The Threats Remain

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At the time of this writing (June 2022) we are still in the midst of a global covid-19 pandemic and on the rising edge of a global monkeypox pandemic.

Both these diseases are spread by respiratory aerosols, short-range droplets, and in the case of monkeypox, material from the pustules and scabs that form on the skin during the later stages of the disease.

Monkeypox can persist in cloth for a long time, which may be a factor in handling costumes in future.

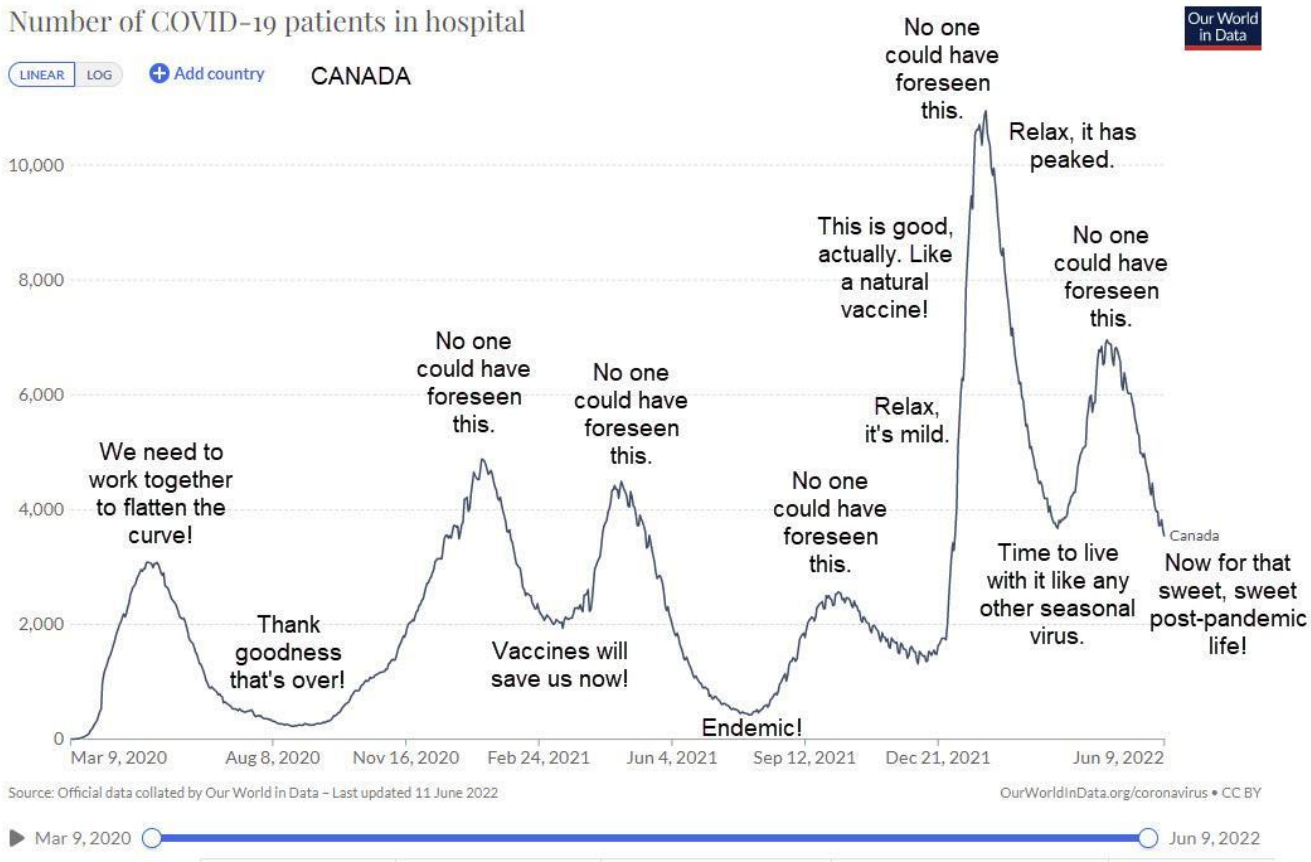

Figure 1: The Canadian covid situation over the past 2.5 years as measured by covid hospitalizations, annotated by Prof. T. Ryan Gregory, a very frustrated epidemiologist at the University of Guelph.

The current global monkeypox situation is very clear. For the past two months there has been consistent exponential growth with a doubling time of two weeks. Two cases have been confirmed in BC. Exponential growth will do the rest unless governments take effective action. As monkeypox continues to spread the risks of contact transmission (including from costumes) will have to be addressed.

