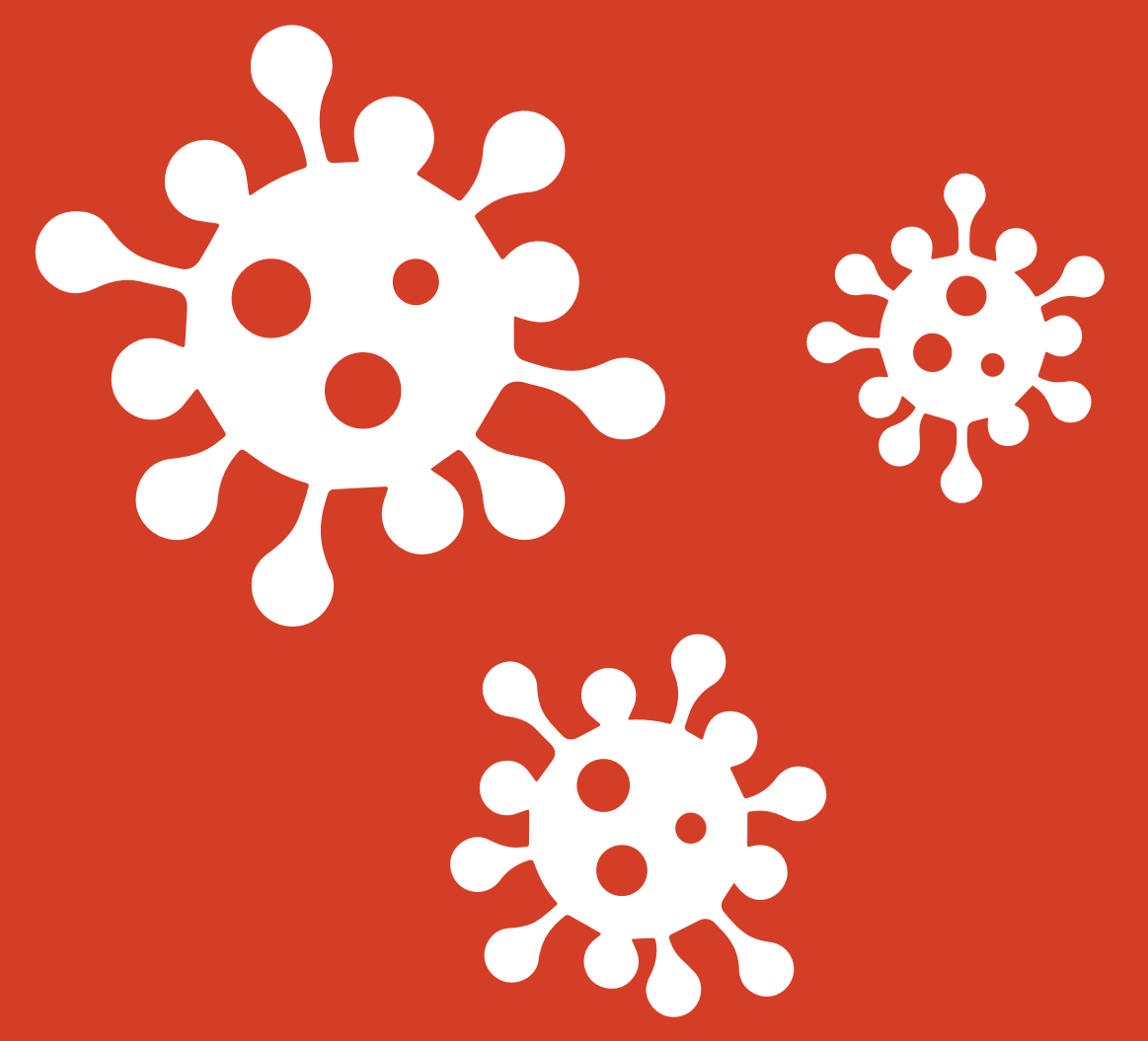


# SARS-CoV-2. What's the infection origin in humans?

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## 1. Introduction SARS-CoV-2

- It started in Wuhan, China.
- Evidence, the concept "ONE HEALTH" in a globalized world.
- Rhinolophus ferrumequinum* reservoir.
- Uncertainty about the intermediate host I.

