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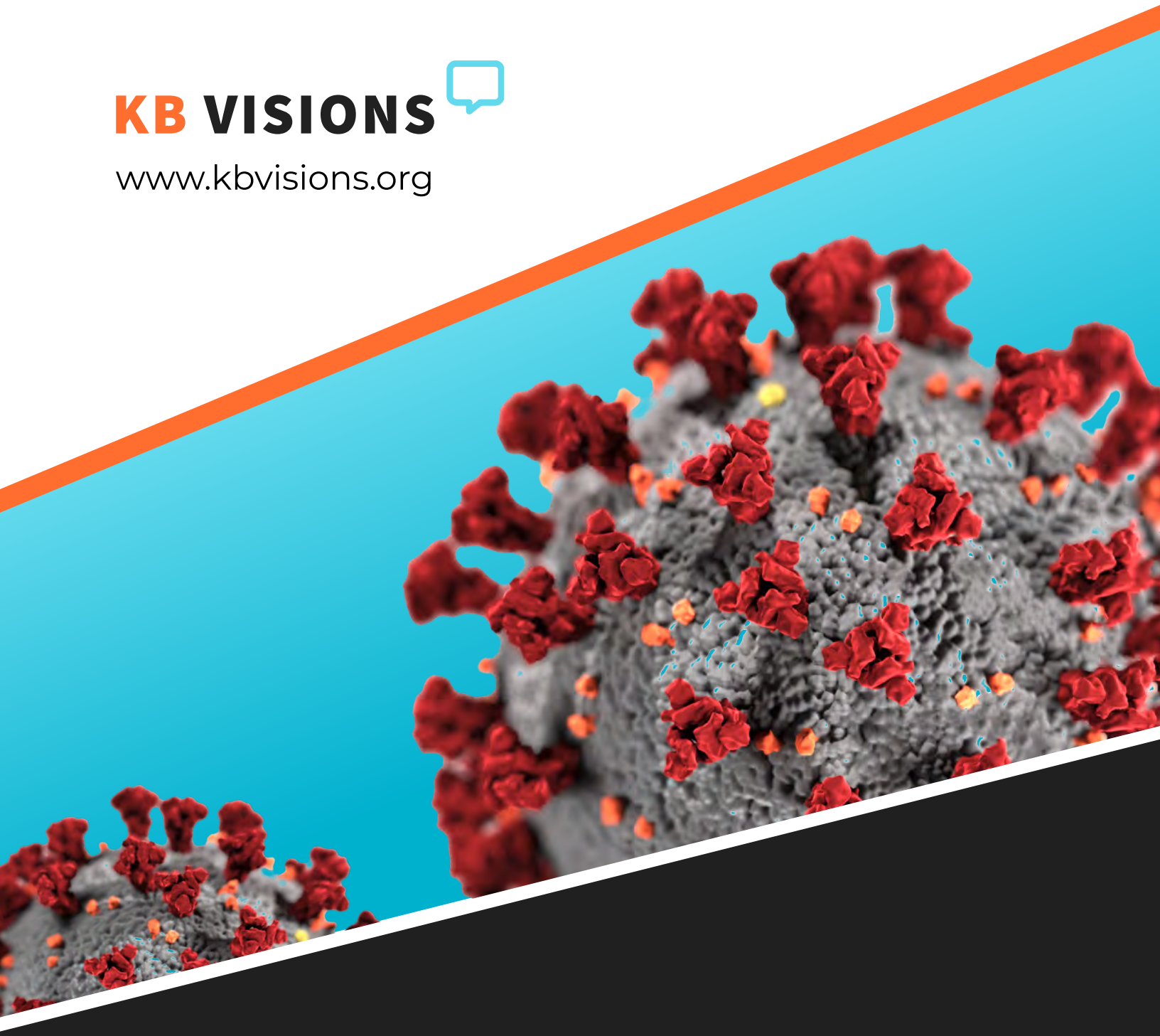