I have tried in what follows to cite reputable studies in high quality journals or in some cases online sources from people known to me personally who I judge are professionally competent (Joey Fox, for example, who is a professional engineer experienced in HVAC active on Twitter).

It is important to keep in mind that the fact of uncertainty is not an argument. It is not impossible that all of this will pass over in the next few weeks or months. No serious Bayesian would take that bet, however, and the precautionary principle of doing relatively easy things to avoid relatively terrible outcomes should apply.

Masking, monitoring CO2, and improving ventilation by opening doors and windows are relatively easy things.

A member of the Players dying or suffering from long covid is a relatively terrible outcome.

Modes of Transmission

Covid, monkeypox, and many other diseases are spread by aerosols and droplets.

Anyone who has spoken or sung on stage will be aware that there is sometimes a fine spray from a speaker's mouth that is visible in the glow of the lights. This spray is mostly droplets of spit, which are too big to drift on air currents. They have a typical range of a meter or so, and fall on ballistic arcs.

It is a useful exercise to stand in the lights on stage and face downstage. Have someone downstage of you speak, shout, sing, and cough while facing stage left or right. You will see the spray of droplets from their mouth. When you stand facing someone on stage, you are bathing each other in a fine mist of your bodily fluids, and all that they contain. There is nothing mysterious about this. It's just a fine mist. If you're in range, you're breathing it in, and it will also get in your eyes. It's too diffuse to feel (unless the speaker is *really* agitated) but more than enough to carry a significant viral load into your body.

As well as droplets, the simple act of breathing releases respiratory aerosols from deeper in the lungs, rather than from the mouth. These transmit disease at both long and short range: aerosols are most dense around anyone who is breathing, because this is how the physical process of diffusion works, but they spread out with time and linger in the air for minutes to hours in poorly ventilated spaces. Therefore aerosol transmission is most effective at shorter distances, but still very effective at any distance within a poorly-ventilated space.

Aerosols are fine particles, typically 0.1 to at most 5 microns in size. For particles with the density of water anything smaller than about 5 microns can float on the air for many hours. The most familiar example of an aerosol, with particles in the 0.3 micron range, is cigarette smoke, which as we know drifts everywhere and can hang about for a long time.

The individual particles in an aerosol are invisibly small: 100 microns is a tenth of a millimetre, which is about the smallest thing the eye can see. Aerosols are 5% of that size or less. They can still scatter light, so if they're dense in the air like smoke they create a cloudy appearance, but they can be present at low density and invisible.

If you think about aerosols the way you would think about cigarette smoke you won't go far wrong. Imagine anyone with asymptomatic covid or monkeypox as being a smoker and it'll be clear why taking aerosol precautions is a really good idea. Remember how in the days of public indoor smoking you'd come home from the bar and your clothes would smell of smoke? That was from aerosols settling on your shirt, and you were also breathing them deep into your lungs.

Respiratory aerosol production is increased when we are breathing hard, speaking loudly, singing, or coughing. How long they last in the air varies with things like temperature and humidity, but "tens-of-minutes at least" is a reasonable heuristic unless the space is well-ventilated.

A "big" virus like monkeypox is 0.2-0.25 microns in size, and so can themselves float in the air as an aerosol, although most will be trapped within larger aerosol water particles or even larger droplets. Monkeypox virus is extremely long-lived on surfaces and there is no reason to believe it becomes inactive while drifting around in the air.

Covid-19 is only about 0.1 microns in diameter and does not appear to be as robust as monkeypox. There is evidence that it only remains viable in the air for tens of minutes rather than hours or days. This still means you can catch covid from the air for ten or twenty minutes after someone with covid has left the room, if it's poorly ventilated.

Monkeypox is also spread by physical contact, especially when the actual pox have formed. Dust from dried scabs from pox can remain infectious in clothing and bedding for many months.

Mitigations

The goal of mitigations is to prevent people from getting covid or other diseases spread by contact, droplets, or aerosols. At the current time there is only one way to avoid both acute and long-term covid effects, and that is not to get infected, and if infected once the only way to avoid further consequences is to not get infected again. Prior infection does not confer robust immunity against future variants. Because evolution.