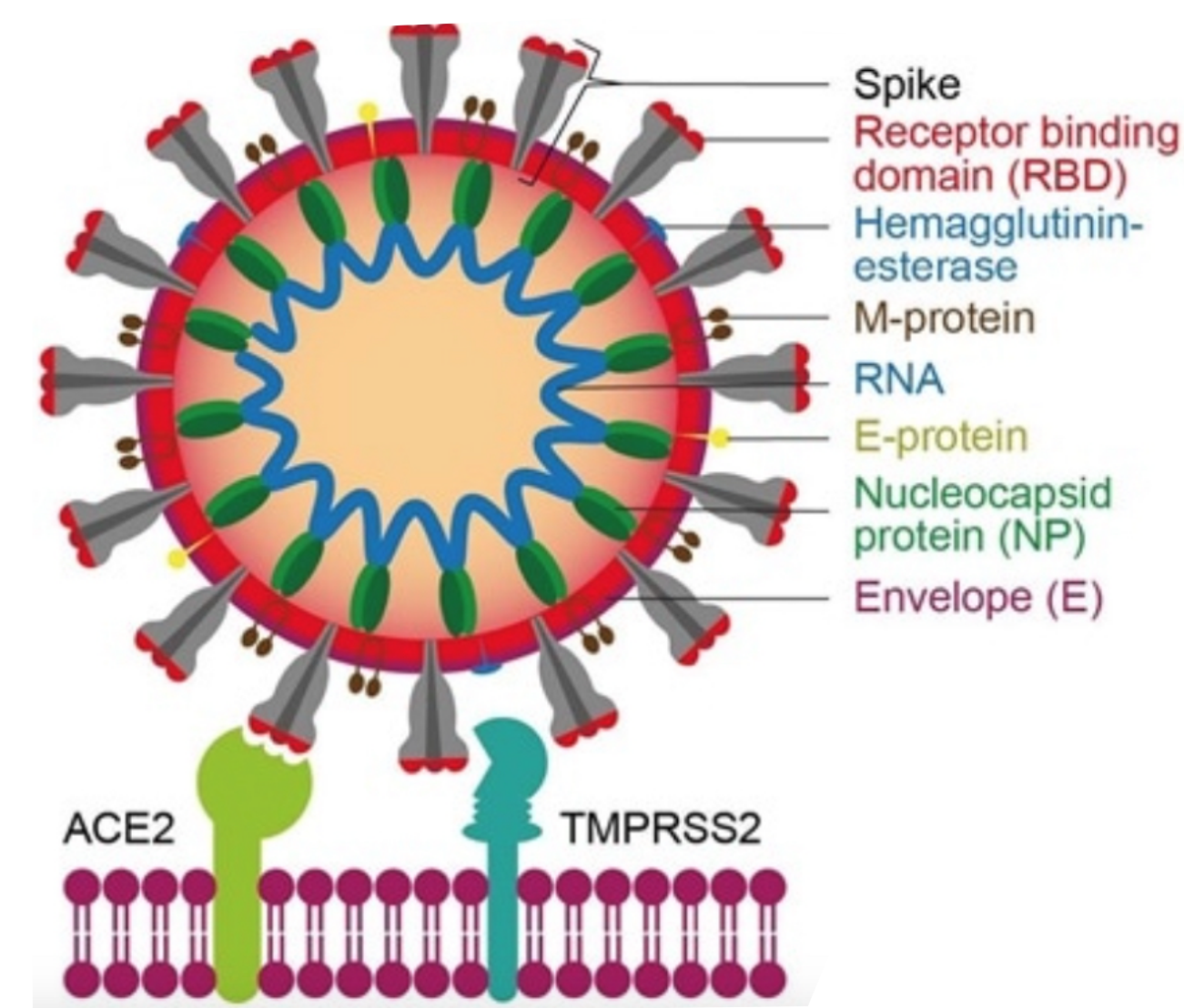


Figure 1: SARS-CoV-2. Structure  
From: (Robertson, 2021)

## 2. Current state of the pandemic situation

- Affected countries: 192
- Infected: 170 million.
- Mortality: 3.54 million.