COVID-19: Transmission & Spread

“Don’t Touch Your Face” Campaign

WHITEPAPER, MAY 2020

Introduction

There are over 1.5 million viruses in wildlife that we do not know of yet. “Any one of those could be spilling into human population right now,” Zoologist and President of EcoHealth Alliance, Dr Peter Daszak, had said in a prescient statement in 2019 (Netflix 2020). When a virus jumps from an animal to a human, it is called a ‘zoonotic virus’. This specific kind of virus has been responsible for an increasing number of outbreaks, be it the Ebola virus, Marburg virus, severe acute respiratory syndrome coronavirus (SARS-CoV), Nipah virus and many others. These outbreaks have caused panic around the globe, and yet gaps remain in effectively identifying and addressing the spread of these viruses. This has become evident with the advent of COVID-19. The world hasn’t seen a pandemic like this in more than a century. The virus has affected all domains of life, and hence it is important to better understand this disease. So, what is this virus? How does it spread and what can be done to tackle an outbreak? This paper delves into these questions and provides recommendations based on insights from experts and early research findings into the COVID-19 pandemic.

To clarify, the official name of the virus causing this pandemic is ‘Severe Acute Respiratory Syndrome Coronavirus 2’ (SARS-CoV-2). The name of the disease caused by this virus is the ‘Coronavirus Disease 2019’ (COVID-19). The World Health Organization (WHO) explains that the reason for this naming choice was to avoid causing fear in certain populations. “From a risk communications perspective, using the name SARS can have unintended consequences in terms of creating unnecessary fear for some populations, especially in Asia which was worst affected by the SARS outbreak in 2003,” the organisation states (World Health Organization 2020). Judging by the magnitude of this epidemic, one must wonder if this is now a moot point. The

paper will continue to refer to the virus and disease as 'COVID-19' for the sake of easier reading.

What is COVID-19?

Regarding the virus itself, COVID-19 comes from a family of viruses called 'coronavirus'. Some of these viruses can cause illness in animals, while others can lead to illnesses in humans as well, hence the term 'zoonotic virus' is associated with it. Human coronaviruses are common and are often associated with mild illnesses, say the common cold. COVID-19, however, is a novel disease that has never been identified in humans before. Unlike its close relatives, COVID-19 can readily attack human cells at multiple points, with the lungs and the throat being the main targets. Genetic evidence suggests that this type of coronavirus has been hiding out in nature, possibly for decades (Cyranoski 2020).

In terms of how the virus interacts with the human host, a paper reveals that a virus surface spike protein mediates the SARS-CoV-2 entry into cells (Shang et al. 2020). "To fulfill its function, SARS-CoV-2 spike binds to its receptor human ACE2 (hACE2) through its receptor-binding domain (RBD) and is proteolytically activated by human proteases," Shang et al. elaborate in their paper. Simply put, this means that the spikes of the COVID-19 virus act as a grip, locking onto the proteins commonly found in the outer membrane of human cells. These very spikes also enable cell entry i.e. it allows the virus to enter the human cells and engage in viral replication, which is the process by which virus particles make new copies of themselves within a host cell. These copies then infect other cells, further spreading the virus in the body.

Transmissibility of COVID-19

These features of the virus enable it to be viral and evasive. It is reflected in the current R0 (pronounced 'R-Naught') value of COVID-19. The basic reproduction number (R0), also known as the 'basic reproduction ratio' or rate or the 'basic reproductive rate', is a metric used to describe the contagiousness or transmissibility of infectious agents. While this is a complex metric, it is also very useful to help model an outbreak's possible trajectory (Delamater et al. 2019). This value is affected by numerous biological, sociobehavioral and environmental factors that affect pathogen transmission. It is usually estimated by public health experts using various types of complex mathematical models (Delamater et al. 2019).

In terms of how exactly this metric works, if the R0 of a disease is 2.5, then one person with the disease is expected to infect, on average, 2.5 others. A New York Times report explains that R0 is calculated from the "innate features of a disease, like how easily it jumps from one person to the next, along with elements of human behavior that shape how often sick and susceptible people will come into contact" (Fisher 2020). The report and aforementioned study caution that there is no such thing as a fixed R0. "It's better to think of this number as a starting point for the virus's behavior in the absence of real-world human or environmental factors," Fisher reports. As of April 2020, studies have estimated that the pathogen that causes Covid-19 has an R0 of 2 to 2.5 (Fisher 2020). This is pretty contagious, and unlike initial statements by world leaders and pandemic sceptics, the spread of this virus is significantly higher than the flu.

