



The COVID-19 Pandemic: Science 101

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The COVID-19 pandemic imposes extraordinary circumstances upon all of us. Beyond all the appropriate measures taken by Fasken to safeguard the health of its employees and business partners, it is important that each of us have access to reliable and easy-to-understand information about the scientific aspects of this crisis.

In this context, our **Intellectual Property Group**, which includes a great number of professionals holding B.Sc., M.Sc. and Ph.D. degrees in life sciences such as in microbiology, immunology, biochemistry and molecular biology gathered together – virtually of course – and prepared a Q&A, based on the questions they received most frequently from their children, parents and friends, to provide easy understanding of the basic science behind the COVID-19 pandemic.

Please note that the following information is provided for education purposes only and, as the situation is changing constantly, it is accurate to the best of our knowledge, as of March 25, 2020. The information provided here is not intended to be legal advices nor health advices. Any health concerns in connection with COVID-19 should be brought to the attention of a qualified health specialist.

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1. WHAT IS A VIRUS?

A virus is small infectious agent that can multiply only in living cells. Viruses are composed of a small piece of genetic material (DNA or RNA) surrounded by a protein shell. Once a virus enters a living cell (the host cell) it takes over the cell's inner workings such that the cell cannot carry out its normal life-sustaining tasks. The host cell becomes a virus manufacturing plant, making viral parts that then reassemble into multiples copies of the virus which then go on to infect other cells. Eventually, the host cell dies. A virus is the smallest of infectious microbes, smaller than a fungi or a bacteria.¹

¹ <https://www.health.harvard.edu/diseases-and-conditions/coronavirus-resource-center>

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2. WHAT IS CORONAVIRUS?

Coronaviruses (CoV) are a large family of viruses that spread from animals to humans and include diseases like Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). They are so named because they comprise “spike” proteins which, when viewed under an electronic microscope, looks somewhat like a crown (“corona” in latin).

3. WHAT IS COVID-19?

COVID-19 is a new discovered infectious disease caused by a virus name SARS-CoV-2 or nCoV-2019. This new virus and disease were unknown before the outbreak began in Wuhan, China, in December 2019².

4. WHY IS THE WORLD SO CONCERNED WITH COVID-19?

Scientists are concerned as the disease is caused by a virus newly emerged in humans, the world’s population is completely immune-naïve and therefore vulnerable.

The virus is also contagious such that transmission can be massive in a short period of time with thousands of new patients diagnosed daily.

For instance, the basic reproduction number, also called the R-nought value, is the expected number of individuals who can catch the virus from a single infected person. For COVID-19, the R-nought value is estimated to be between 2 and 2.5, at the moment, meaning that each infected person will infect 2-2.5 more persons. This is worse than the 2009 H1N1 virus (the mean R-nought value was 1.46) or the seasonal flu (R-nought of about 1).³

The virus is also lethal in some instances. Though the death rate for COVID-19 is unclear, most research suggests it is higher than that of the seasonal flu (typically around 0.1%)⁴. Estimates of 2–3% are commonly reported⁵. The percentage of mortality greatly varies by age segment and by countries, with elderly being the most at risks. For instance, Italy is reporting a death rate of 7.2% (compare to 2.3% in China), likely because of a relatively high proportion of older people⁶.

The good news is that the actual percentage of infected people who die from the disease (the death rate) are likely presently lower than the 2–3% estimates commonly reported. That is because the number of infected people is much larger than the number tested and reported⁷.

It is estimated that the majority of infections (80%) are mild (with flu-like symptoms) and can recover at home, about 14% are severe, developing severe diseases including pneumonia and shortness of breath and about 5% are critical (e.g. respiratory failure, septic shock, and multi-organ failure)⁸.

² World Health Organization, March 19, 2020 (<https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>)

³ Livescience.com, March 18, 2020 (<https://www.livescience.com/covid-19-pandemic-vs-swine-flu.html>)

⁴ Livescience.com, March 19, 2020 (<https://www.livescience.com/new-coronavirus-compare-with-flu.html>)

⁵ As of March 23, 9:31:51 am there were 15 374 deaths, 351 731 confirmed cases and 100 430 recovered according to the data provided by Johns Hopkins University (<https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6>).

⁶ Center for Infectious Disease Research and Policy (CIDRAP) (<http://www.cidrap.umn.edu/news-perspective/2020/03/italian-doctors-note-high-covid-19-death-rate-urge-action>)

⁷ Figure and information obtained from article published by Humanprogress.org on March 02, 2020 (<https://humanprogress.org/article.php?p=2472>)

⁸ <https://www.worldometers.info/coronavirus/coronavirus-symptoms/#mild>

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5. WHAT IS A PANDEMIC, AND WHAT IS THE DIFFERENCE WITH AN EPIDEMIC?

