces and attachment to other bacteria.

Clade

A clade is a group of organisms that has a common ancestor. As a result, they often have clade-specific genes in common that confer unique clinical symptoms (e.g., Candida auris, mpox). They are frequently identified using bioinformatics approaches. Understanding biological contaminants of emerging concern clades can provide insights into where specific strains are concentrated, how they spread geographically, and how to interrupt transmission (Tassy and Fischer 2021 [D5DKMFHP] Tassy, P., and M. S. Fischer. 2021. “‘Cladus’ and Clade: A Taxonomic Odyssey.” Theory in Biosciences 140 (1): 77–85. https://doi.org/10.1007/s12064-020-00326-2. Akingbola et al. 2025 [V8WDMQK7] Akingbola, Adewunmi, Adegbesan Abiodun, Courage Idahor, et al. 2025. “Genomic Evolution and Epidemiological Impact of Ongoing Clade Ib MPox Disease: A Narrative Review.” Global Health, Epidemiology and Genomics 2025 (1): 8845911. https://doi.org/10.1155/ghe3/8845911.).

Communicable disease

Usually refers to transmission from person to person, or from animal to person (e.g., body fluids, droplets). While all communicable diseases are infectious, not all infectious diseases are communicable (e.g., tetanus is an example of an infectious but not communicable disease).

Conceptual Exposure Model (CEM)

A visual representation of a site, such as illustrations or block diagrams, that maps known and potential interactions among an environment, pathogen, and host. These relationships and interactions presented in the conceptual exposure model inform the identification and evaluation of key variables that influence the presence and severity of a biological contaminants of emerging concern scenario or outbreak.

Cross-media transfer

The process of contaminants traveling within and between different environmental media

D

Deposition

An airborne contaminant lands on a surface

Dermal exposure

Contaminated environmental media touches the skin or mucosal membrane of an individual.

E

Endotoxins

Are toxic polysaccharides that are produced as part of the outer layer of the gram-negative bacterial cell envelope. In contrast to exotoxins, which are secreted by living cells, endotoxins are cell bound and are only released upon cell lysis. Endotoxins cause a variety of universal symptoms, such as fever, since the endotoxin causes the release of pyrogens in the host. In addition, endotoxins can cause release of cytokines; diarrhea; and decreased lymphocyte, leukocyte, and platelet numbers. Even though large doses of endotoxin can result in hemorrhagic shock and tissue necrosis, the overall toxicity of endotoxins is lower than that of exotoxins. Studies show that both the lipopolysaccharide and polysaccharide portions are necessary for pathogenicity, since the lipopolysaccharide portion confers toxicity and the polysaccharide portion provides water soluble and immunogenic properties (Madigan et al. 2021 [MXEA6KXC] Madigan, Michael T., Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl, and Thomas D. Brock. 2021. Brock Biology of Microorganisms. Sixteenth edition, Global edition. Pearson Education Limited.).

Environmental media

Soil, water, and air.

Environmental Persistence

The length of time a pathogen can survive in the environment and retain infectivity.

Epidemiologic triangle

A model used to describe the interaction among a pathogen, a population susceptible to infection from the pathogen (host), and conditions favorable for exposure of the host to the pathogen (environment).

Exotoxins

Are toxic proteins released from the pathogen cell as it grows. Upon release, the toxins travel to sites away from the site of infection and cause damage. Exotoxins fall into one of three categories: **cytolytic**, **AB toxins** and **superantigen toxins**. Cytolytic toxins result in the degradation of the cytoplasmic membrane and therefore host cell lysis through destruction of phospholipids. Because these cytolytic toxins are usually observed in assays involving red blood cells, these are often called hemolysins. Not all cytolytic enzymes are phospholipases; many affect sterols (e.g., streptolysin O produced by

Streptococcus spp.) or act as leukocidins that lyse white blood cells and reduce host immunity. AB toxins are composed of two subunits. The B subunit binds to the host cell surface receptor facilitating the transfer of the A subunit across the host cell membrane where it causes damage. An example is the diphtheria toxin produced by *Corynebacterium diphtheriae*, where the A subunit disrupts protein synthesis by blocking transfer of an amino acid from a tRNA to the growing polypeptide chain. The superantigen toxin causes a heightened immune response through increased production of lymphocytes, which cause extensive inflammation and tissue damage (Madigan et al. 2021 [MXEA6KXC] Madigan, Michael T., Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl, and Thomas D. Brock. 2021. Brock Biology of Microorganisms. Sixteenth edition, Global edition. Pearson Education Limited.). **Enterotoxins are exotoxins whose activity specifically impacts the small intestine.** They result in massive secretion of fluids into the intestinal lumen resulting in both vomiting and diarrhea. They are primarily produced by pathogens associated in food poisoning (e.g., *S. aureus*, *Clostridium perfringens*, *Vibrio cholerae*, *Bacillus cereus*, and *Salmonella enteritidis*).