Another aspect of this metric is the 'serial interval' of the virus. Unlike the R0 value, this unit is fixed. It is calculated to know how quickly a virus spreads; i.e. the average time estimated between each successive infection is

considered its serial interval. Early research findings show a range of results, from 4 to 4.5 days (Nishiura, Linton, and Akhmetzhanov 2020) and a considerably shorter estimate of 3.96 days (Stephen G. Baum 2020). Regardless of this contention, we do know that the serial interval of COVID-19 is significantly shorter than the mean serial interval calculated for SARS (8.4 days) or MERS (14.6 days) (Stephen G. Baum 2020).

This is crucial because it means that pre-symptomatic transmission is much more likely in coronavirus. As the name suggest, pre-symptomatic transmission means that the spread of the disease is occurring before symptoms appear in the carrier of the virus. Nishiura et al. explain that when the serial interval is shorter than the incubation period, “pre-symptomatic transmission is likely to have taken place and may even occur more frequently than symptomatic transmission" (Nishiura, Linton, and Akhmetzhanov 2020). The incubation period is the time from exposure to the virus to first symptoms. In case of COVID-19, the median incubation period has been estimated to be around 5 days, similar to that of SARS (Lauer et al. 2020).

In conjunction to this, certain studies have indicated that there is also asymptomatic transmission of COVID-19. According to WHO, asymptomatic transmission refers to transmission of the virus from a person, who does not develop symptoms (World Health Organization 2020). A study of an outbreak of COVID-19 in a skilled nursing facility in Washington State revealed that the patients did display asymptomatic transmission of COVID-19 (Arons et al. 2020). The issue with this kind of spread is that it weakens the effectiveness of symptom-based screening of possible patients. This further highlights the importance of unprecedented measures to clamp down on the spread of this disease.

Symptoms

Now that we know the nature and contagiousness of COVID-19, we can move on to the symptoms of the disease. According to the Centers for Disease Control and Prevention (CDC), people with COVID-19 have had a wide range of symptoms reported, ranging from mild symptoms to severe illness. These symptoms are likely to appear 2 to 14 days after exposure to the virus. Some of these symptoms include dry cough, difficulty breathing, fever, chills, muscle pain or body ache, sore throat and loss of taste or smell (CDC 2020). The agency also states that children have similar symptoms to that of adults and they generally have mild illness. In some people, COVID-19 is likely to cause more severe symptoms like high fever, severe cough, and shortness of breath, which often indicates pneumonia. Patients with COVID-19 can also experience neurological symptoms, gastrointestinal (GI) symptoms, or both. These may occur with or without respiratory symptoms (Harvard Health Publishing 2020).

Some of these less common GI symptoms include nausea, vomiting, or diarrhea. COVID-19 has also been detected in stool, which "reinforces the importance of hand washing after every visit to the bathroom and regularly disinfecting bathroom fixtures" (Harvard Health Publishing 2020).

The disease is also likely to affect brain function in some people. These specific neurological symptoms include, as mentioned before, loss of smell, inability to taste and muscle weakness, but also tingling or numbness in the hands and feet, dizziness, confusion, delirium, seizures, and stroke (Harvard Health Publishing 2020).

The CDC has also stated some emergency warning signs for COVID-19: trouble breathing, persistent pain or pressure in the chest, new confusion, inability to wake or stay awake and bluish lips or face. These symptoms, along

with the other symptoms at a severe level, call for immediate medical attention (CDC 2020).

