Q. & A.

A DEMOGRAPHER'S VIEW OF THE CORONAVIRUS PANDEMIC

By Isaac Chotiner

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The new coronavirus has placed special importance on the work of demographers, like C. Jessica Metcalf, who says the pandemic can teach us about aging societies. Source Photograph by Chris McGrath / Getty

C. Jessica Metcalf, a professor of ecology, evolutionary biology, and public affairs at Princeton, is a demographer who studies the spread of infectious diseases. Her work on health policy has special importance now, as scientists and public officials seek to halt the spread of COVID-19, the novel coronavirus. I recently spoke twice by phone with Metcalf about her work and how demographers assist in the response to rapidly spreading diseases. During our conversations, which have been edited for length and clarity, we also discussed what demography can teach us about the effectiveness of school closings, the history of disease outbreaks having a disproportionate effect on certain age groups, and what demographers have learned about aging societies.

What principally interests you, as a demographer, about the coronavirus?

There are probably many risk factors associated with the coronavirus, and it feels like we learn something new and different every day about it. But one of the clear signals that seems to come through is that there is an age trajectory of morbidity and mortality that's very striking. The older individuals seem to be at greater risk. And, as a demographer, this gives you one lever to try and predict what the consequences will be as the virus moves through different countries, since one of the striking differences between countries around the world is age profile. Of course, there are a million other differences as well. Health-system functioning will tend to go in the other direction, but it gives you one projection to make. What I mean is that countries that are on average older, which tend to be the more developed countries, also have better functioning health systems, so, even though the burden might be greater, they will have greater ability to meet it.

Does demography teach us anything about the way we can counteract the virus? How would demography help us in fighting its spread?

So, demography is a very broad umbrella. I call myself a demographer because that means you can do anything, right—because everything is born and dies. And, arguably, a lot of the tools that one uses to capture and describe infectious-disease dynamics are, at some scale, demographic tools. For

example, I don't know if you've heard about the very famous—very famous in a very small circle—susceptible-infected-recovered model.

I have not.

So, one of the classic ways that we can describe outbreaks is you take the world and you divide it into classes of individuals. So, especially for a large and emergent pathogen event like this one, most individuals in the world will be susceptible. And then, over the course of time, they will enter into the infected class if they bump into an individual who is infectious and they become infected. And then, after some period of time, they'll recover. And just that simple definition, which one can write down as a mathematical model, describing flows of individuals between these different categories, gives you an awful lot of insight into how fast the disease might spread, and what you might expect. You can also gauge from it things like the age profiles of infections.

I'm not sure people would entirely agree that that is analogous to demographic models, but a lot of what one does in demography is also putting people in boxes. When you are building a mathematic model of anything, you are building a caricature of reality. So, a classic set of models are demographic models where the flow is over age. You are born in the age-one class, and then you flow into the age-two class, and then you flow into the age-three class. For infectious-disease biology, you might be born susceptible, and then you might flow into the infected-age class, and then you would hopefully flow into the recovered-age class.

Can you explain a little bit about what your work consists of, and what your interactions with medical professionals are like?

I am a mathematical modeller mostly, so what I end up doing is working with data that other people have collected, and probing that data using the theories that we have and the models that we have, to try and better understand the processes that we see. So, for example, the outbreak that occurred in Wuhan showed this early exponential growth, and the models that we have put together allow you to pin down key characteristics of the outbreak, such as the number of new infections per infectious individual, and also the serial interval, or the time that separates one infectious individual from another. So basically trying to draw a line through the evidence that we have, given the mechanisms that we suspect are at play.

I also do a certain amount of field work. I grew up, partly, in Madagascar, so I work closely with postdocs and graduate students who do a lot of things like, for example, how rabies transmits across

Madagascar, or understanding how poultry pathogens are spreading in that population.

Are there specific things about this outbreak that have particularly caught your eye in the past couple of weeks?

It seems like patterns of contact over age are one of the real determinants of the age at which people become infected. This is because we tend to enter into contact with people of our own age, and that will concentrate transmission in particular groups. People of certain ages tend to enter into contacts that might lead to infectious-disease transmission. So you tend to talk to people your own age, and then, when you turn about twenty or thirty, you start talking to very young people, because people have children. And, if you quantify the magnitude of contact, you also find that children seem to have much higher contact than any of the other groups between each other. And so that means that you expect them to be an important hub of transmission.

That is also what you tend to see for many things. But that's not what we're seeing here. We don't know everything because the data is still coming in. We just don't know whether kids are completely asymptomatic but still transmitting the infection. I think there are still a lot of really interesting questions there, but that really affects how we think about things like school closures to control it.