According to the website of the United States Center for Disease Control and Prevention (the “CDC”), the level of a spreading of a disease comprises multiple levels. When a specific disease is typically observed in a community under normal conditions, it is referred to as the **endemic** level. When the incidence of disease rises above the observed endemic level, this is typically referred to as an **epidemic** or, in some cases, an **outbreak** where the incidences are restricted to a limited geographic area. **Pandemic**, on the other hand, refers to an epidemic that has spread over multiple geographic areas, such as multiple countries or continents⁹.

6. HOW DOES THE VIRUS SPREAD?

The virus is thought to spread mainly between people who are in close contact with one another (within about 1-2 meter or 3-6 feet). Respiratory droplets produced when an infected person coughs or sneezes can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. You can also get infected if you touch your eyes, nose, and mouth with your contaminated hands¹⁰.

Preliminary studies suggest the COVID-19 virus may persist on surfaces for a few hours or up to several days¹¹. That is another reason to **wash your hands** frequently since you may have touched surfaces contaminated with live viruses (handle door, elevator button, counter, etc.).

7. HAND SANITIZER OR SOAP AND WATER? WHAT WORKS BEST? IS LYSOL AND SIMILAR PRODUCTS EFFECTIVE?

Coronaviruses are enveloped viruses. This means they are one of the easiest types of viruses to kill. To protect yourself you should **wash your hands** often with soap and water for at least 20 seconds especially after you have been in a public place. To protect others, you should also **wash your hands** after blowing your nose, coughing, or sneezing.

If soap and water are not readily available, **use a hand sanitizer that contains at least 60% alcohol** such as Purell® or the like. Cover all surfaces of your hands and rub them together until they feel dry¹².

If you think a surface may be infected, clean it with simple disinfectant to kill the virus. Health Canada has approved several hard-surface disinfectants for use against COVID-19. The list is available here: <https://www.canada.ca/en/health-canada/services/drugs-health-products/disinfectants/covid-19/list.html>

8. WHO IS AT RISK? WHY?

As indicated in Question 4, this is a novel virus everyone is at risk.

⁹ United States Center for Disease Control and Prevention (CDC): <https://www.cdc.gov/csels/dsepd/ss1978/lesson1/section11.html>

¹⁰ WHO : <https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>

¹¹ WHO : <https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>

¹² CDC : <https://www.cdc.gov/coronavirus/2019-ncov/prepare/prevention.html>

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However, older persons and persons with pre-existing medical conditions such as high blood pressure, heart disease, lung disease, cancer or diabetes appear to develop serious illness more often than others¹³. As indicated above at Question 4, older people are most at risk to die from COVID-19. However younger adults should take the disease seriously since more and more analysis show that healthy younger adults also experienced severe cases of the disease and required hospitalization^{14, 15}.

9. HOW DO I KNOW IF I HAVE COVID-19? WHAT ARE THE SYMPTOMS?

The most common symptoms of COVID-19 are fever, tiredness, dry cough and difficulty breathing. Some patients may have aches and pains, nasal congestion, runny nose, sore throat or diarrhea. These symptoms are usually mild and begin gradually. Accumulating evidences also suggest that lack of taste and/or smell may also be symptoms of a COVID-19 infection¹⁶. Some people become infected but don't develop any symptoms and don't feel unwell. Most people (about 80%) recover from the disease without needing special treatment.¹⁷

10. WHAT SHOULD I DO IF I HAVE SYMPTOMS?

Each province has its own procedure.

If you have a cough or fever the Government of **Québec** recommends the following :

- Call 1-877-644-4545
- Do not go to a medical clinic unless you have first obtained an appointment.
- Visit the emergency room only if you have difficulty breathing.
- Before you go to the emergency department, contact 1-877-644-4545 if your condition allows it. If you are a traveller who has returned within less than 14 days, mention it. You will be given directions and told what precautions to take, such as wearing a mask, using personal transportation or an ambulance, and so on. Moreover, the hospital will be notified of your arrival.

