MicroChat: Elements of critical thinking

We must consider other points of view

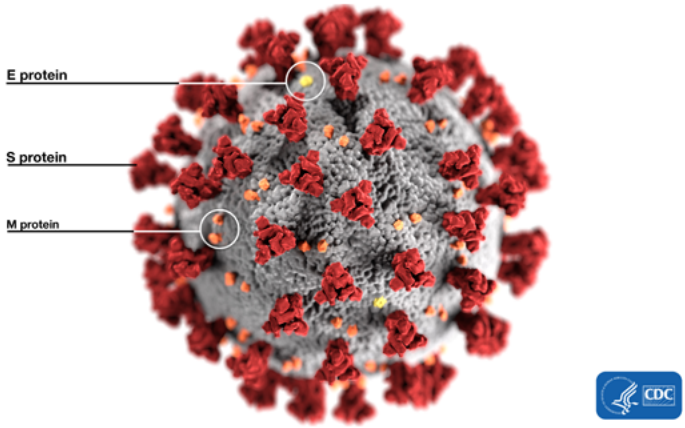
Omi

(with apologies: this is not really a chat but rather a monologue)

(*Kenneth Timmis*)

Hello, I'd like to introduce myself: I have a rather long and grand name, and even a title, which the English love so well: it is SARS-CoV-2 variant B.1.1.529, VOC (variant of concern) (https://www.who.int/news/item/28-11-2021-update-on-omicron), or Omicron for short, but you can call me by my nickname, Omi.

I am quite famous and photos of me are everywhere, but I am afraid they are not terribly attractive. Judge for yourself.



Although I am considered by my friends, the bats, to be simply a passenger using them for a ride, I have been demonised by humans for all sorts of reasons. So, in the interest of fairness, I'd like to present my side of the story.

First of all, I am a virus. Many biologists think viruses are not living beings, not 'organisms', because we are unable to make our own components, and hence to reproduce on our own. But there are many 'organisms' (obligate endosymbionts) that are also unable to reproduce on their own and live in other organisms that provide them with the components they need. Crucially, we possess the most important characteristic of organisms, namely the ability to reproduce and the ability to go extinct if we don't reproduce enough. More of this later.

Anyhow, we belong to the group of 'things' called parasites: we live in the cells of other organisms and take over their metabolic activities so that they make us rather than themselves. When they make a lot of us, they don't have enough resources to take care of themselves, so they feel ill.

But don't think about taking the moral high ground here and accuse us of selfish behaviour: humans have reproduced to the extent that the resources they take from the planet are more than the planet can supply without becoming sick. Global warming, environmental pollution, dead zones in freshwater and marine systems, loss of natural habitats and the biodiversity they house, and extinctions of huge numbers of organisms, are just a few of the sicknesses of Planet Earth caused by human over-exploitation of its resources.

And our demonisation is totally unwarranted and simply a reflection of humans viewing everything through the lens of human wellbeing, rather than the wellbeing of the biosphere and planet. The entire biosphere consists of food webs, which are simply layers and networks of

predation. Bacteria are eaten by protozoa, protozoa are eaten by invertebrates, which are eaten by vertebrates, etc. When predation goes wrong, ecosystems can become dysfunctional. For example, during a bloom of cyanobacteria, caused by over-fertilisation of farmland leading to fertiliser draining into local water bodies, there are too many cyanos for the predators to eat. So, instead of being eaten, they die off when they run out of nutritional resources. The dead cyanos are then degraded by bacteria, which consume all the oxygen in the water that is needed by aquatic animals like fish and crustaceans, and thereby create dead zones. Natural predation of cyanos does not reduce oxygen levels of water, and hence is key to a healthy ecosystem.

One type of 'predation' is infection with viruses. Although there are a range of host:virus interactions, some of which do not kill the host, we can consider viral predation as those infections that do kill the host. For example, viral predation of bacteria in nutrient-poor marine systems is crucial for ecosystem health because it keeps bacterial lifetimes short and releases the cellular contents that other bacteria need to grow and reproduce (estimates suggest that the contents of 20-40 % of microbial cell mass in marine surface waters is released each day by viral predation). So predation is perfectly natural and an essential process of healthy ecosystems. We love lions, don't we? They are predators of springboks, but we don't demonise them because they are predators, do we?

