The SARS-CoV-2 Pandemic: why it happened, how it is unique, and what we can all do to help limit the spread of this virus

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The purpose of this article is to provide you with accurate information on the SARS-CoV-2 pandemic including why it happened, how it is unique, and what we can all do to help limit the spread of this virus. There is an overwhelming amount of information published daily on SARS-CoV-2. Not all of it is true. I have tried to cover some key aspects; that said, so much information is being released daily that I may have missed something. For this reason, I have also included some reliable resources for you. If you have questions, comments, or want to know more, please contact me by email at: jennifer.corcoran@ucalgary.ca

Why did the SARS-CoV-2 pandemic happen?

SARS-CoV-1, MERS-CoV, and SARS-CoV-2 are all recent zoonotic viruses that have emerged from bats. Bats harbor many thousands of coronaviruses. SARS-CoV-1 and MERS used the intermediate hosts, civet cats and camels, respectively, to transfer from bats to humans. The intermediate host for SARS-CoV-2 is unclear, but some reports suggest it may be pangolins (not yet proven though). This is not the last of these viruses to emerge, and sadly this is not a surprise to many scientists who predicted that bat coronaviruses were poised for human emergence.

- Menachery *et al.* 2016. PNAS 113(11): 3048-3053
- Menachery *et al.* 2015. Nat. Medicine. 21(12): 1508
- Andersen *et al.* 2020. Letter to Nature Medicine https://doi.org/10.1038/s41591-020-0820-9
- Lam *et al.* 2020. Identifying SARS-CoV-2 related coronaviruses is Malayan pangolins. https://doi.org/10.1038/s41586-020-2169-0

Why is SARS-CoV-2 worse than SARS-CoV-1 in 2003?

To combat SARS-CoV-1, the spillover reservoir (civet cats) was culled. Here, the reservoir is unclear and has not yet been targeted. SARS-CoV-1 transmission in North America was limited primarily to hospitals versus SARS-CoV-2 which shows widespread community transmission. For SARS-CoV-1, transmission did not occur until 24-36 hours after symptoms appeared and there were few/no asymptomatic cases. SARS-CoV-2 transmits before symptoms occur and perhaps from asymptomatic carriers.

- Kelvin and Halperin. 2020. Comment in Lancet Infectious Diseases https://doi.org/10.1016/S1473-3099(20)30198-5
- Li *et al.* 2020. Science. 10.1126/science.abb3221

How infectious is SARS-CoV-2?

For seasonal influenza virus, every 1 person will infect ~1.4 others. For SARS-CoV-2, every 1 person will infect ~3 others. This does not sound like a big difference, but for exponential growth, it is.

One of the following references showed that the virus can persist on surfaces and be aerosolized. But to my knowledge, there is no evidence that the virus is actually transmitted from person-to-person via aerosols; rather, it is transmitted via droplets from a nearby infected person. It also survives on surfaces for hours-days depending on the material.

- Doremalen *et al.* 2020. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. New Engl. J. Med. Letters to the Editor doi: 10.1056/NEJMc2004973
- Ong *et al.* 2020. Air, surface environmental and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 from a symptomatic patient. JAMA Letters to the Editor. doi:10.1001/jama.2020.3227

Why is SARS-CoV-2 extremely pathogenic in some people but not others?

Reports based on SARS-CoV-1, and more recently on SARS-CoV-2, suggest that the initial interferon response, if early and robust, can control viral load. If this response is delayed, viral replication is pronounced, and the delayed interferon response initiates a pathological cytokine storm resulting in more severe symptoms. There are already many people researching this phenomenon and asking how we can boost early immune responses and limit the magnitude of pathological inflammation in severely ill patients.

- Channappanavar *et al.* 2016. Dysregulated type I interferon and inflammatory monocyte-macrophage responses cause lethal pneumonia in SARS-CoV-infected mice. Cell Host Microbe. 19: 181-193.
- Chen *et al.* 2020. Clinical and immunologic features in severe and moderate coronavirus disease 2019. J. Clin Invest. https://doi.org/10.1172/JCI137244.
- Pedersen and Ho. 2020. SARS-CoV-2: A storm is raging. J. Clin. Invest. https://doi.org/10.1172/JCI137647.

