

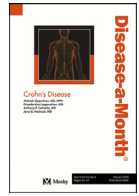


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## Human pathogen coronaviruses – An overview

R.B. McFee, DO, MPH, FACPM, FAACT, *Guest Editor*

*Department of Emergency and Family Medicine, LMU-DCOM, United States*



Coronaviruses (CoV) are a diverse group of viruses capable of infecting humans, and a wide range of animals. CoV affect multiple systems, and can cause respiratory, gastrointestinal, hepatic, and neurological illnesses, ranging from mild sickness to death. CoV are classified into multiple genera, including Alpha, Beta, Gamma and Delta coronaviruses.<sup>1–10</sup> Of note, CoV seem to be able to adapt to new hosts and changing environments; this may be related to CoV ability to mutate and recombine,<sup>1,3,5,7</sup> perhaps contributing to novel viruses with varying human pathogenicity.

Coronaviruses (order Nidovirales, family *Coronaviridae*, genus *Coronavirus*) are large, enveloped, single stranded, positive-sense RNA viruses, capable of infecting a variety of animals, including bats, mice, birds, dogs, pigs, cattle, and humans.

Identified many decades ago, Coronavirus (Fig. 1)<sup>9</sup> – from the Latin *corona* (translation “crown” or “halo”) represents the appearance of CoV virions as they are viewed through an electron microscope.<sup>2,7–10</sup> The virus appearance is created by viral spikes (S), peplomers that populate the surface and determine host tropism (Fig. 1).<sup>8–10</sup>

Typically CoV are considered to be highly species-specific. In immunocompetent hosts, infection elicits the immune response of neutralizing antibodies and cell-mediated immune responses that attempt to kill infected cells.<sup>1, 10, 11</sup>

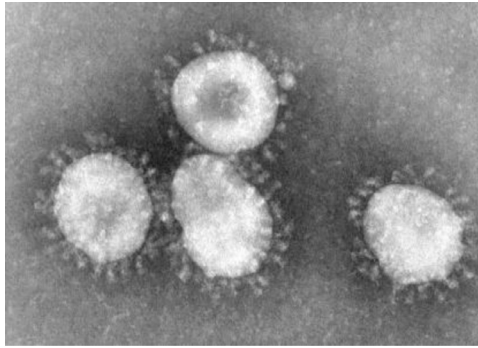
Coronaviruses, members of the *Coronaviridae* family were identified and grouped based upon their serological cross-reactivity, and genomic sequence homology. Host ranges are diverse, and can include canines, felines, swine, mice, camels, bats, birds, and humans.<sup>1,2, 7, 10–14</sup>

Across the four genera of coronaviruses are Alphacoronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus<sup>2,5,10,11</sup> there is a high frequency of recombination and rate of mutation which are believed to allow CoVs to adapt to new hosts and environments.<sup>3, 11–16</sup> SARS Cov<sup>2,5,6,17–34</sup> is a good illustration of this; studies revealed it originated from animals – bats as the natural reservoir,<sup>5–8, 10, 11, 25,26,27</sup> and palm civet as the intermediate host.<sup>11–13</sup> This underscores the infection risk in human animal interactions – occupational, or adventure or travel, as

*E-mail address:* [drmcfee2020@gmail.com](mailto:drmcfee2020@gmail.com)

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**Fig. 1.** Coronavirus. Centers for Disease Control and Prevention (CDC)/Dr. Fred Murphy.<sup>9</sup>

well as environmental incursion and changing habitats expected with climate change, which can pose significant risks to human, as well as animal health.

As an animal pathogen, coronaviruses can lead to highly virulent respiratory, enteric, and neurological diseases, in addition to hepatitis, resulting in epizootics of respiratory diseases and/or gastroenteritis. As a human virus the range of disease is broad, from cold like to severe multisystem involvement (These CoV infections are associated with short incubation periods (2-7 days), such as those found in SARS.<sup>2, 5, 6, 17, 18, 24, 25</sup> Several coronaviruses are capable of causing fatal systemic diseases in animals, including feline infectious peritonitis virus (FIPV), swine hemagglutinating encephalomyelitis virus (HEV), some strains of avian infectious bronchitis virus (IBV) and mouse hepatitis virus (MHV). These particular CoV can replicate in liver, lung, kidney, gut, spleen, brain, spinal cord, retina, as well as other tissues.<sup>2,7,13</sup>

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