

A New York State of Mind: Transmission and Management of COVID-19

by

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Part I – A Quick Run to the Store (April 15, 2020)

“You know what I want right now?” asked Michelle, looking at Alex who sat next to her on the couch. “Some pickles and ice cream. Seriously, I want chocolate gelato and kosher dill spears, not sandwich slices,” she specified. He smiled at her. Even amidst the urging of local and federal governments to self-quarantine and practice social distancing due to the coronavirus pandemic, the cravings of a pregnant woman could not be abated.

Alex loved Michelle and wanted her to be happy and comfortable during her pregnancy. “I’ll be right back,” he said, grabbing his car keys from the hook by the door.

On the way out, Alex could hear Michelle yell after him, “Be careful. And get whatever you want from the store, too!”

Before leaving the apartment, he grabbed a face mask, the disposable kind that could be bought by anyone at the store. The new normal. Facemasks were required to go anywhere. Alex stretched the elastic loops of the mask around his ears, secured it to his face by pinching the bridge of his nose, and tucked the extra fabric under his chin. He was ready.

Since Alex and Michelle lived in an apartment, he had to walk a short distance to their assigned parking spot. On the way to his car, he saw a group of people having a conversation in the middle of the sidewalk. Hoping the group would notice him and move, Alex kept walking. At the last second, they finally stepped aside. “Social distancing and all that,” one of them said playfully as he walked past. “Achoo!” Alex heard one of them sneeze as he got into the car. *That was a close one*, he thought to himself.

During his drive to the store, Alex noticed that his fuel tank light was on. He pulled into a gas station across the street from the store and stopped in front of a vacant pump. He grabbed his wallet from his back pocket and pulled out his debit card. He inserted the card, typed in his PIN, and retrieved the gas nozzle from its holster to start pumping. Alex looked across the street to the store parking lot. Mumbling under his breath, Alex tried to gauge how many people might be shopping. As he was counting cars, a gust of wind blew dirt into his face. Reflexively, Alex started rubbing his eyes to clear the debris. *Click!* The pump automatically stopped as the gas tank reached capacity. He replaced the nozzle and made his way to the grocery store.

As Alex shopped, he decided to snag a bag of the cheesy popcorn that he knew Michelle would ask for later. *It’s important to limit trips in a pandemic*, Alex thought. After arriving back home, he took off his shoes and placed them by the door and went straight into the kitchen. There, he planted his foot on the trash can pedal and opened the lid. He removed his mask by grabbing the front and tugging so that the elastic loops fell from his ears. Alex immediately rubbed his nose to relieve himself of an itch. Finally, he washed his hands with soap and water before joining Michelle in the living room.

Five days later, Alex woke up with a dry cough and difficulty breathing. He simply did not feel well. After checking his temperature, it registered 101.2 °F.

Question

1. If Alex is infected, at what point(s) in time could this have happened?

Part II – Transmission of COVID-19 (April 22, 2020)

It had been one week since Alex went to the store. His condition had not improved at all. In fact, he felt like it might be getting worse. He no longer had a sense of smell and food just did not taste right. Alex thought to himself, *It's not looking good*. To be cautious, he slept separately from Michelle, trying to protect her and their unborn baby. Since he was still feeling unwell, Alex decided it was time to get tested. He quickly made an appointment and headed off to the testing center.

As a symptomatic patient, Alex was directed to a separate area from the rest of the public. He was met by a clinician wearing a N95 respirator, a protective face shield, gloves, and a gown. Seeing how the medical assistant was dressed increased his anxiety. *Surely*, he thought, *it could be the common cold or maybe even the flu? Any of these are better options than contracting COVID-19... What about Michelle and the baby?*

A nasal swab was inserted into his left nostril and moved in a wide circular motion for approximately 15 rotations. Alex's eyes immediately started tearing up. The medical assistant said, "Yep, that's how we know it's in the right spot. Hang in there, one more to go." Before he knew it, the test was done. The clinician said, "Your viral test results will be available in two to three days. Go home and continue to quarantine."

