UC | Center for Laboratory Safety

The SARS-CoV-2 Pandemic: an Opportunity for Biotechnology

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Overview

- SARS-CoV-2 genome and structure
- SARS-CoV-2 propagation
- Opportunities for biotechnology

COVID-19 Biotechnology Research

Challenge Areas

- Testing and tracing
- Prevention of spread and reoccurrence
- Treatment of disease

Goals for Biotechnology

- Safe
- Affordable
- Efficient
- Flexible
- Easy to produce
- Easy to store
- Easy to transport

SARS-CoV-2

Pneumonia outbreak, December 2019

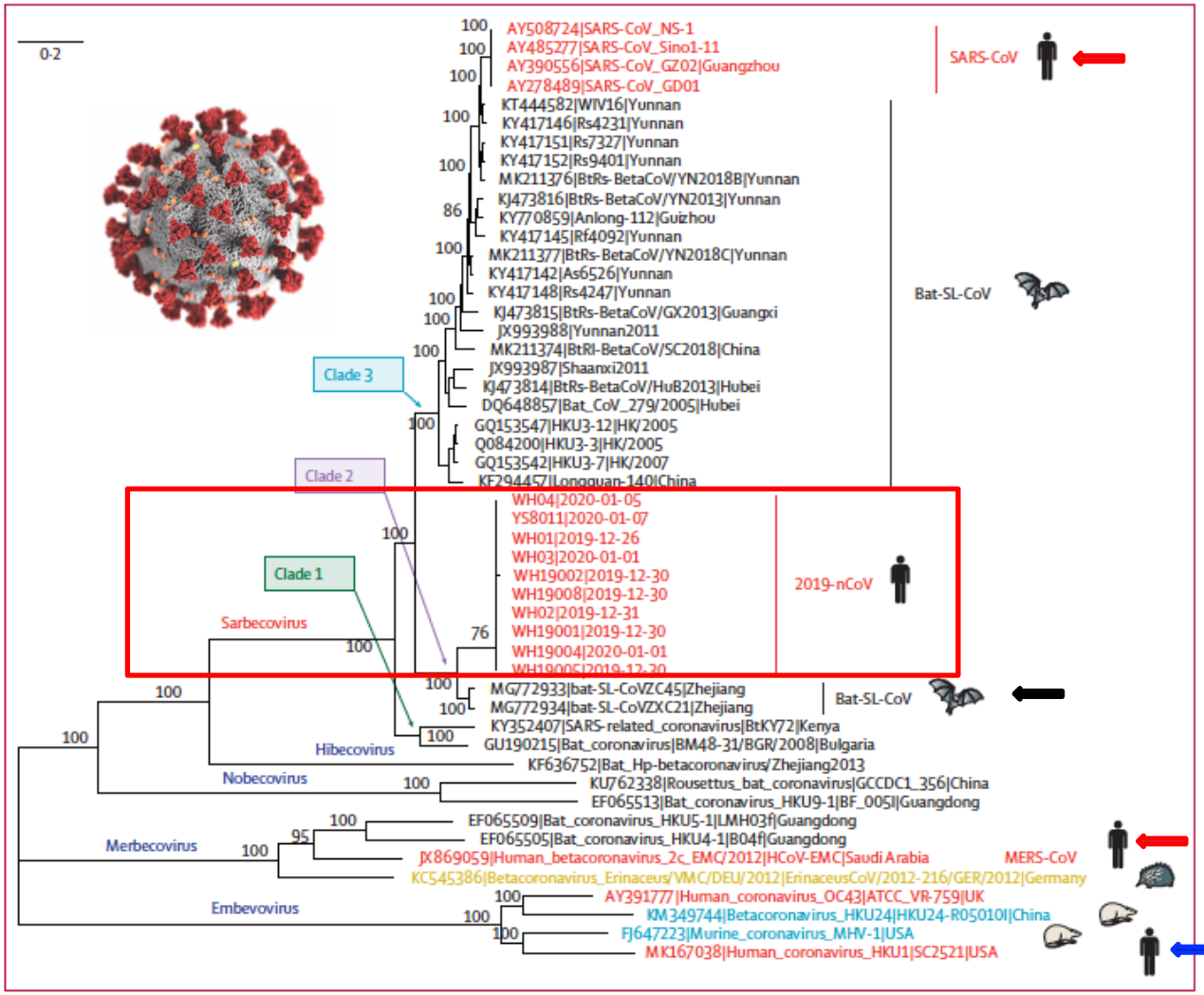
Wuhan, China

Viral genome sequenced and published

Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding, Lu et al., Lancet, Jan 30, 2020

A pneumonia outbreak associated with a new coronavirus of probable bat origin, Zhou et al., Nature, Feb. 3, 2020

SARS-CoV-2 Genome Sequence Analysis



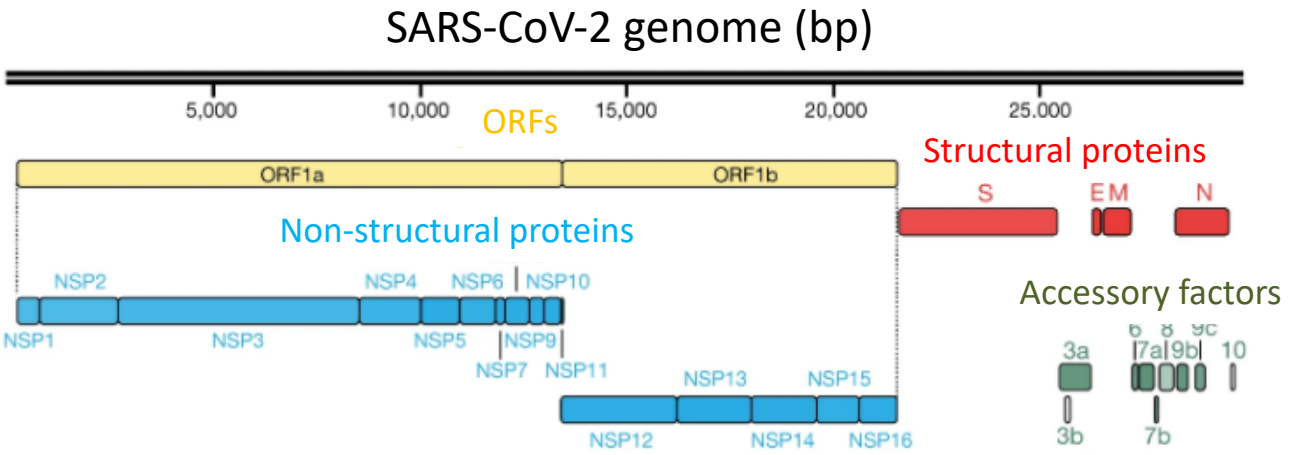
- A new Coronavirus
- Related to:
  - SARS-CoV
  - MERS-CoV
  - Bat-CoV
  - Human common cold
- SARS-CoV-2 not all identical