What does it make you think about school closures in particular?

In the 2009 flu pandemic, one of the steps that was taken was school closures. It's likely to reduce transmission, which could reduce the risk in the population in general. And one of the absolute emphases in such moments is to try and "flatten the curve," because one of the real concerns is that we're going to overwhelm our health systems. If we think that children are an important hub of transmission, then one way to reduce that would be to close schools. But, if they're not a hub of transmission, then that's not an effective strategy. And so it's an important question. And I think the calculus on these things is incredibly difficult, because closing schools imposes such steep social and economic costs, which tend to be very gendered. It ends up being mothers who stay at home to take care of the kids. So there's a whole slew of costs that go along with the closing-school option.

What about the argument that, just because any sort of large gatherings could be bad, you should try any form of social distancing?

I think we should all be thinking about social distancing now. I think we should be trying to reduce transmission as much as we possibly can. I have no idea how old you are, but you and I are probably not in a particularly high-risk group. But it's not about our personal risk—it's about trying to reduce the risk in the population at large. I think, absolutely, washing your hands much more than you do usually, doing that for twenty seconds, being very careful about it, and then thinking about how much public transport you take, the degree to which you can keep yourself a little socially distant from people, is probably a really good thing. The more time we can buy, I think, the better. The example of northern Italy makes that very stark. An awful lot of the scientific conferences I was thinking about attending have just been cancelled, and I think that's the right move. Whether you go from that to closing schools, particularly given this question mark over whether kids are transmitting, is an interesting question. I don't have the answer to it.

To turn to history for a minute, is there an example that you can think of where old people were particularly vulnerable to something like this?

So, there is the example of onchocerciasis, or river blindness. I grew up in many parts of Africa, and it's something that comes on slowly with age. But it meant that there were places you could go where most of the older individuals were being led around by little boys or children because they couldn't see anymore, because they were blind. I think it's the statue in front of the World Health Organization. The control of river blindness in many parts of the world is an incredible triumph. It still exists in some cases.

Is there a way in which demography could help prevent outbreaks in the future?

That's an interesting question. I think one of the lenses on the world that demography gives us is an awareness of the fact that we live in increasingly aging populations. And increasingly aging populations come with a whole set of challenges, in everything from health systems to insurance profiles. I think that this isn't going to be the last pandemic. One of the terrifying things about the 1918 influenza pandemic was that it affected younger adults, who seemed to suffer greater mortality.

So, we study the way in which pandemics, and the footprints of pandemics, will intersect with the age trajectory of populations. One of the things that has been suggested for this novel coronavirus is a role for co-morbidities that manifest in late ages. Many countries are going through a demographic transition right now where they shift from most mortalities being attributable to

infectious diseases to most mortalities being attributable to more chronic diseases, which will interact in unpredictable ways with these sorts of pandemics.

Can you explain that more?

Over time, most countries shift from suffering mostly mortalities from infectious diseases, which are often concentrated at very young ages, to scenarios where most causes of death are attributable to things that manifest at late ages, like strokes or heart disease or that sort of thing. And so different countries are at different places along that trajectory. It's very hard to say what will happen in the face of the next pandemic, because we don't actually know. Every single pandemic we've experienced so far has surprised us in some way. So I'm not quite sure, but I know that the next one will intersect in an interesting way with where countries are in the demographic transition.

What are the things that have specifically struck young people in the past?

So, measles has a case-fatality rate as high as twenty per cent in settings where there's something like malnutrition going on or something. We have a really inexpensive and efficacious vaccine, which gives you lifelong immunity, that's referred to as the best buy in public health. So, once you have the vaccine, you'll never have the infection. But, if you have the infection, you also will never be infected again, because it protects you for life. And that means that all of the infections are concentrated at young ages, and the mortality rate and morbidity rate is really striking.

Are there any specific responses to the novel coronavirus that you worry about as a demographer? We have seen a variety of responses around the world.

The thing that we worry about is the health system being overwhelmed. You can plot the number of attended hospital beds in the country against the average age of that country, and that relationship, at least in Europe, goes up—which makes sense, right? If you've got an older population, you might need more hospital attended beds. So you probably have more in place already if you're an older population, but whether they're increasing costs or it's spiralling resource requirements, as something as devastating as this comes through, is an open question.

A GUIDE TO THE CORONAVIRUS

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We are all irrational panic shoppers.

The strange terror of watching the coronavirus take Rome.

How pandemics change history.

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