When Alex returned home, his worry still had not subsided. He decided to do some research to understand how COVID-19 spreads. He began his search on the website for the Centers for Disease Control and Prevention (CDC). There he learned that SARS-CoV-2 is the virus responsible for COVID-19 and is genetically similar to SARS-CoV-1, the causative agent of sudden acute respiratory syndrome (SARS). SARS-CoV-1 was first identified in February 2003 during an outbreak that originated in China and spread to two dozen countries, spanning across North America, South America, Europe, and Asia before the outbreak was contained (CDC, 2017). The SARS outbreak only lasted from November 2002 to July 2003, but caused 8,437 cases and 813 deaths, putting the fatality rate at 9.63% (World Health Organization [WHO], 2003). Alex also learned that as of April 22, 2020, there were already 47,000 cases of COVID-19 in the United States alone and nearly 183,000 cases worldwide (Reals *et al.*, 2020).

Based on data from previous SARS outbreaks, Alex decided that COVID-19 was likely spread person-to-person through respiratory droplets, which meant that facial masks, face shields, and social distancing should be effective strategies to reduce transmission (Jayaweera *et al.*, 2020). However, Alex still needed to run essential errands such as grocery shopping, banking, or getting gas, and he wasn't sure whether he could have contracted the SARS-CoV-2 virus from a grocery cart, a package, or some other hard surface during his trip to the store. To be well informed and to better protect his family, Alex found data examining the viability of SARS viruses on different surfaces (Figure 1).

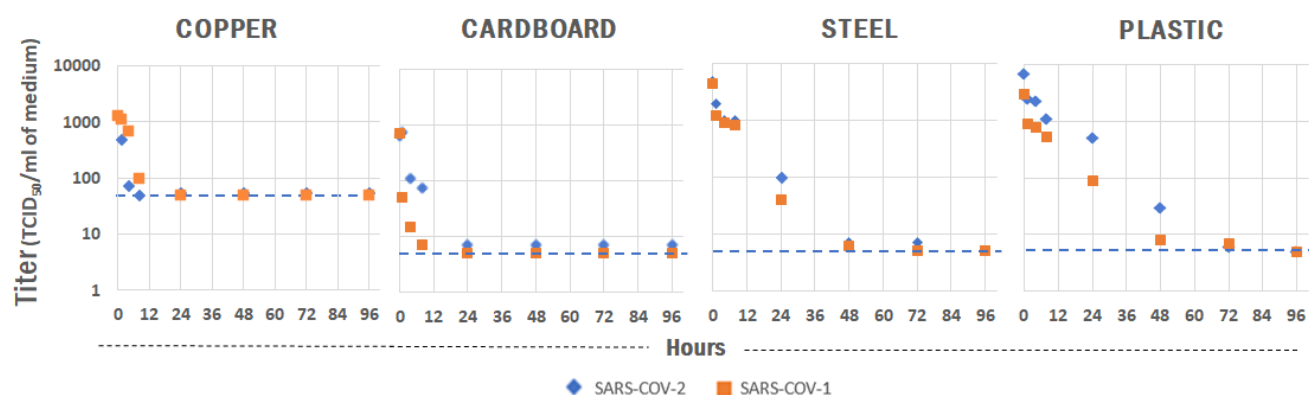


Figure 1. Viability of SARS-COV-2 versus SARS-COV-1 on surfaces. 50 microliters of 105 TCID₅₀/ml were added to copper, cardboard, steel, and plastic and extracted with 1 ml of media at 1, 4, 8, 24, 48, 72 and 96 hours post inoculation. (Adapted from van Doremalen *et al.*, 2020.)

First, Alex needed to understand how to interpret the data. He discovered that the median tissue culture infectious dose (TCID₅₀) is a method to determine the titer or amount of infectious viral particles present in a known volume of fluid capable of infecting half (50%) of the susceptible cells. The viral titer is counted by measuring the cytopathic effect, which is simply the cellular changes caused by viral infection (AJMC staff, 2021).

Questions

1. Based on the graphs in Figure 1, identify the earliest time point where no viral particles were detectable. Insert this data into Table 1 below. The dashed line on each graph is the limit of detection for each experimental condition.