Ontario: <https://www.publichealthontario.ca/en/diseases-and-conditions/infectious-diseases/respiratory-diseases/novel-coronavirus>

British Columbia: <https://www.healthlinkbc.ca/health-feature/coronavirus-disease-covid-19>

Alberta: <https://www.albertahealthservices.ca/topics/Page16944.aspx>

Manitoba: <https://www.gov.mb.ca/covid19/>

Saskatchewan: <https://www.saskatchewan.ca/government/health-care-administration-and-provider-resources/treatment-procedures-and-guidelines/emerging-public-health-issues/2019-novel-coronavirus>

Prince Edward Island: <https://www.princeedwardisland.ca/en/information/health-and-wellness/covid-19-faqs>

Newfoundland and Labrador: <https://www.health.gov.nl.ca/health/publichealth/cdc/coronavirus/>

¹³ WHO : <https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>

¹⁴ Science News, March 19, 2020 : <https://www.sciencenews.org/article/coronavirus-covid19-young-adults-can-face-severe-cases>

¹⁵ The New York Times, March 23, 2020 : <https://www.nytimes.com/2020/03/23/opinion/coronavirus-young-people.html>

¹⁶ American Academy of Otolaryngology-Head and Neck Surgery, March 22, 2020 : <https://www.entnet.org/content/aao-hns-anosmia-hyposmia-and-dysgeusia-symptoms-coronavirus-disease>

¹⁷ WHO : <https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>

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New Brunswick:

https://www2.gnb.ca/content/gnb/en/departments/ocmoh/cdc/content/respiratory_diseases/coronavirus.html

Nova Scotia: <https://novascotia.ca/coronavirus/>

Yukon: <https://yukon.ca/en/information-about-novel-coronavirus-yukoners>

North West Territories: <https://www.hss.gov.nt.ca/en/services/coronavirus-disease-covid-19>

Nunavut: <https://www.gov.nu.ca/health/information/covid-19-novel-coronavirus>

11. ARE THERE TREATMENTS AVAILABLE?

No drugs have been approved by health authorities yet.

However, the broad-spectrum antiviral Remdesivir, which was first developed by US drug firm Gilead to treat Ebola, is being tested in five COVID-19 clinical trials including by the US National Institutes of Health (NIH). On March 18, 2020 it was reported that a 79-year-old Italian man was successfully treated with the experimental drug¹⁸.

The anti-viral drug chloroquine, which has been approved for the treatment of malaria, is also being investigated for COVID-19^{19, 20}, so is colchicine, an anti-inflammatory drug used especially in the treatment of gout.²¹

Also, many studies are ongoing to identify existing drugs that could address complications associated with COVID-19. For instance, the Montreal Heart Institute just started a clinical study on the use of colchicine to see if it can mitigate inflammation of the lungs and reduce the risk of serious pulmonary complications and death^{22, 23}.

12. WHAT IS THE DIFFERENCE BETWEEN A VACCINE AND ANTIBIOTICS?

An antibiotic is a drug used to treat bacterial infections. Antibiotics have no effect on viral infections²⁴.

Vaccines are one of the most effective ways to prevent diseases. Vaccination greatly reduces disease, disability, death and inequity worldwide²⁵ and over the years, vaccines have prevented countless cases of disease and saved millions of lives²⁶. Unfortunately there exist an harmful anti-vaccine sentiment in the population such that the World Health Organization recently declared that "vaccine hesitancy," was one of the top 10 threats to global health of 2019 along with other threats such as air pollution, climate change, Ebola, and ... a global pandemic²⁷!

¹⁸ <https://www.telegraph.co.uk/news/2020/03/18/coronavirus-cure-hope-79-year-old-italian-man-successfully-treated/>

¹⁹ <https://www.inverse.com/mind-body/chloroquine>

²⁰ https://www.mediterranee-infection.com/wp-content/uploads/2020/03/Hydroxychloroquine_final_DOI_IJAA.pdf

²¹ <https://www.lapresse.ca/covid-19/202003/22/01-5265931-des-chercheurs-quebecois-testeront-un-medicament-contre-les-complications-graves.php>

²² <https://montrealgazette.com/news/local-news/covid-19-clinical-study-launched-in-canada-to-test-the-effectiveness-of-existing-drug/>

²³ <https://www.colcorona.org/index.php?lang=en>

²⁴ <https://www.medicinenet.com/script/main/art.asp?articlekey=8121>

²⁵ <https://www.who.int/bulletin/volumes/86/2/07-040089/en/>

²⁶ <https://www.cdc.gov/vaccines/vac-gen/howvpd.htm>

²⁷ <https://www.who.int/news-room/feature-stories/ten-threats-to-global-health-in-2019>

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A vaccine is a biological preparation that provides active acquired immunity to a particular infectious disease²⁸. It stimulates an immune response in the body to prevent future infection with similar microorganisms. These preparations are usually delivered by injection²⁹. Once the vaccine is introduced, your body's immune system "learns" to produce antibodies and is able to respond by attacking the virus. Thanks to the acquired immunity generated by the vaccine, when the real virus enters your body it will be quickly targeted by your immune system to prevent the disease.