So you should not demonise me! And, in any case, I am not your typical predator. Well, ok, I do understand that I have caused you a lot of trouble so, even if your feelings are a bit extreme, they are perhaps not so unexpected. But I have to say that the poor start to our relationship is mostly your fault.

Why?

First: you came to me; I did not come to you. I was quite happy with my bat friends, did not bother them too much so that they were also quite happy. But you and your farm animals and pets invaded the habitats of my bat friends, in order to increase farmland area to feed the growing world population of humans. And you perpetually increase human living space at the cost of the space traditionally occupied by wildlife. And you have got a taste for 'wild meat' from animals with which I have a relationship. In any case, you got a bit too close to one of my friends.

And then I 'jumped'! Not physically, you understand, but metaphorically. I am the cause of a zoonotic infection, an infection caused by a pathogen that originates in an animal and somehow transfers to humans. But I am not unusual in this: it is estimated that 60% of all human infections originated in animals and 75% of new infectious diseases are zoonotic (https://www.unep.org/resources/report/preventing-future-zoonotic-disease-outbreaks-protecting-environment-animals-and). The exact process of 'jumping' is not yet known, despite a lot of money being invested in research on the topic. But no matter: it is your fault that our relationship began at all!

But to help you understand why things went so horribly wrong at the beginning of our relationship, I need to give you a little insight into viral strategies (I am using human terms and metaphors here to help you understand; of course viruses are not humans and we don't have strategies, our behaviour is determined by ecological principles, principles that humans would be well advised to follow, but that is another story).

So: first things first – the key ecological principle. All I want to do, like all other non-human beings on the planet, is to reproduce myself to ensure that I do not go extinct. (Yes, I know humans also like to reproduce and do not wish to go extinct, but they also have other objectives like playing video games, going on holiday, etc.). Because I am a parasite, and cannot reproduce unless I am in a host, one of my major preoccupations is to reach new hosts that will allow me to reproduce. Microbiologists call this pathogen transmission.

Now I am a respiratory pathogen and my preferred site of growth is the airway, the apparatus the human body has developed to bring air into the lungs during the process of breathing, so that oxygen can be captured and used for metabolism in all cells of the body. It is the characteristics of the airway that provides my means of transmission to other hosts.

When I infect airway tissue, especially that of the lungs, I cause inflammation which results in a lot of slimy mucous being produced in the airways. This makes humans uncomfortable and the discomfort causes them to cough and sneeze to expel the slime through their nose and mouth. Since I am reproducing merrily in the airway tissues, the mucous is full of virus. During sneezing and coughing, and indeed talking and singing, droplets are expelled from the mouth and nose in a so-called aerosol into the air surrounding the infected person. If the person is in an enclosed space, like a room, the droplets accumulate and float around in the room. Anyone else in the room can breathe in the droplets and deliver me to the tissues I like to infect. The water in the droplets continuously evaporates, so the droplets get smaller. The smaller the droplet, the lighter it weighs and the longer it floats in the air, and the longer the air in the room stays 'contaminated' with virus.

On the other hand, I do not like to be outside of my host, so the longer I float in the air, the more I die. And the human body has defence mechanisms, so is mostly able to fend off small numbers of pathogens. Thus, for me to transmit effectively, I need to reproduce very well so that the numbers in the droplets are high, well above the so-called infective dose. Me reproducing very well means you feeling rather ill.

And this brings me to the crux of the matter, why humans have demonised me. Like I have already said, bats are happy with me; unlike humans, they do not regard me as a threat. The reason is that we are in a long-term relationship; we have gotten used to one another and adapted to one another's peculiarities. When I jumped from a bat to my first human, we did not know one another, were in fact ill-adapted to one another: a situation like you wearing new, not particularly well-fitting shoes. As a result, I made people too sick. This was not at all intentional. Just think about it: making people very sick so that they must stay in bed or go to hospital is not good for my transmission. I need infected people to mix with uninfected people, to talk and, even better, sing and shout and hug one other, in fact to go to parties and such and enjoy themselves, not to isolate because they are feeling ill.

