

Pandemic! What Do and Don't We Know? Robert P. George in Conversation with Nicholas A. Christakis

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00:00:02.310 --> 00:00:14.940

Robert George: Good afternoon and welcome. I'm Robert George I have the honor to be the director of the James Madison Program in American Ideals and Institutions at Princeton University, which is hosting today's discussion.

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00:00:15.540 --> 00:00:27.540

Robert George: I'm delighted that we've been joined as co-hosts by the Elm Institute in New Haven, which provides wonderful services to students, academic programs to students, at Yale University.

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00:00:28.050 --> 00:00:35.220

Robert George: Up there and it's a great privilege and honor to welcome to the Madison Program for discussion of the most timely of issues

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00:00:35.820 --> 00:00:52.980

Robert George: My friend, Professor Nicholas Christakis. Professor Christakis is a leading authority on contagions both biological ones and social and ideological ones. He's been a very important voice a critical voice my go-to guy in ensuring that consideration of COVID-19

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00:00:54.390 --> 00:01:05.880

Robert George: Is fact based and rooted in historical and sociological insight, Professor Christakis is going to help us to understand what is known and what remains to be discovered.

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00:01:06.360 --> 00:01:12.810

Robert George: About the current pandemic and we're also going to talk a bit about what lessons can be learned from it.

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00:01:13.470 --> 00:01:27.960

Robert George: Nicholas Christakis is Sterling Professor of Social and Natural Sciences at Yale. He's appointed in the departments of Sociology, Medicine, Ecology and Evolutionary Biology, Biomedical Engineering, and in the School of Management.

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00:01:28.650 --> 00:01:40.290

Robert George: He works in the fields of network science, biological science, and behavioral genetics and he directs the Human Nature Lab and is the Co-Director of the Yale Institute for Network Science.

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00:01:40.680 --> 00:01:54.600

Robert George: He is a scholar of what connects us for good and sometimes for ill and Nicholas, thank you so very much for being with us today. And beyond that, for the work that you're doing to keep us all well-informed during this pandemic.

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00:01:55.380 --> 00:02:01.260

Nicholas Christakis : Thank you so much, Robby. Thank you for having, having me and thank you both to the James Madison Program and the Elm Institute.

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00:02:02.010 --> 00:02:12.540

Robert George: Could you begin Nicholas please by just giving us a bit of a summary of where we aren't perhaps commenting. A bit about historical experience. So what we know from the past about pandemics.

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00:02:13.470 --> 00:02:18.150

Nicholas Christakis : Yeah, so, so we're experiencing something that's very unusual.

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00:02:18.780 --> 00:02:27.540

Nicholas Christakis : In our species in the history and life of our species, which is the introduction of a new pathogen has entered our species and it's going to circulate among us.

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00:02:27.930 --> 00:02:35.370

Nicholas Christakis : As near as we can tell, this coronavirus bears a strong similarity to viruses that had been circulating in bats.

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00:02:35.610 --> 00:02:43.740

Nicholas Christakis : It's a bit of an oddity of why bat viruses so often cause us problems. There's been some speculation that their immune system is very similar to ours.

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00:02:43.920 --> 00:02:51.870

Nicholas Christakis : So when the virus adapts to being transmissible in bats. Then when eventually on occasion it leaks to us. It's sort of pre-adapted to

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00:02:52.440 --> 00:02:59.040

Nicholas Christakis : The human immune system probably sometime in November. This transition occurred in the Wuhan region of China.

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00:02:59.850 --> 00:03:06.270

Nicholas Christakis : In a, in a, by means we still don't understand and by December, there were already many people getting sick and many dying.

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00:03:06.720 --> 00:03:21.780

Nicholas Christakis : In Wuhan a young doctor there by the name of Dr. Wenliang Li noticed that unusual kind of pneumonia, many, many cases coming to his hospital and shared his observations on social media with some of his physician and nurse colleagues, this

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00:03:22.380 --> 00:03:31.680

Nicholas Christakis : was seen as inappropriate by local authorities there he was called in and accused of rumor mongering. Of course, he was right, and was silenced.

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00:03:32.310 --> 00:03:35.070

Nicholas Christakis : He said, Oh, I'm terribly sorry I don't know what I'm talking about.

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00:03:35.370 --> 00:03:40.530

Nicholas Christakis : But of course he didn't know what he was talking about. He eventually was infected as many healthcare workers have been

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00:03:40.770 --> 00:03:47.850

Nicholas Christakis : For reasons we can discuss why there is special risk and died of the condition. He's become somewhat of a hero in China as a result.

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00:03:48.360 --> 00:04:05.280

Nicholas Christakis : By the middle of January. It was quite clear what was happening, one of China's leading experts who had dealt with a SARS one epidemic in 2003 some of the listeners may remember that pandemic and we can talk about why this pandemic is different than that pandemic.

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00:04:06.420 --> 00:04:14.670

Nicholas Christakis : He went on a mission to Wuhan saw what was happening and by the late January, the Chinese government had begun to respond extremely forcefully

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00:04:15.900 --> 00:04:20.040

Nicholas Christakis : On January 24 or 25th, I was contacted by some Chinese colleagues of mine.