Currently, no approved vaccines exist to prevent infection with SARS-CoV-2, the virus causing COVID-19.

Human clinical trials on vaccine started March 16, 2020 in the US³⁰ and in China³¹. Even if everything goes well, a vaccine will not be available for widespread use for 12-18 months.

13. HOW LONG COULD A VACCINE TAKE TO DEVELOP?

There is currently no vaccine against SARS-CoV-2, the virus causing COVID-19. Industry experts expect that many vaccine candidates will need to be tested before we can identify one vaccine that is safe and effective.

The development process typically follows the following steps: exploratory, pre-clinical (animal testing), clinical, regulatory approval, manufacturing and quality control. Clinical development is the most critical and longest part. It first involves testing a vaccine candidate's safety on a small group of volunteers, then testing its safety and efficacy on progressively larger and more diverse groups of people. Of course, such testing may reveal that the vaccine candidate is not safe or ineffective. Next, the data demonstrating the vaccine's safety and efficacy are submitted to national regulatory authorities, who may approve the vaccine for sale if the data are adequate. It is only once the vaccine is considered safe and effective that it is approved for mass-production and for distribution for vaccinating populations.

Human clinical trials on a COVID-19 vaccine started March 16, 2020 in the US and in China. Overall, experts expect that it will take 12 to 18 months for a vaccine to be widely available.

14. WHAT CAUSES A VIRUS TO DISAPPEAR?

If sick people can be stopped from infecting healthy people, the disease will eventually die off. This is one of the reasons why infected people are isolated and social distancing is important.

It is possible that COVID-19 will never disappear entirely and always persists in someone somewhere (see Question 16).

15. WHY ARE WE ASKED TO STAY HOME? QUARANTINE VS SOCIAL DISTANCING?

As mentioned in Question 4 the virus causing COVID-19 is quite contagious. Quarantine and social distancing both prevent transmission of the disease.

²⁸ <https://en.wikipedia.org/wiki/Vaccine>

²⁹ <https://www.medicinenet.com/script/main/art.asp?articlekey=8121>

³⁰ Source: Apnews.com: see <https://bit.ly/3dhLmPm>

³¹ <https://www.clinicaltrialsarena.com/news/china-launches-coronavirus-vaccine-clinical-trials/>

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Preventing, or at least slowing, transmission of the disease will also avoid having massive number of people being infected in a short period of time. The capacity of the health care system is limited and can only provide for a limited number of patient simultaneously. That is why authorities have taken measures to achieve what is called a “flattening of the curve” (see **Figure 1** below).

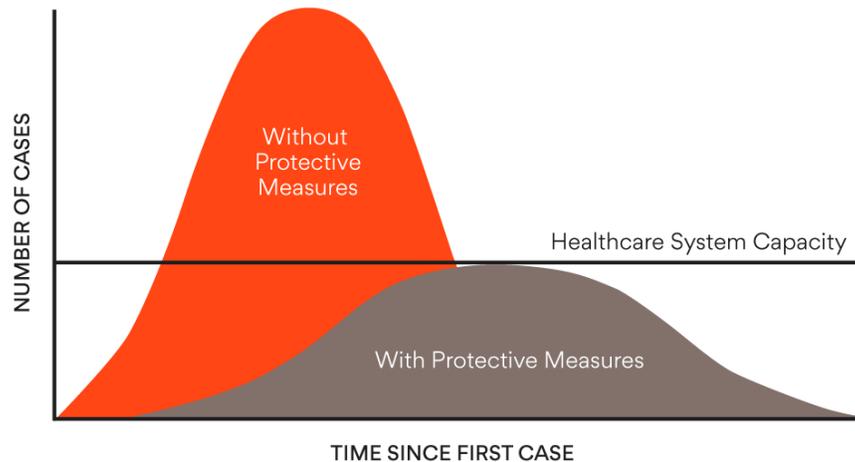


Figure 1: Graph illustrating why protective measures must be taken to avoid overwhelming the healthcare system.

16. HOW LONG CAN WE EXPECT THIS PRESENT SITUATION TO LAST? WHEN WILL THE CORONAVIRUS PANDEMIC END?

No one really know. Most likely, the situation will last at least for a few months. It will ultimately depend on containment efforts³².

It is possible that COVID-19 will never disappear entirely, surviving somewhere waiting to resurface. Spreading of the virus should become less and less common through accumulating herd immunity and future vaccination. It is possible that COVID-19 may become, like the flu, a recurring seasonal disease against which we make a vaccine every year³³.