Table 1. Viability of SARS-CoV-2 (COVID-19) versus SARS-CoV-1 on surfaces.

<i>Surface Tested</i>	<i>SARS-CoV-2 Time</i>	<i>SARS-CoV-1 Time</i>
Copper		
Cardboard		
Stainless Steel		
Plastic		

2. Based on the data recorded in Table 1, are there differences in viability of SARS-CoV-2 versus SARS-CoV-1 on surfaces? Justify your answer.
3. SARS-CoV-2 is spread by aerosolized droplets from person to person. Predict whether the results would have been different if the researchers had added the virus to surfaces using a nebulizer to aerosolize the inoculum rather than directly pipetting the broth to the surface. Why or why not?
4. Why are there so many more cases of SARS-CoV-2 than previously seen with other SARS viruses? Based on external research, are there any geopolitical issues that may have increased transmission? Give two or more reasons.

Part III – Mitigating the Damage

Individual states were responsible for establishing COVID-19 response plans (Washington Post staff, 2020). On March 19, 2020, California was the first state to announce a mandatory stay-at-home order; soon other states followed (AJMC staff, 2021). California also began opening workplaces, barber shops, and salons in May, a bit sooner than other states (Figure 2), whereas New York Governor Andrew Cuomo did not begin reopening the state until June (Figure 3).

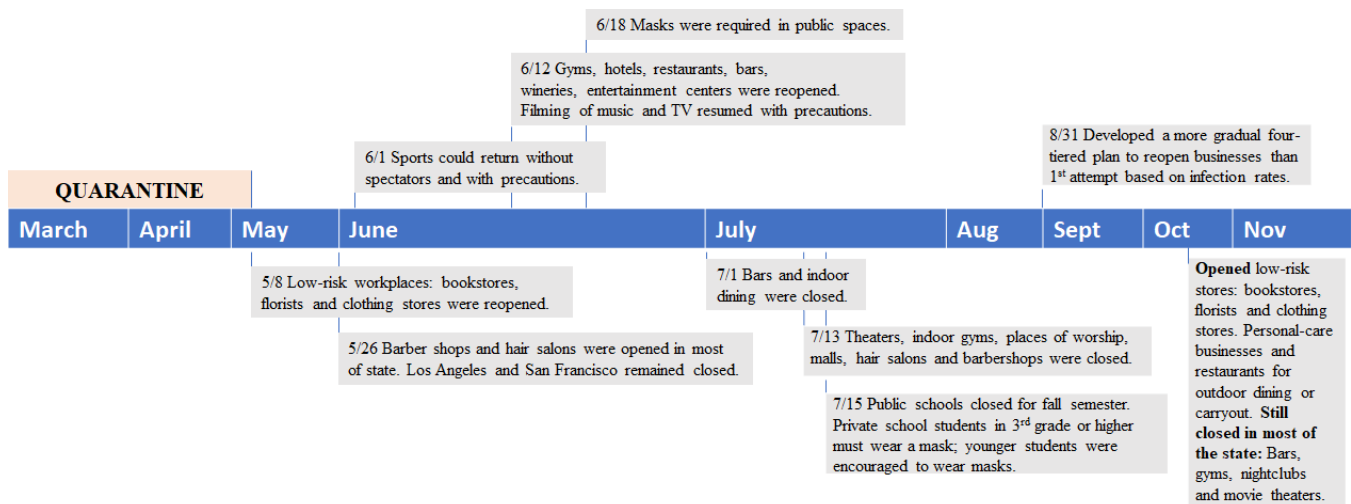


Figure 2. California Governor Gavin Newsom's response to COVID-19 from March-November 2020 (Washington Post staff, 2020).