What about testing?

See the following review to learn about testing.

- Patel *et al.* 2020 Report from the ASM COVID-19 international summit, 23 March 2020: Value of diagnostic testing for SARS-CoV-2/COVID-19. mBio DOI: 10.1128/mBio.00722-20

What can *you* do to help?

Many of us are asking what we can do to help. For trained scientists with lab experience, it can be unfulfilling to sit at home writing a review when there is a viral pandemic. But the reality of the situation is that the best way to reduce the spread of this virus is for most of us to stay home.

1. Social distancing. Number one. Do not socialize with friends or host parties at your house. Do not go visit your Grandma. Social distancing will save many lives by flattening the curve allowing our health care system to be able to handle the patients that require hospital care.

2. As scientists, please model social distancing behavior to others and teach why it is important to your families and friends that may not appreciate its importance.

> *How long will we need to practice this?*
> See Ferguson *et al.* Impact of non-pharmaceutical interventions to reduce SARS-CoV-2 mortality and healthcare demand. Mar 16, 2020.
>
> See Walker *et al.* The global impact of SARS-CoV-2 and strategies for mitigation and suppression. Mar 26, 2020. Both published by Imperial College COVID-19 Response Team.)

3. Don't spread misinformation. There are a lot of reliable sources out there for SARS-CoV-2 including the links in this article; however, there is a lot of information out there right now that is either preliminary or untrue. Check the validity of articles that you read as best you can. You can also feel free to contact me by email.

4. Wash your hands. Don't touch your face. When you do go out to get necessities, stay 6 feet away from other people.

5. If you feel sick, stay home.

6. Volunteer to deliver groceries/essentials to those who are sick/isolated/elderly.

7. Donate lab PPE to public health labs or hospitals. Donate reagents to testing labs.

8. Add your name to a volunteer list to help perform SARS-CoV-2 testing, perform contact tracing etc. CSM has set up a volunteer list. If labs become overwhelmed this may be required. https://cumming.ucalgary.ca/volunteer

9. Check out this website for SARS-CoV-2 resources in Canada for both researchers and clinicians. Set up by a lab in Toronto.
https://covid19resources.ca/

Other useful resources and information about SARS-CoV-2 provided by scientists:

A podcast about viruses called *This Week In Virology* hosted by Dr. Vincent Racaniello (Columbia Univ.) often with Drs. Alan Dove and Rich Condit

- several recent episodes about SARS-CoV-2 including this one: http://www.microbe.tv/twiv/twiv-592/

YouTube lecture on the molecular virology of coronaviruses by Dr. Britt Glausinger

- https://www.youtube.com/watch?v=8_bOhZd6ieM&feature=youtu.be

Dropbox of coronavirus publications created by Dr. Sachin Shah at UCSF

- https://ucsf.app.box.com/s/2laxq0v00zg2ope9jppsqtnv1mtxd52z

Benhur Lee's Lab is writing daily posts about SARS-CoV-2

- https://leelabvirus.host/covid19

Gordon *et al.* 2020 A SARS-CoV-2-Human Protein-Protein Interaction Map Reveals Drug Targets and Potential Drug Repurposing. bioRxiv preprint

- https://doi.org/10.1101/2020.03.22.002386

Bao *et al.* 2020. The pathogenicity of SARS-CoV-2 in hACE2 transgenic mice. bioRxiv preprint

- https://doi.org/10.1101/2020.02.07.939389

Glossary of Terms

Coronaviruses = the viral family. There are many coronaviruses in animals and 7 known coronaviruses that infect humans. 4 of these cause 'common cold' symptoms. 3 are more severe.

SARS-CoV-2 = the official name of CoVID-19, the virus that emerged in late 2019.

SARS-CoV-1 = the official name of the SARS virus that emerged in late 2002.

MERS-CoV = Middle Eastern respiratory syndrome virus, another recently emerged coronavirus (2011) that causes severe respiratory disease.