USEFUL LINKS:

- Government of Canada: <https://www.canada.ca/en/public-health/services/diseases/coronavirus-disease-covid-19.html>
- Official site of the Gouvernement of Quebec: <https://www.quebec.ca/sante/problemes-de-sante/a-z/coronavirus-2019/>
- World Health Organization (WHO): <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>
- Centers for Disease Control and Prevention (CDC): <https://www.cdc.gov/coronavirus/2019-ncov/index.html>

³² <https://www.zmescience.com/medicine/how-long-will-the-coronavirus-pandemic-last/>

³³ <https://www.theatlantic.com/health/archive/2020/03/how-will-coronavirus-end/608719/>

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DASHBOARDS OF DISEASE PROGRESSION AND CURRENT SITUATION:

- John Hopkins University:
<https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6>
- Worldometer: <https://www.worldometers.info/coronavirus/>
- World Health Organization (WHO):
<https://experience.arcgis.com/experience/685d0ace521648f8a5beeeee1b9125cd>
- Province of Québec:
<https://www.quebec.ca/sante/problemes-de-sante/a-z/coronavirus-2019/situation-coronavirus-quebec/>
- Canada:
<https://www.canada.ca/en/public-health/services/diseases/coronavirus-disease-covid-19.html>

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- Fasken Employee Portal: <https://faskenmartineau.sharepoint.com/sites/covid-19>
- Fasken Knowledge Center: <https://www.fasken.com/en/knowledgeCovid-19>

AUTHORS

- **Jean-Raphaël Champagne**, M.Sc. Molecular Biology, Québec City
- **Richard Cheung**, PhD Pharmaceutical Sciences, Toronto
- **Michael Gardiner**, B.Sc. Biochemistry, Montréal
- **Patricia Hénault**, B.Sc. Pharmacology and Therapeutics, Montréal
- **Joanie Lapalme**, M.Sc. Molecular Biology, Montréal
- **Serge Lapointe**, Ph.D. Reproductive Biology, Montréal
- **David McLauchlan**, B.Sc. Biochemistry, M.Sc. Experimental Medicine, Montréal
- **Mark Penner**, M.Sc. Immunology, Toronto
- **David Turgeon**, B.Sc. Microbiology, Ph.D. Physiology-Endocrinology, Montréal
- **Mark Vanderveken**, B.Sc. Biology, M.Sc. Environmental Physiology, Toronto



Jean-Raphaël Champagne

M.Sc. Molecular Biology

PARTNER

Québec

☎ +1 418 640 2084

✉ jchampagne@fasken.com

www.fasken.com/en/jean-raphael-champagne



Richard Y. Cheung

PhD Pharmaceutical Sciences

PARTNER

Toronto

☎ +1 416 865 5490

✉ rcheung@fasken.com

www.fasken.com/en/richard-cheung



Michael Gardiner

B.Sc. Biochemistry

ASSOCIATE

Montréal

☎ +1 514 397 7504

✉ mgardiner@fasken.com

www.fasken.com/en/michael-gardiner





Patricia Hénault

B.Sc. Pharmacology and Therapeutics
ASSOCIATE

Montréal

☎ +1 514 397 7488

✉ phenault@fasken.com

www.fasken.com/en/patricia-henault



Joanie Lapalme

M.Sc. Molecular Biology
PARTNER

Montréal

☎ +1 514 397 5294

✉ jlalpalme@fasken.com

www.fasken.com/en/joanie-lapalme



Serge Lapointe

Ph.D. Reproductive Biology
PARTNER

Montréal

☎ +1 514 397 5219

✉ slapointe@fasken.com

www.fasken.com/en/serge-lapointe



David McLauchlan

B.Sc. Biochemistry, M.Sc. Experimental Medicine
ASSOCIATE

Montréal

☎ +1 514 397 4353

✉ dmclauchlan@fasken.com

www.fasken.com/en/david-mclauchlan



Mark D. Penner

M.Sc. Immunology
PARTNER

Toronto

☎ +1 416 868 3501

✉ mpenner@fasken.com

www.fasken.com/en/mark-penner



David Turgeon

B.Sc. Microbiology, Ph.D. Physiology-Endocrinology
PARTNER | LEADER, INTELLECTUAL PROPERTY

Montréal

☎ +1 514 397 5222

✉ dturgeon@fasken.com

www.fasken.com/en/david-turgeon



Mark Vanderveken

B.Sc. Biology, M.Sc. Environmental Physiology
ASSOCIATE

Toronto

📞 +1 416 943 8927

✉ mvanderveken@fasken.com

www.fasken.com/en/mark-vanderveken