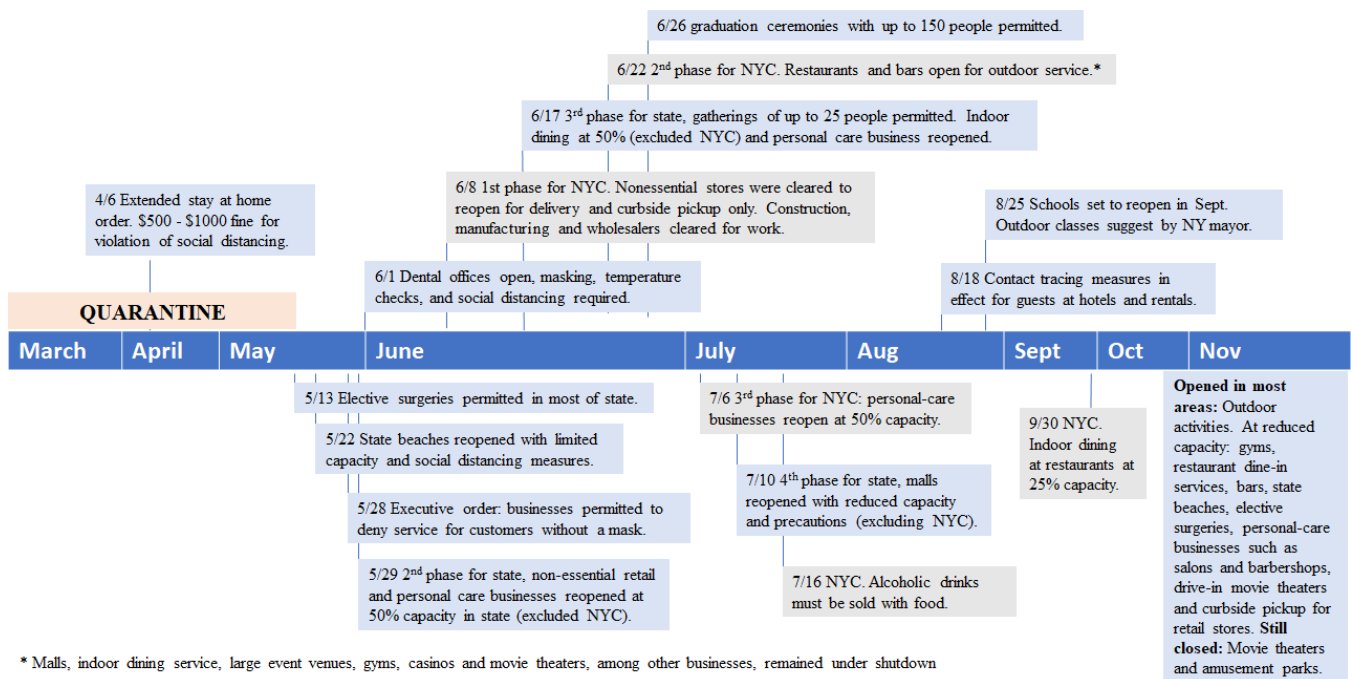


Figure 3. New York Governor Andrew Cuomo's response to COVID-19 from March-November 2020 (Washington Post staff, 2020).

On April 2, 2020, the world was in an uproar when a COVID-19 outbreak was associated with air conditioning in a restaurant in Guangzhou, China (Lu *et al.*, 2020). Previously it was understood that COVID-19 could be transmitted directly by respiratory droplets (often occurring within 3 feet), but this was the first piece of evidence demonstrating transmission through poor indoor ventilation from across a restaurant. Ten restaurant patrons from three families were infected despite being seated at neighboring tables (CDC, 2021). This evidence provided the premise for reducing the capacity in public spaces to allow for increased social distancing to reduce COVID-19 transmission. Only one day later, on April 3, 2020, the CDC officially recommended the use of masks in public (Brenan, 2020).

Questions

1. Examine the COVID-19 case counts for New York and California from March 15 to October 15, 2020 in Figure 4 below. What trends do you notice in the data?