Updated May 30, 2021  
from Johns Hopkins University

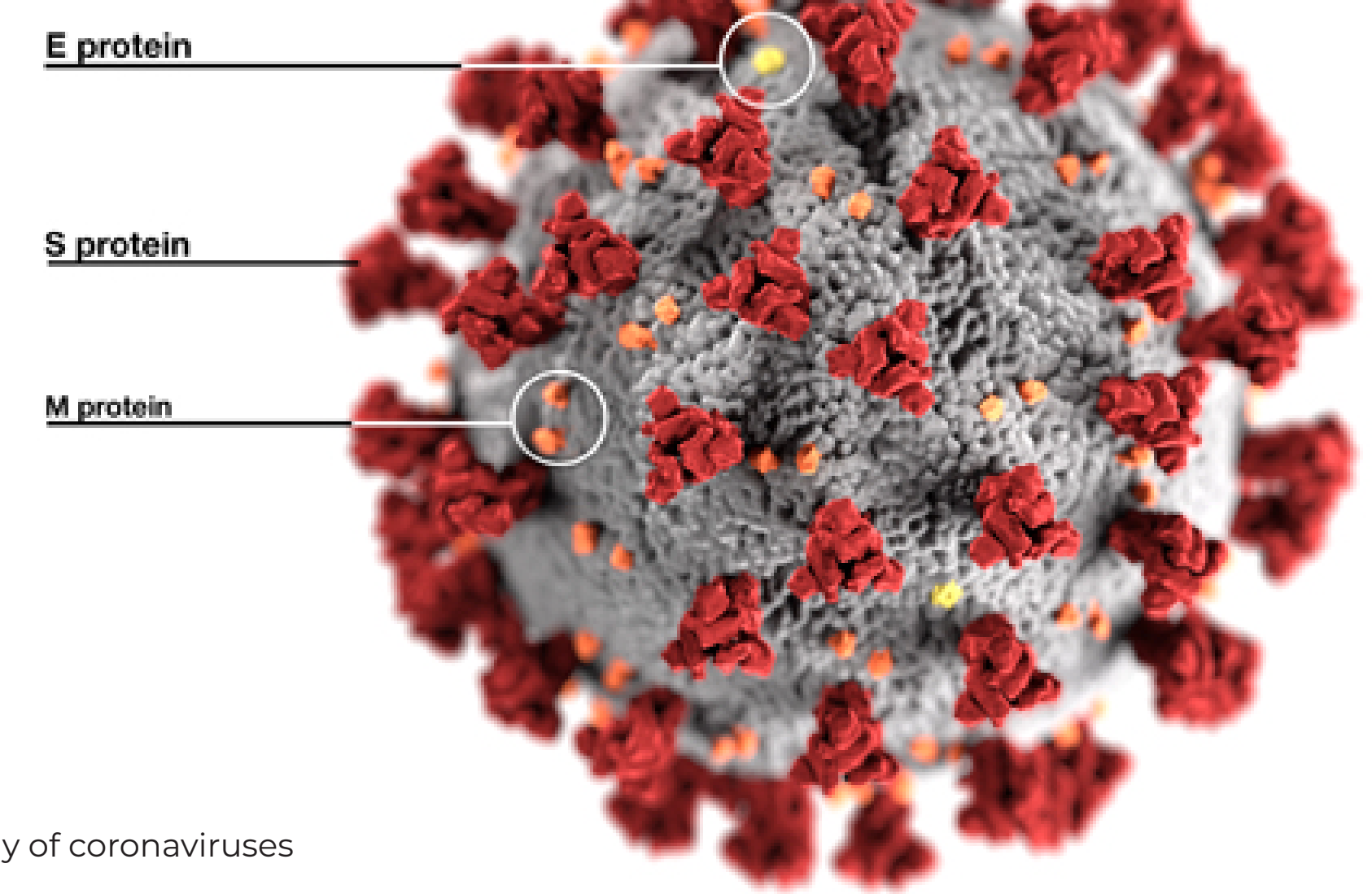


Figure 2: the ultrastructural morphology of coronaviruses  
From: (Eckert, A. & Higgins, D. 2021)

## 3. What are coronaviruses?

- Taxonomically: Viruses belonging to the order *Nidovirales*, family *Coronaviridae* and subfamily *Orthocoronavirinae*.
- Divided into 4 genres: *Alphacoronavirus*, *Betacoronavirus*, *Gammacoronavirus* and *Deltacoronavirus*.