Investigation into the symptoms of COVID-19 continue, so this information may be subject to changes and modifications. But what has been noticed is that those with underlying conditions are more likely to be vulnerable to COVID-19. A recent report from Italy revealed that the majority (96.2 percent) of patients who died in-hospital from COVID-19 had comorbidities, primarily non-communicable diseases (NCDs). Cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes are a few of these NCDs. The most prevalent NCDs among these patients in Italy were hypertension (69. 2 percent), type 2 diabetes (31.8 percent), coronary heart disease (28.2 percent), chronic obstructive pulmonary disease (16.9 percent), and cancer (16.3 percent) (Palmieri et al. 2020). An association between COVID-19 severity and NCDs has also been reported in Spain, China, and the USA. Many COVID-19 deaths also occur in older people who often have existing comorbidities (Kluge et al. 2020). Hence, it becomes even more important to protect these vulnerable sections of society from the pandemic.

How does it spread?

Understanding the numerous facets of COVID-19 makes it easier to provide concrete recommendations to tackle it. But perhaps the most important dimension is how exactly the transmission of this virus takes place. Experts are still learning about how COVID-19 spreads, but current evidence suggests that the virus can be spread through respiratory droplets after an infected person coughs or sneezes, between people who are within about 6 feet of each other, and possibly through touching surfaces that have the virus on them. (Desai and Patel 2020)

To further elaborate on these modes of transmission, the most likely way a person can catch COVID-19 is from others who have the virus. Human-to-human transmission, including transmission within families and healthcare settings, are the most likely ways this virus is likely to spread. Basically, coronavirus is transmitted via liquid droplets when a person coughs or sneezes. The virus can enter through eyes, nose or throat if one is in close contact with a patient who might expel droplets that carry the pathogens. These respiratory droplets have been shown to be propelled up to 2 meters in most studies.

Early on, there were misconceptions and misunderstandings about how COVID-19 spreads. It was assumed that the virus was primarily airborne. However, a study clarifies the modes of transmission of COVID-19 were similar to SARS-CoV-1. In their paper, van Doremalen et al. state that aerosol and fomite transmission of COVID-19 is probable. They conclude that, "Our results indicate that aerosol and fomite transmission of SARS-CoV-2 is plausible, since the virus can remain viable and infectious in aerosols for hours and on surfaces up to days (depending on the inoculum shed). These findings echo those with SARS-CoV-1, in which these forms of transmission were associated with nosocomial spread and super-spreading events, and they provide information for pandemic mitigation efforts" (van Doremalen et al. 2020).

To put it simply, evidence shows that COVID-19 is not chiefly transmitted through the particles floating in the air, and it is also not something that comes in through the skin (British Columbia Centre for Disease Control 2020). As mentioned before, COVID-19 is transmitted via droplets during close, unprotected contact.

There is also the possibility of fomite transmission to consider. Researchers have found that the virus is present on surfaces in the environment of patients who have tested positive for COVID-19, often for days. A meta-analysis of studies related to human coronaviruses reveals that

this is a common trend for these kinds of viruses. “The analysis of 22 studies reveals that human coronaviruses such as Severe Acute Respiratory Syndrome (SARS) coronavirus, Middle East Respiratory Syndrome (MERS) coronavirus or endemic human coronaviruses (HCoV) can persist on inanimate surfaces like metal, glass or plastic for up to 9 days,” the paper reveals (Kampf et al. 2020). Stool has also been considered a potential route of transmission. A study found that toilet bowl and sink samples were positive for COVID-19, suggesting that viral shedding in stool could be a potential route of transmission. However, post-cleaning samples were negative, suggesting that if the surfaces are effectively decontamination, it is enough to eradicate the virus (Ong et al. 2020). There is no consensus yet on whether there are other modes of transmission like bloodborne transmission or vertical transmission of COVID-19 from mother to child. So far fomite, droplet and contact transmissions are the key modes of transmission to pay heed to (Public Health Ontario 2020).

Recommendations

Now that we have a better understanding of the nature of the virus, we can move on to assessing the measures that can be taken to slow its spread. Dr David Price of Weill Cornell Medical Center provided a comprehensive list of recommendations during an online discussion about COVID-19. The doctor, who is on the frontlines in the fight against coronavirus, said that the first tip to keep in mind is to keep one’s hands clean at all times. Disinfecting hands using soap or hand sanitizer is crucial for protection against COVID-19. The CDC and WHO have consistently asserted that frequent handwashing with soap for at least 20 seconds at a time can be an effective preventive measure against COVID-19. In fact, a study’s regression analysis found a strong correlation between hand hygiene and the magnitude of outbreak in different countries. It states that locations where people do not have a habit

of washing their hands automatically tend to have a much higher exposure to COVID-19 (Pogrebna and Kharlamov 2020).