Exposure medium

An environmental matrix housing the pathogen that a host interacts with.

G

Genotype

The genotype of an organism refers to its genetic properties that may or may not be expressed phenotypically or in a visible manner. Genotyping determines the differences in the genetic makeup of the pathogen by examining the individual organism's DNA or RNA sequences using molecular tools; having a gene does not necessitate its expression or activity. Genes can be up- or downregulated.

H

Host

An organism that harbors a pathogen or parasite.

I

Infectious disease

An illness caused by the transmission of a pathogen from an infected host to a susceptible host either directly (e.g., person to person) or indirectly (by insects or other animals, or through air, water, food, waste, or soil).

Ingestion

An individual eats or drinks contaminated media.

Inhalation

An individual breathes in an airborne contaminant.

Intake

Water is taken from the environment and used as drinking water, or for industrial and agricultural operations, without complete disinfection.

Irrigation

Surface water, groundwater, or treated wastewater are supplied to land or crops

L

Land-use controls

Controls that prevent access to an exposure medium, which can include physical barriers, signage, and restricted use

Leaching

Contaminants within soil or waste become entrained in flowing water and are transported to environmental media on the surface or subsurface

Lethal Dose$_{50}$ (LD$_{50}$): The LD_{50} is the single dose of an organism, compound, or substance that is expected to kill 50% of a group of test animals in a laboratory setting. The LD_{50} dose is usually expressed as milligrams or grams of material per kilogram of animal body weight (mg/kg or g/kg).

M

Macrophages

Specialized immune cells that engulf and destroy pathogens, debris, and damaged cells; they play a crucial role in innate immunity. They also present antigens to other immune cells, initiating immune responses.

O

Opportunistic Pathogens

Opportunistic or facultative pathogens are organisms for which the host is only one of the potential niches they can exploit to reproduce (Balloux and van Dorp 2017 [WKTVNTAP] Balloux, Francois, and Lucy van Dorp. 2017. “Q&A: What Are Pathogens, and What Have They Done to and for Us?” BMC Biology 15 (1): 91. https://doi.org/10.1186/s12915-017-0433-z.). They usually do not cause disease in healthy hosts and are primarily environmental bacteria, parasites, or fungi that can occasionally cause infection when the right conditions present themselves (Haas et al. 2014 [78R697XZ] Haas, Charles N., Joan B. Rose, and Charles P. Gerba. 2014. “Quantitative Microbial Risk Assessment, 2nd Edition | Wiley.” Wiley.Com. https://www.wiley.com/en-us/Quantitative+Microbial+Risk+Assessment%2C+2nd+Edition-p-9781118910030.).

P

Particle size

The diameter of the airborne particle.

Pathogen

An organism that can cause disease in a host. The severity of the disease symptoms are referred to as virulence.

Pathogen Invasiveness

The ability of the pathogen to grow in host tissue in such large numbers that it triggers inhibition of host functions.

Pathogenicity

The ability of a pathogen to cause disease in a host.

Phenotype

The expressed (i.e., visible) traits of the organisms, which are influenced by genetic determinants and environmental factors.

S

Slime Layer

Some macromolecules responsible for bacterial attachment are not covalently attached to and secreted by bacteria. This loose network of macromolecules extending outward from the cell is called a slime layer.

Source

A contaminated medium that is primarily responsible for transmitting pathogens to exposure media or susceptible hosts.

Strain

A specific microbial genome or collection of clonally identical cells (i.e., a genotype); one or more colonies (believed to be)

derived from the same progenitor cell; or most often, in practice, a collection of cells or genomes within a relatively small range of phylogenetic variation (i.e., a very narrow subspecies clade) (Yan et al. 2020 [NFSA7SD7] Yan, Yan, Long H. Nguyen, Eric A. Franzosa, and Curtis Huttenhower. 2020. “Strain-Level Epidemiology of Microbial Communities and the Human Microbiome.” Genome Medicine 12 (1): 71. https://doi.org/10.1186/s13073-020-00765-y.).

T

Toxicity

The ability of the pathogen to cause damage and disease through a preformed toxin that inhibits host cell function, causes damage, or kills the host cell. A good example of this is *Clostridium tetani.* While the bacterium stays at the site of infection, it produces a toxin that moves to different body parts and initiates irreversible muscle contraction and potentially death of the host.

V

Vectors

Organisms that carry a pathogen to a human host.

Vector-borne Diseases

Diseases that result from an infection transmitted to humans and other animals by blood-feeding arthropods, such as mosquitoes, ticks, and fleas. Examples of vector-borne diseases include Dengue fever, West Nile virus, Lyme disease, and malaria.

Virulence

Severity of disease symptoms

Z

Zoonotic Diseases

Infectious illnesses that spread between animals and humans. Bacteria, parasites, viruses, fungi, and prions can cause them. Zoonotic diseases can spread through contact with infected body fluids, animal bites, and contaminated water and from eating infected meat. Bats, livestock, rodents, birds, and other vertebrates can carry them.