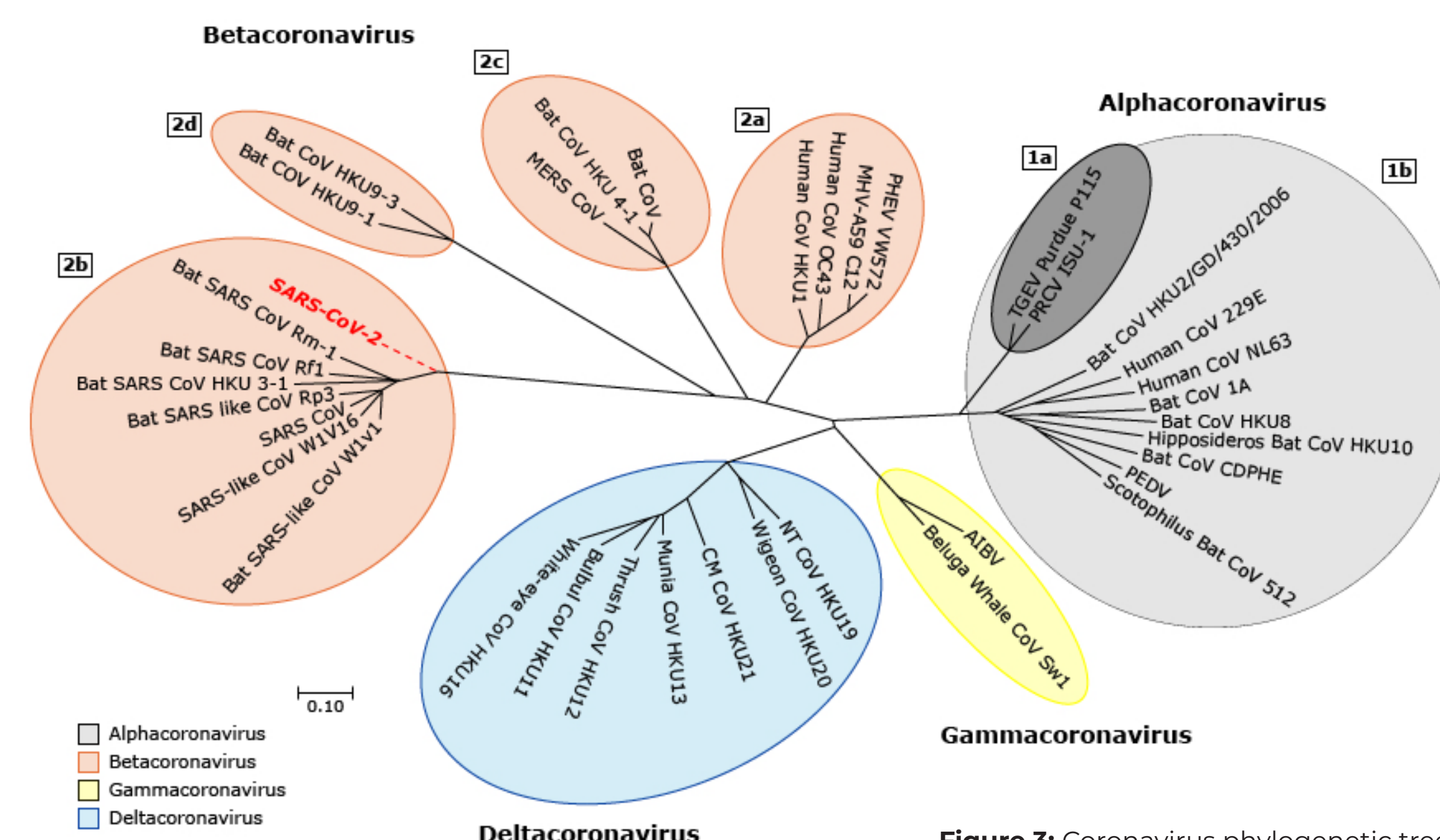


Figure 3: Coronavirus phylogenetic tree  
From: (McIntosh, 2021)

## 4. Seven infectious Coronaviruses in humans:

- *Alphacoronavirus*: HCoV-229E i HCoV-NL63.
- *Betacoronavirus*: HCoV-OC43, HCoV-HKU1, SARS-CoV, MERS-CoV i SARS-CoV-2.

## 5. SARS and MERS

- SARS-CoV: Start in China in 2003. Horseshoe bat reservoir. Intermediate civet host.
- MERS-CoV: Start in Saudi Arabia 2012. Egyptian Sheath-tailed Bat Reservoir (*Taphozous perforatus*). Intermediate dromedary host.