- Spike protein binds to ACE2 receptor protein

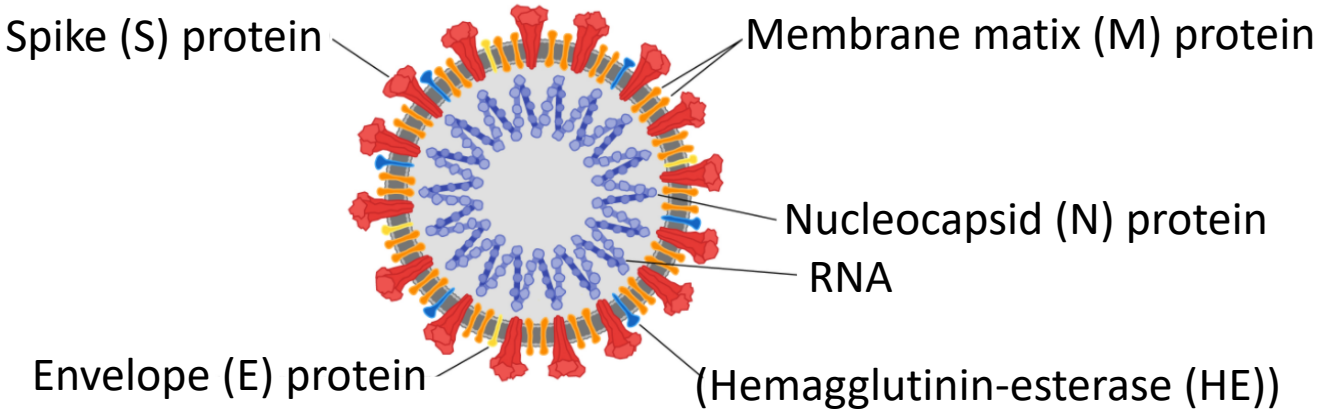
  ACE2 on the surface of many human tissues including the lungs

Lu et a., Lancet, 2020, https://www.sciencedirect.com/science/article/pii/S0140673620302518?via%3Dihub

SARS-CoV-2 Viral Structure



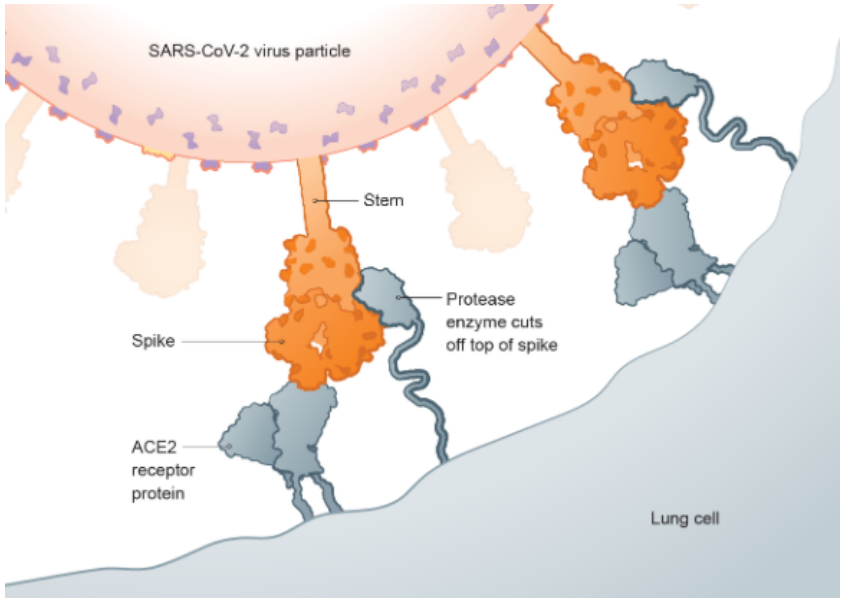
Gordon et al., Nature 2020 (https://www.nature.com/articles/s41586-020-2286-9)