Masking, distance, and ventilation are the most effective, lowest cost mitigations: "While the efficacy of any individual control was highly variable among scenarios, combining universal mask-wearing with distancing of 1 m or more reduced the median exposure by more than 99% relative to a close, unmasked conversation, with further reductions if ventilation is also enhanced. The large reductions in exposure to airborne pathogens translated to large reductions in the risk of initial infection in a new host. These findings suggest that layering controls is highly effective for reducing transmission of airborne pathogens and will be critical for curbing outbreaks of novel viruses in the future."

Vaccinations are not a significant mitigation for spreading covid. Vaccines do a lot to prevent serious illness and death in the acute phase of the disease, but vaccinated individuals are almost as capable of catching and spreading the disease as the unvaccinated: "This study showed that the impact of vaccination on community transmission of circulating variants of SARS-CoV-2 appeared to be not significantly different from the impact among unvaccinated people."

Vaccines also do not appear to offer much protection against long covid, which like long HIV and long polio is turning out to be where the most serious consequences of covid lie.

For monkeypox, having had a childhood smallpox vaccination should offer a degree of protection, although how much is not yet clear, and the US CDC recommends re-vaccination after exposure if your smallpox vaccination is more than three years out of date. Because of the life-cycle of monkeypox in the body, smallpox-vaccinated individuals should have a lower chance of spreading the disease. In Canada, childhood smallpox vaccination was discontinued in 1972, and most people born after 1964 have not been vaccinated against smallpox, while almost everyone born earlier has. However, 1972 is more than three years ago.

At short range, droplet transmission is a big risk. There is some evidence that people who wear glasses are very slightly less likely to get covid than people who don't, but it would be wrong to infer that this is a major transmission path, which is why goggles are not a significant mitigation. Face shields stop droplets but not aerosols, and are modestly effective mitigation at best.

Cloth masks, like face shields, stop droplets but not aerosols, and so are also only modestly effective. They are appropriate for very well-ventilated spaces and the outdoors, where droplet transmission dominates. For less-well-ventilated indoor spaces, where aerosols build up like cigarette smoke in a crowded bar, they are much less useful.

N95 masks (or better) are very effective at mitigating spread and may reduce severity due to lower viral load when the disease gets past them. Out of 27 studies on masking effectiveness 22 found them effective, one was inconclusive, and four found them ineffective. Not all studies are created equal, however, and precisely what is meant by "masking" and "effective" varies between them. Several of the negative studies were aimed at comparison of jurisdictions with and without mask mandates, rather than actual mask wearing behaviours by individuals, whereas the question of interest is: if this group of people masks in higher-risk settings consistently and that group does not, who will get more covid? Furthermore, mask quality matters a great deal: cloth masks, like face shields, will reduce droplet transmission but do very little for aerosol transmission, which requires N95 masks or similar to prevent.

Mask wearing also has a non-linear effect: because masks both act as source control (they stop infected individuals from breathing out high levels of virus-carrying particles) and prevention (they stop uninfected individuals from breathing in high levels of virus-carrying particles) a situation where everyone is masked is much safer *for the mask-wearers* than a situation where only half the people are masked.

Some people find N95 masks give them headaches. We should be open to alternative masks, including elastomeric respirators (which offer equivalent or better protection to N95) or high-quality cloth masks, for people who suffer from this. Slower, more measured, breathing may reduce N95-associated headaches.

Permanent upgrades in the form of improved ventilation, filtration, upper-room UV and other engineering mitigations are beyond the scope of this report, except to say that they are effective, important, and the Gabriola Players Theatre Society should encourage and support the upgrading of performance and meeting spaces on Gabriola for the benefit of all.

Ventilation is known to make indoor spaces safer. It is also the province of engineering, not medicine, and ventilation recommendations should come from professional engineers, not medical doctors.

Opening windows and doors, and monitoring CO2 to keep the level below 800 PPM for rehearsals and 1200 PPM for performances are easy ways of reducing risk. The levels of 800 and 1200 PPM are fairly arbitrary, but in it's easy to make things more complicated than they need to be: outdoor air is about 410 PPM, and around twice that level is a matter of concern, especially when people are moving around and speaking loudly.

One way of thinking about CO2 is like temperature: 800 PPM is kind of like 80 F: if you felt a bit hot and saw the temperature was 80 F, you'd probably do something to lower it. It's not like 80 F will give you heat stroke, but it's uncomfortable and unpleasant and should be addressed. We can't feel CO2 level the way we feel temperature, but should treat high levels similarly.

For performances, based on experiences so far with Gabriola indoor venues, it is extremely difficult to keep the level below 1000 PPM even with limited audiences. Accepting a higher level of risk is the price we pay for indoor performance.