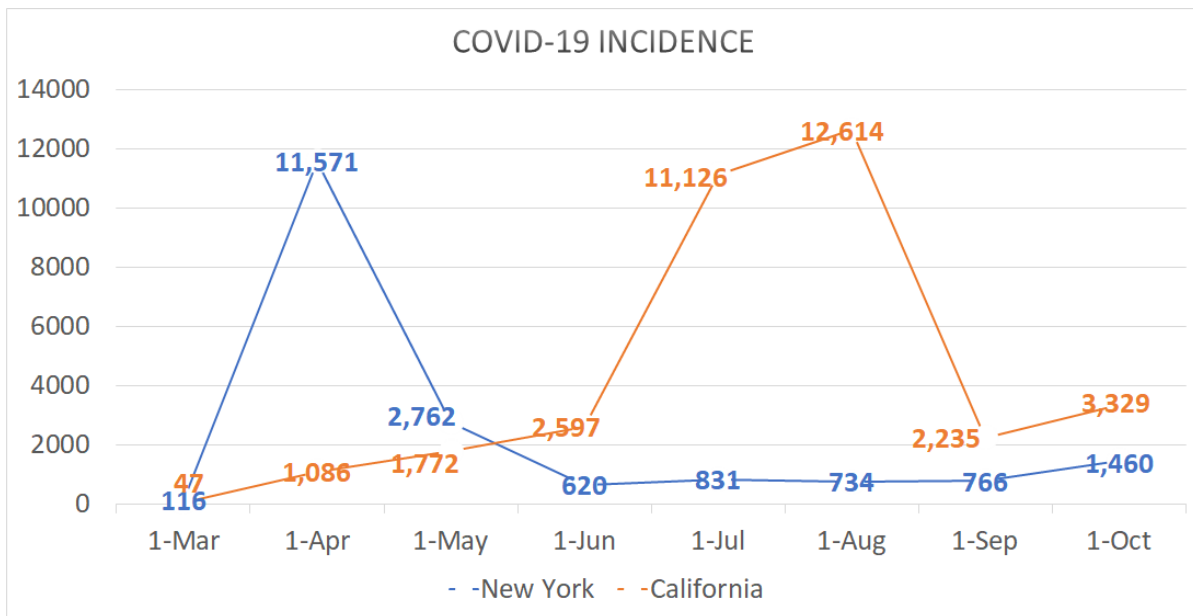


Figure 4. Incidence of COVID-19 cases in New York and California from March 15 through October 15, 2020 (Washington Post staff, 2020).

2. Insert case counts from Figure 4 into Table 2 below and correlate these numbers with the COVID pandemic response plan provided by California Governor Gavin Newsom in Figure 3. Keep in mind, the incubation period for SARS viruses is ~2–14 days. Actions taken two weeks prior have a delayed impact on COVID cases.

Table 2. California case counts and the preparedness actions responsible for the case count fluctuations over time.

Date	Number of COVID-19 Cases	California Governor's COVID Response
June 15 th		
July 15 th		
August 15 th		
September 15 th		

3. Insert case counts from Figure 4 into Table 3 and correlate these numbers with the COVID pandemic response plan provided by New York Governor Andrew Cuomo in the Figure 3 timeline. Remember, the incubation period for SARS viruses is ~2–14 days. Actions taken two weeks prior have a delayed impact on COVID cases.

Table 3. New York case counts and the preparedness actions responsible for the case count fluctuations over time.

<i>Date</i>	<i>Number of COVID-19 Cases</i>	<i>New York Governor's COVID Response</i>
April 15 th		
May 15 th		
July 15 th		
September 15 th		

4. Based on the data presented above, what is the most effective way to reduce the spread of COVID-19 or any other aerosolized, highly communicable infectious disease?
5. What has the trend in the number of COVID-19 cases in New York, California, or your state been in the past six months? Predict why these numbers have increased, decreased, or remained steady.

Closure

After learning that he had indeed tested positive, Alex continued to quarantine in the guest bedroom and bathroom. Since Michelle had potentially been exposed to the virus, she chose to remain at home for fear that she would infect her elderly parents or someone else. The couple navigated their home separately and Michelle cleaned continually.

After 14 days, Michelle still had not shown signs or symptoms; it was time for the couple to go back and be tested again for COVID-19. This time, both Alex and Michelle tested negative. Their family had made it safely to the other side.

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