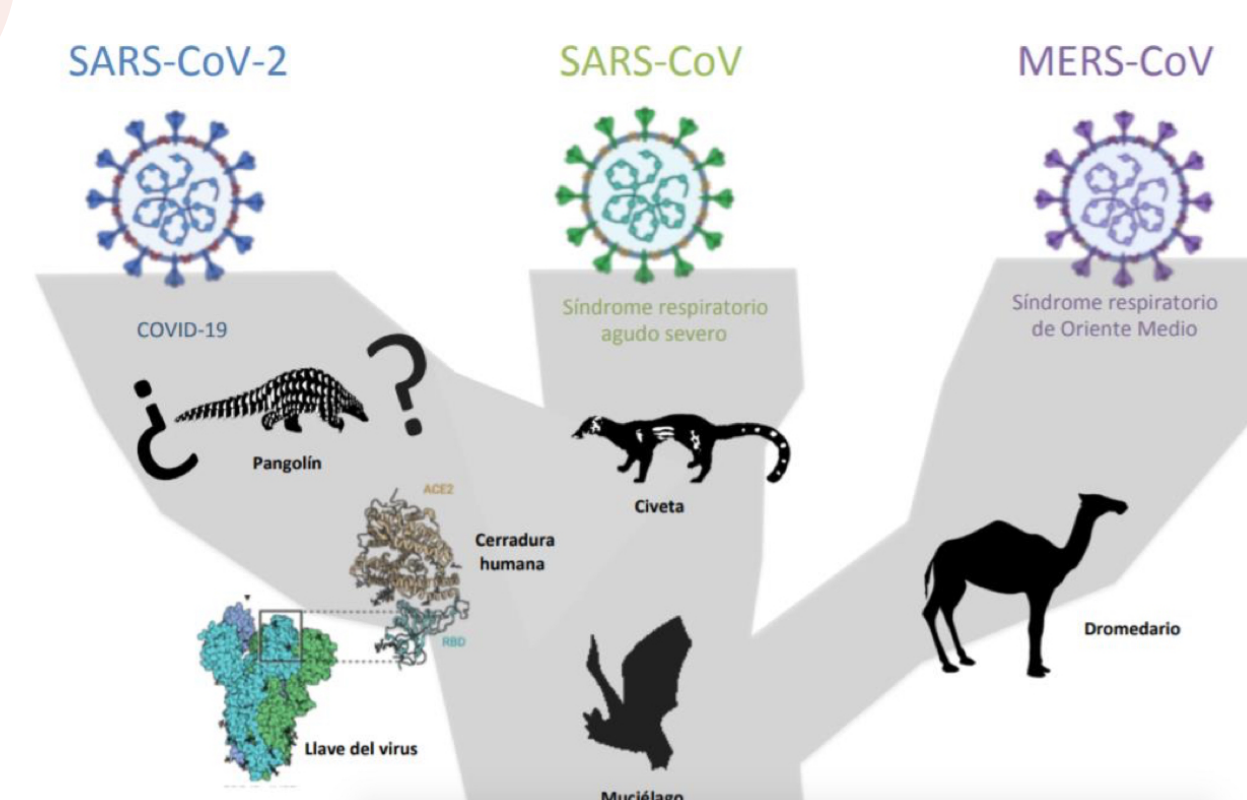


Figure 4: SARS-CoV, MERS-CoV and SARS-CoV-2  
From: (Diez et al., 2020)

## 6. SARS Cov-2 in animal species

- Cats, ferrets, hamsters, big cats, bats and non-human primates. Dogs limited susceptibility.
- Other domestic species, including pigs and poultry, do not appear susceptible.
- Susceptibility given by the sequence of 22 amino acids (ACE-2) directly involved in the ACE-2 and RBD interaction of the virus.

