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Healthy Choices for Mind and Body - Newsletter

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Putting medical and nutrition news in historical, scientific, and just plain practical context.

Viral Virulence - Part 2

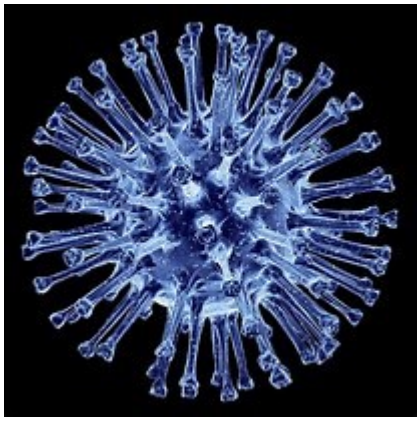
by Ann Gerhardt, MD April 5, 2020

Virulence is the severity of injury caused by an infecting organism, dependent on factors involving both the virus and susceptible host. I'll discuss the virus first.

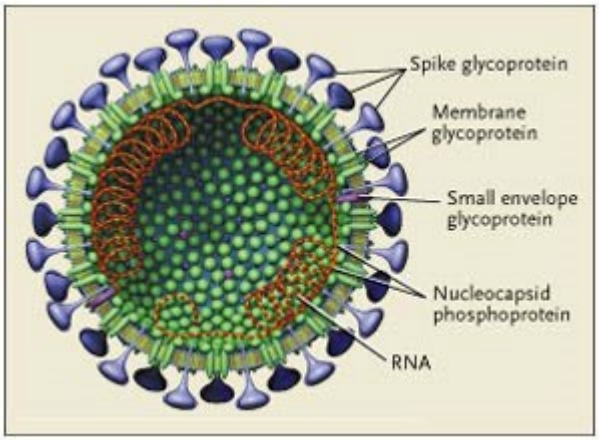
Viruses are submicroscopic infectious agents that can only live and reproduce themselves (replicate) inside another living entity. Mammals, fish, amphibians, fowl and microorganisms, all have viruses capable of infecting their cells.

A virus is genetic material contained in a package. The genetic material type, RNA or DNA, and the characteristics of the package vary among virus families. Species within the family have their differences, but a family of viruses has enough things in common that they tend to cause similar diseases.

Coronaviruses have an RNA core covered by a layered envelope of proteins, each of which has a function, as shown in the SARS2003 virus picture below on the left. Compare that structure to a picture of an influenza virus on the right. Not only the appearance, but also the types of envelope proteins differ between the two species.



Drawing of an Influenza virus



Drawing of coronavirus (2003 SARS)

A virus' proteins are responsible for attachment to host cells and for living and replicating inside those cells. Attachment proteins determine which host the virus can infect. The SARS-CoV-19 virus' RNA sequence is very similar to that of bat coronavirus, suggesting that this virus "jumped" from bats to humans, possibly through an intermediate of pangalins. The bat virus likely changed (mutated) its proteins in a way that enabled the virus to infect a new host, humans.

SARS-CoV-2 might seem capable of infecting heart cells in addition to lung tissue. That increases virulence. Doctors have noticed worse outcomes in COVID-19 patients with underlying cardiac disease. COVID-19 patients often develop an abnormal blood troponin level, indicating cardiac injury. Of 187 hospitalized Chinese COVID-19 patients, those with elevated troponin levels died 5-6 times as frequently if they had high troponin levels, up to a horrifying 69.44% death rate in those with underlying heart disease.

A virus' proteins also determine the speed with which it enters a host's cells, replicates and bursts the cell so its progeny can infect other cells. This efficiency is part of virulence and likely determines how many viruses we need to inhale to be infected. The fact that non-coughing, asymptomatic people can infect others suggests that humans require relatively few SARS-CoV-19 to be infected.

Virulence also relates to how fast a virus kills its host. It takes us 10-14 days to make substantial antibodies to a new organism. Severe COVID-19 infections peak and often kill at about 10 days. Only non-specific, less effective immunity is available up to that point to fight infection. SARS-CoV-2 also tends to trigger cytokine storm, which is part of non-specific immunity, contributing to death.

There are at least 4 mildly pathogenic coronaviruses that cause cold-like symptoms throughout the world. Because they don't kill, we pass them around to friends and family, allowing the virus to persist in the world. If the virus killed all its susceptible hosts quickly, it would die off. That may be what happened in 2002-2004, when SARS-CoV-1 spread to 29 countries, causing 8,098 known human infections and 9.6% mortality before it abruptly ended. With a lower death rate, COVID-19 could be around for a long time.

ANN L. GERHARDT, M.D.
Nutrition Consultation

Board Certified: Internal Medicine
Clinical Nutrition

5025 J Street, Suite 203
Sacramento, CA 95819

(916) 457-3466
Fax (916) 457-0151
algerhardt@sbcglobal.net

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