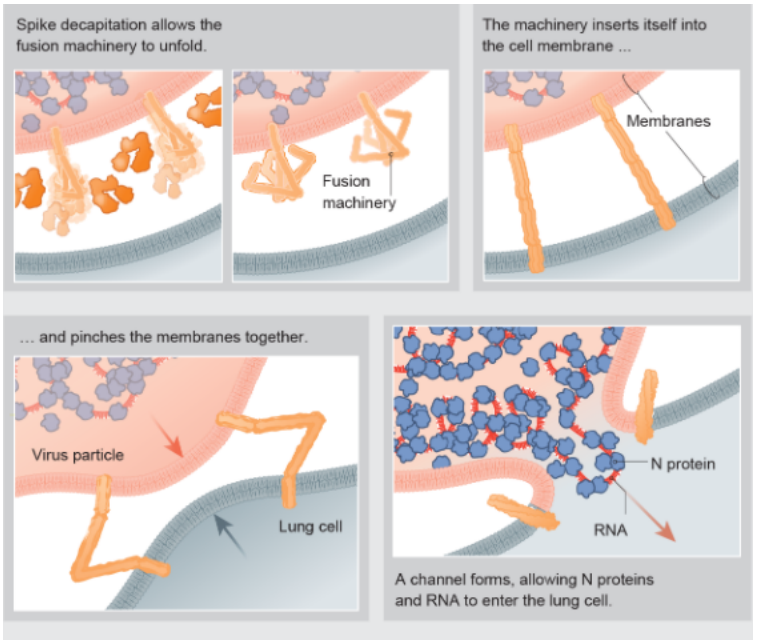
https://www.britannica.com/science/coronavirus-virus-group

SARS-CoV-2 Life Cycle

1) Virus binds to ACE2 receptor and Spike protein is cleaved by TMPRSS2 protease



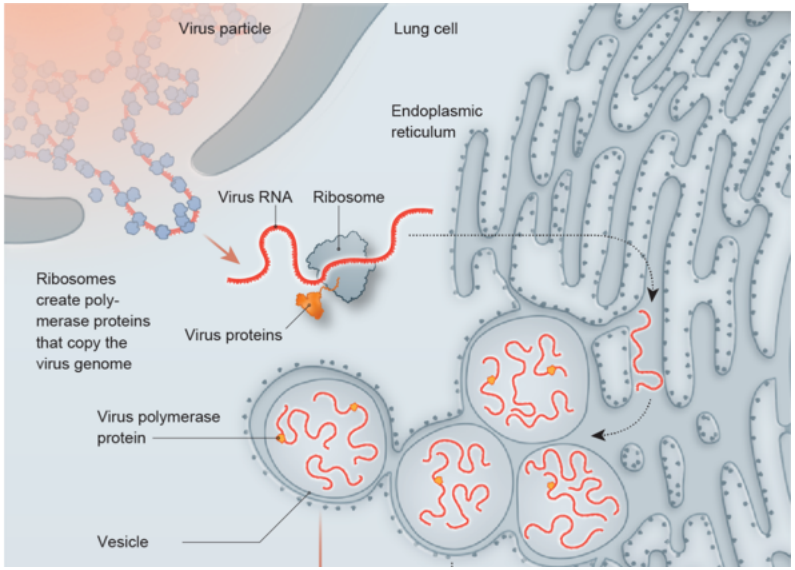
2) After 10 min, viral RNA enters cell



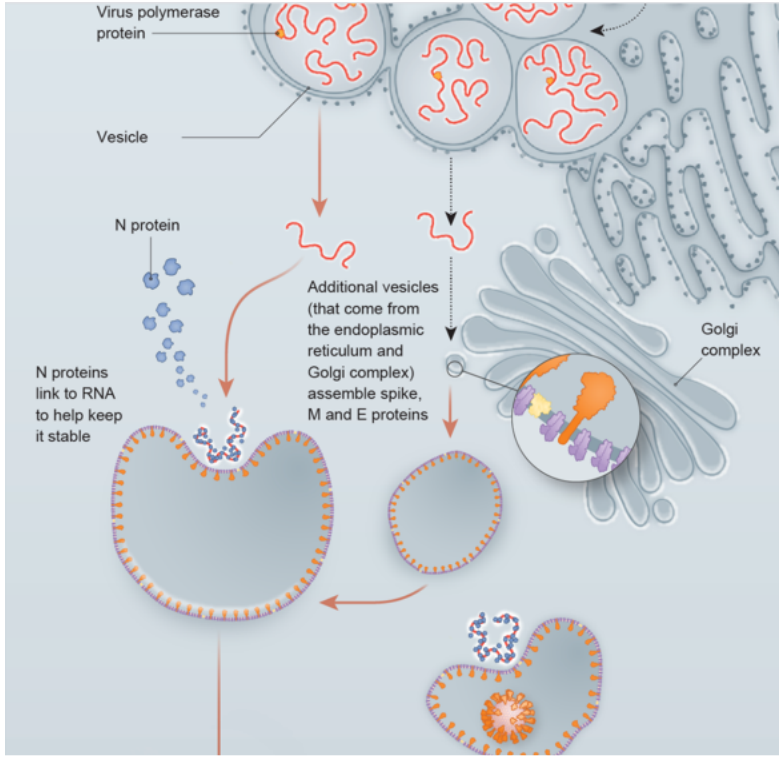
https://www.scientificamerican.com/article/a-visual-guide-to-the-sars-cov-2-coronavirus/