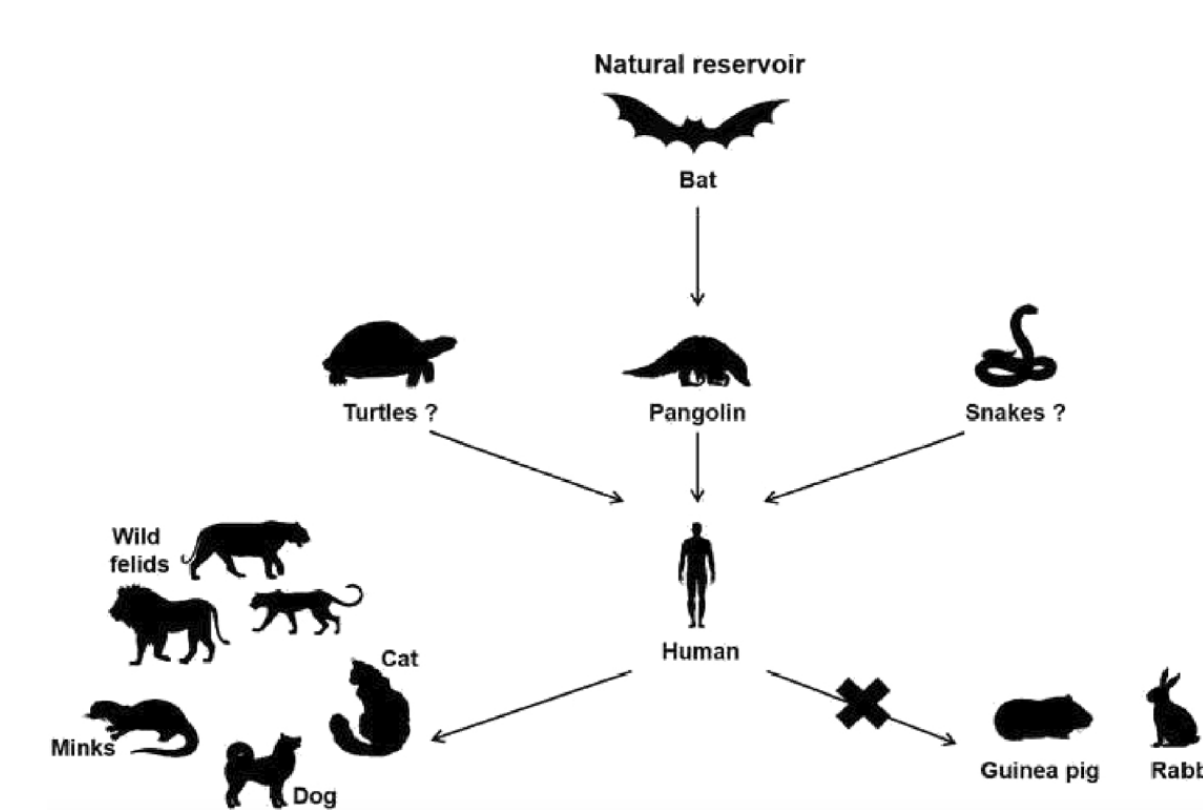


Figure 5: Susceptibility of a range of animals to natural infection by SARS-CoV-2.  
From: (do Vale et al., 2021)

## SARS-CoV-2 infections in animals

Since the initial outbreak of COVID-19, multiple countries have reported infections of SARS-CoV-2 in nonhuman animals, in addition to in people. This is a global snapshot of the reported cases of naturally acquired SARS-CoV-2 infections in animals.



Sources: World Organisation for Animal Health (OIE), U.S. Department of Agriculture (USDA), Danish Veterinary and Food Administration, Netherlands Ministry of Agriculture, Nature and Food Quality, ProMED, February 9, 2021.

Figure 6: Infective animals  
From: (AVNA, 2021)

## 7. Hypothesis of the origin of SARS-Cov-2

- November 2020, joint study between China and WHO.
- "Extremely unlikely" - No evidence in genome sequences that occurred in a laboratory.
- "Probable to very probable" a zoonotic effect of an intermediate host.

## 8. Natural origin of SARS-CoV-2

- It has circulated among the population and evolved to SARS-CoV-2.
- Zoonosis from an intermediate host.
- It probably existed in other countries such as France, India and Holland before Wuhan outbreak.

## 9. Conclusions

- It is essential to know the source to report on global strategies to mitigate the risk of future outbreaks.
- Human and animal health is interdependent and closely linked to the ecosystems in which they coexist (One Health).