The second tip that Dr David Price suggests is to stop touching one's face. This is no small feat, since a study found that their test subjects were likely to touch their face at least 23 times per hour (Kwok, Gralton, and McLaws 2015). As mentioned in the transmission section of the paper, the virus can enter through eyes, nose or throat. Consciously eradicating this face-touching behavior can be a powerful method to break the transmission cycle of COVID-19.

The third tip provided by Dr Price is that any form of veil or face covering can go a long way to quell COVID-19's spread. This recommendation aims at shielding people from droplet transmission of COVID-19. An evidence review on studies related to face masks corroborates this suggestion. The studies, as per the review, indicate that mask-wearing reduces transmissibility per contact by reducing transmission of infected droplets in both laboratory and clinical contexts. It also mentions that public mask wearing is most likely to be effective at stopping spread of the virus when compliance is high. "The decreased transmissibility could substantially reduce the death toll and economic impact while the cost of the intervention is low," the review says, urging policymakers to pay attention to this frugal yet effective intervention (Howard et al. 2020).

The final tip that Dr Price advocates for is to simply stay away from people. He explains that engaging in social distancing can significantly dampen the spread of COVID-19. By staying at home, and maintaining a six-feet distance when one goes out, citizens can effectively contain and control transmission of the virus. An analysis echoes this information, "The application of all four social distancing interventions: school closure, workplace non-attendance, increased case isolation, and community contact reduction is highly effective in flattening the epidemic curve, reducing the

maximum daily case numbers, and lengthening outbreak duration" (Milne and Xie 2020). The aim of 'flattening the curve' of COVID-19 is to stagger the number of new cases over a longer period so that people have better access to healthcare and the health infrastructure is not burdened by too many cases. As the study mentions, social distancing proves effective in flattening the COVID-19 curve.

Even though a lot of governments have incorporated these measures, authorities in many countries remain complacent about the magnitude of COVID-19. It is crucial that policymakers incorporate these suggestions to mitigate the impact of COVID-19 and impeded its spread. Dr Price's tips become increasingly important now as world leaders have started considering the relaxation of lockdown measures. Dr Price says that these recommendations remain just as important to avoid a second wave of coronavirus cases. "The first thing you do is you bring down the amount of cases, so hospitals don't get overwhelmed and then by human nature people will become a little relaxed with their social distancing. And so, there's then a second small spike. And then after the second small spike, it usually comes under control in the population. And so, I think social distancing is something that you need to just put in your brain," he explains.

Conclusion

While the situation is still unpredictable, there is no doubt that the COVID-19 pandemic has changed the way medical professionals and policymakers will deal with outbreaks. Despite the nascent state of research around COVID-19, there is still a wealth of information on how to contain and control the spread of this virus. Simple tips like washing one's hands, changing face-touching behavior, using face masks and maintaining social distancing can change the trajectory and mortalities caused by this

pandemic. Early research indicates that social distancing and other measures have already begun showing results: “While social distancing interventions were in place, 20 percent of new cases and most hospitalizations and deaths were averted, even with modest reductions in contact among adults... Our models suggest that social distancing can provide crucial time to increase healthcare capacity but must occur in conjunction with testing and contact tracing of all suspected cases to mitigate virus transmission.” (Matrajt and Leung 2020). The study further notes that when interventions ended, the epidemic rebounded. Hence, policymakers and medical professional must not get complacent in relaxing these efforts. After all, the cost of this impatience could be millions of lives.

About

Dr. Kaswan is Professor Emeritus from UGA College of Veterinary Medicine. She is the inventor of Optimmune for dogs, and Restasis for People. Restasis is the largest selling ophthalmic drug of all time. Her experience with repeatedly questioning conventional wisdom leads her to questions like these. Follow us on KBVisions.org.

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