SARS-CoV-2 Life Cycle, cont.

3) Viral RNA is translated by the cell's ribosome into viral proteins. Proteins recruit ER to form protective vesicles. RNA is replicated inside vesicles



4) Golgi vesicles are recruited to assemble viral membrane-bound proteins. Viral RNA is packaged with N protein and assembled to form intact viral particles.



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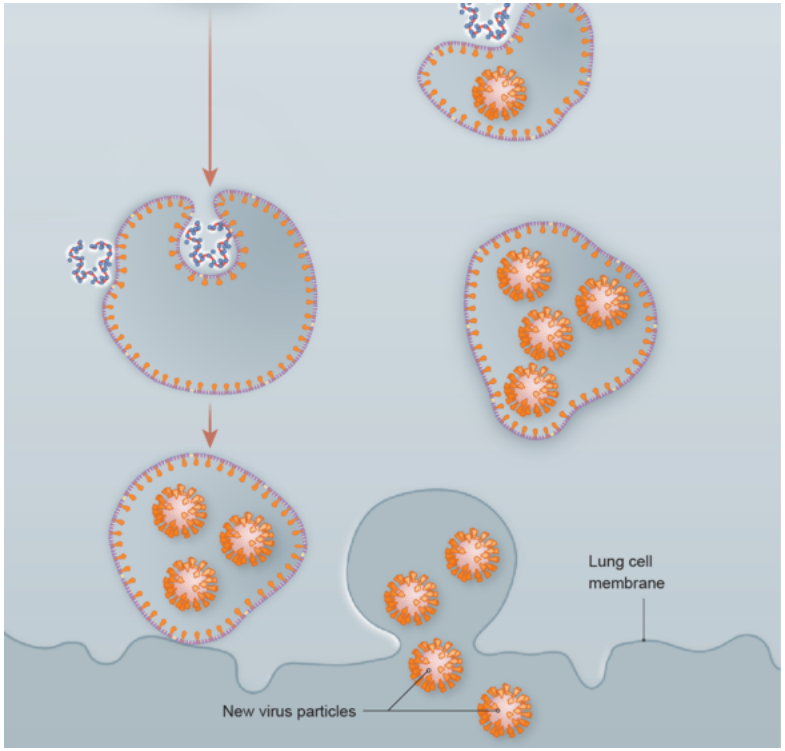
SARS-CoV-2 Then Reinfects

5) After about 10 h, viral particles are released from cell and attack new cells or are expelled. The cell either dies or is killed by immune cells