- Zoonotic origin has the bat as a reservoir because the genetic sequence has a coincidence of 96%.
- Likeliest hypotheses of infection:
  - Non-pathogenic zoonotic infection that mutated in humans to SARS-CoV-2.
  - Pathogenic zoonotic infection already like SARS-CoV-2.
- Androgenic SARS-CoV-2 infection, but not infected from animals to humans.
- Nationwide News reported on May 8 that the possibility of genetic manipulation is being considered.

## References

- Figure 1: Robertson, S. (2021). Protein-based vaccines against SARS-CoV-2 may provide advantages over mRNA-based vaccines. News-Medical.
- Figure 2: Eckert, A., & Higgins, D. (2021). SARS-CoV-2\_illustration. CDC. <https://www.cdc.gov/coronavirus/2019-ncov/images/2019-nCoV-virus-illustration.jpg>
- Figure 3: McIntosh, K. (2021). Coronaviruses. UpToDate, Inc. <https://www.uptodate.com/contents/coronaviruses/print>
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- Figure 5: do Vale, B., Lopes, A. P., Fontes, M. da C., Silvestre, M., Cardoso, L., & Coelho, A. C. (2021). Bats, pangolins, minks and other animals - villains or victims of SARS-CoV-2? Veterinary Research Communications, 45(1), 1-19. <https://doi.org/10.1007/s12559-021-09787-2>
- Figure 6: AVMA (2021). SARS-CoV-2 in animals. American Veterinary Medical Association All Rights Reserved. <https://www.avma.org/resources-tools/animal-health-and-welfare/covid-19/sars-cov-2-animals-including-pets>