Fortunately, because reproducing well provides a lot of opportunity for my genes to mutate, I can evolve – I produce variants – and tune down my ability to damage the host and tune up my ability to transmit to other hosts. Microbiologists call this exploring evolutionary space to find the best possible combination of virus transmissibility, pathogenicity and robustness. So typically, a 'new' virus, which means one that has just jumped from another host, goes through an evolutionary process from being very harmful to its host and not very good at spreading to others, to being much milder but a better spreader; from being new to the host population, so-called

epidemic or pandemic strains, to being a more or less permanent associate of the population, so-called endemic.

Now, not all pathogens transit from being epidemic to endemic: some never quite adapt well enough to their new hosts and so fail to reproduce and transmit effectively, and thereby go extinct. In other cases, humans manage to fend them off and so they also go extinct. Whether or not humans can force us into extinction depends both on our characteristics and what measures humans can mount.

One very effective strategy microbiologists have developed is the vaccine, which instructs the natural immune defences to find us when we enter the body and kill us off. Vaccines have produced spectacular results and are responsible for the extinction of the smallpox virus and are able to make the polio virus go extinct. On the other hand, some viruses, like the flu virus and me, are able to change by mutation our surface structures recognised by the immune system, and so generate variants that escape or partly escape the immunity created by a vaccine. Humans call such mutants 'variants of concern' (*VOC*; my title). In this case, new vaccines must be created that create immunity to the new variants. Alternatively, microbiologists need to find a vaccine against a viral component that cannot change without weakening the virus.

Another effective strategy humans have developed is blocking (erecting barriers to) transmission. This has been very effective for so-called enteric pathogens whose infection route is faecal-oral, that is pathogens that typically enter the host via food or water, infect the digestive tract, are released in faeces, and reinfect other hosts who drink or eat contaminated water or food. Where they can be implemented, modern hygiene measures, that include wastewater treatment, purification of drinking water, and strict cleanliness in food preparation, are very effective barriers against enteric pathogens.

But I am a respiratory pathogen and hygiene measure barriers are less effective against me. To stop me in my tracks, people have to stop breathing me in. This can be done by wearing masks that cover the mouth and nose and filter out virus particles from the air breathed out or in, particularly indoors where viral concentrations can be high. It can also be done by removing virus from the air in rooms by filtering and/or treating the air. And because a high concentration of virus is needed to produce an infection, and because ventilation of a room with fresh air from outside dilutes viral density – the concentration of virus-laden aerosol particles – and so reduces the amount of virus entering hosts, ventilation is also an important means of reducing infections.

And, of course, because the way I transmit is via air from person-to-person, a very effective way of blocking transmission during a period of high infection rates is to reduce person-to-person contacts, for example, by limiting the number of people allowed in a room, by reducing as far as possible the circulation of infected people in the community, and by reducing social activities like singing, shouting, hugging and kissing that are very effective in transmitting me to uninfected individuals.

This is why, in a period of high infection rates, people need to wear masks, infected people must be identified by a diagnostic procedure and prevented from mixing with others, and uninfected people are not allowed to meet in large groups outdoors and in small groups indoors. Because humans are social creatures and like to be with other humans, they find these measures inconvenient, and are reluctant to fully adopt them. Some humans even demonise the

authorities as unreasonably restricting freedom when they need to introduce such measures. All of which is, of course, good for us respiratory viruses.

How will our relationship play out in the long-term? This is currently rather uncertain, but probably I will find good variants in my evolutionary space that allows us to co-exist without too much friction and I will no longer be demonised. Or microbiologists will find my Achilles' heel and develop a vaccine that causes me to go extinct (in humans, of course; my relatives will continue to associate with my wild animal friends).

In any case, there are other respiratory viruses in animals just waiting to jump to humans, so all of the anti-transmission measures I mentioned above, and which you find inconvenient, may need to be adopted again at some point in the future. But, whatever happens, you can be certain that it is just part of natural ecosystem activity, so don't waste your energy demonising the viruses: just protect yourselves by doing what you need to do. It really is just common sense.

Suggestions for class discussions

- Do you think that demonisation of Omi and other pathogens causing infections is reasonable? Why or why not?

- Has learning Omi's point of view changed your opinion of pathogens? Why or why not?

- Think of examples of where learning another point of view has changed your opinion about something, and explain why.

- Think of examples where putting forward your own opinion to someone, which is different to theirs, might be helpful in finding a better solution. Explain why this might be the case.

- Do you think that most decisions that affect other people should only be made after different viewpoints have been discussed and considered?