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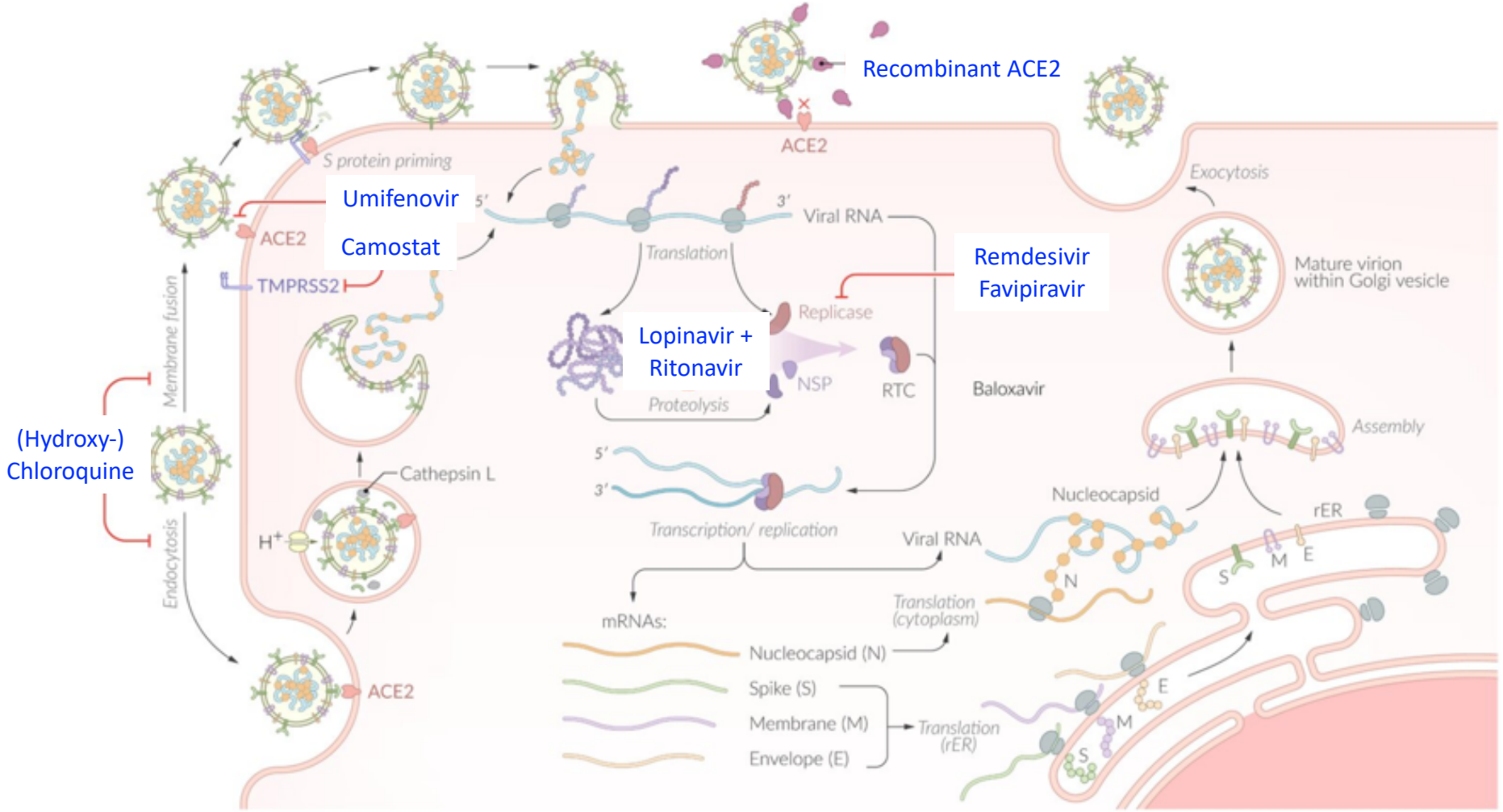
Knowledge of the viral replication mechanism reveals targets for drug development

Inhibitors could target:

- Viral proteins
- Viral protein/host cell interactions
- Viral biogenesis and export processes

Viral Propagation Steps - Targets for Biotechnology



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Conclusions

- SARS-CoV-2 identified in January 2020
- Good understanding of its life cycle is important:
  - Exploit existing drugs
  - Identify new drug targets

Thank You and Stay Safe

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