

## KEY POINTS J: BACTERIOPHAGE, THE BENEFICIAL GOOD VIRUSES

1. Bacteriophage were recognized as an antibacterial circa 1917, WWI, considerably before antibiotics and used as therapeutic interventions in Russia and Poland, routinely, where unlike the Western World, phage are still considered prominent therapy against infections.
2. The application of bacteriophage has had varying emphasis in Western medicine, always an alternative to growing antibiotic resistance. In my Masters Studies at Syracuse University, 1964-67, phage were used in epidemiological research, tracking the origin of bacterial outbreaks, in my case tracking *Proteus mirabilis* UTIs in critical care; we developed a phage battery of 8-12 isolates to unmask a predominant bacterial strain and its potential origin. A growing list of studies now includes wound infections with emphasis on GUT and potential alternative/complement to *C. difficile* dysbiosis and fecal transplants.
3. Bacteriophage are considered the most abundant and diverse biological species on earth, the biosphere, with an estimated population of  $10^{31}$ , compared to humans at  $10^{13}$ , with oceans having the greatest single concentration. Every known bacterium has at least one known bacteriophage, usually more. A gram of soil may contain up to  $10^9$  phage particles.
4. In humans, a Danish study of diapers from 647 healthy 1 year olds, uncovered 10,000 viral species from 248 viral Families; there were 10X as many bacteriophage as bacteria.
5. Today, bacteriophage are considered part of the “Dark Matter” of the universe, including virus like particles, VLPs, the majority uncultured, unclassified and their specific host and strategies unknown, recognized by molecular detection, only. In the human GUT, they represent 40-70 % of genomes recognized and are referred to as the GUT “phageome”.
6. In recent clinical studies, the importance of bacteriophage is being reevaluated, where 8 factors have been identified that shape the human virome including: Breast feeding, medication, cohabitation, geography, disease, aging, genetics and diet. A monthly stepwise assembly of the pediatric virome recognizes NB, 1 and 4 months influenced by maternal antibody, human milk and lactoferrin. Bacterial GUT colonization with integrated prophage by one month, established prophage as the first viral particles of the virome.
7. Ongoing studies of the virome and the phageome, specifically, highlight the recognition that “bacteriophage don’t cause disease, they shape bacteria’s competitive abilities and the balance of bacterial populations”, are critical mediators of genetic exchange between pathogenic and nonpathogenic bacteria” and “regulate and modulate “ microbial abundance. Given the parallel early development of the immune system, the viruses richness is a stimulant of immune recognition, a potential barrier against chronic diseases including asthma and diabetes, potentially other NCDs.