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00:04:20.760 --> 00:04:28.470

Nicholas Christakis : I had been sort of aware of what was happening, but I hadn't really paid a lot of attention, but I was contacted by them to do some collaborative research which we have since done

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00:04:28.860 --> 00:04:40.500

Nicholas Christakis : And as a result, began to really focus my attention and became aware that this disease was going to be pandemic that it was a very serious threat and that it would, it was likely to be an historic event.

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00:04:41.190 --> 00:04:51.690

Nicholas Christakis : That was similar as I'll talk about in just a moment to the 1957 pandemic and not. I don't think to the 1918 pandemic that afflicted our species. So an event that happens.

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00:04:51.780 --> 00:04:54.390

Robert George: On Nicholas is the one that is known as the Spanish flu.

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00:04:54.420 --> 00:04:55.080

Robert George: Yes.

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00:04:55.290 --> 00:05:02.370

Nicholas Christakis : But right so the most serious one we've had in a century that you know killed many millions of people and was very lethal so

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00:05:03.150 --> 00:05:17.910

Nicholas Christakis : So so so I began to do some work on this. And then in February began to redirect more and more of my lab to do a research of a variety of kinds. We are a dry lab primarily on the pandemic and began to think about it increasingly

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00:05:18.660 --> 00:05:23.940

Nicholas Christakis : And began to follow some of the research that was being published first in China. And then eventually in Italy.

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00:05:25.140 --> 00:05:39.870

Nicholas Christakis : Italy had the misfortune of two people business people who had business exchanges with China landed in Lombardy, and one of those two people was a super spreading event. So about 43 people were infected by that person.

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00:05:40.140 --> 00:05:47.130

Nicholas Christakis : And as a result, the epidemic exploded there and we can talk a little bit about some of the other features of Italy that have made it

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00:05:47.940 --> 00:05:53.580

Nicholas Christakis : So particularly vulnerable, although I need to emphasize that I don't think we can look to

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00:05:54.000 --> 00:06:02.010

Nicholas Christakis : Any particular social arrangement that will spare any nation. I think some nations will be spared by for chance reasons.

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00:06:02.250 --> 00:06:12.210

Nicholas Christakis : But if you look around the world, whether it's Wuhan or Lombardy or Qom in Iran or New York City, you know, the epidemic or Seattle, although Seattle's a special case.

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00:06:12.420 --> 00:06:23.700

Nicholas Christakis : Follows a very similar trajectory, it is a it is a wave of destruction that falls upon us and we can talk a little bit about what it means to flatten the curve.

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00:06:24.180 --> 00:06:33.000

Robert George: Yeah, we should talk about all those things. Let me just interrupt very briefly to ask you to tell us what you mean by a super spreader. I think or something like that.

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00:06:33.030 --> 00:06:34.110

Nicholas Christakis : You mentioned that so

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00:06:34.230 --> 00:06:36.630

Robert George: Not 43 other people infected somehow in Lombardy

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00:06:36.990 --> 00:06:44.130

Nicholas Christakis : So, so there's a couple number of parameters to think about when we talk about an epidemic.

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00:06:44.760 --> 00:06:50.820

Nicholas Christakis : One is the attack rate, which is what fraction of people even contract the infection.

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00:06:51.150 --> 00:07:00.690

Nicholas Christakis : And even with historical pandemics. That number is typically not above 50% so probably even with this epidemic in the end. When the dust settles in several years.

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00:07:00.990 --> 00:07:10.710

Nicholas Christakis : Maybe 40% of us will have been exposed to this pathogen maybe only 20% maybe as many as 60% but probably not more than 50% that's the attack rate.

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00:07:11.370 --> 00:07:24.120

Nicholas Christakis : There's something called effective reproductive rate or sometimes they R_0 . They R_0 the R zero is the number of new cases each case of a virus creates in an

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00:07:24.570 --> 00:07:34.620

Nicholas Christakis : In an unfettered fashion, that is to say if it's just running rampant. If there's no one immune in the population of a very similar number which is the number. I'd like to use today as the R . E.

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00:07:34.860 --> 00:07:42.990

Nicholas Christakis : The effective reproductive rate which is sort of in a kind of a steady state with a typical mixture of people and the typical levels of immunity.

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00:07:43.530 --> 00:07:52.470

Nicholas Christakis : How many new cases do you get for every old case so very early, the Chinese were able to establish that for every case of the virus.

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00:07:53.010 --> 00:08:15.510

Nicholas Christakis : About 3.8 new cases appeared. So if I get sick. I will infect on average 3.8 other people and that means the virus keeps spreading and escalates, and that is, say I replace more than replace myself. Ebola has an R.E. of about to the Measles is very infectious as an R.E. of about 18

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00:08:15.960 --> 00:08:20.610

Nicholas Christakis : So, this this this parameter for for for COVID-19

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00:08:21.690 --> 00:08:40.560

Nicholas Christakis : Is about it's come down from 3.86 it's about three. Let's say something like that. And we'll return to this a super spreading event is an event when an individual causes not say the average number of new cases like three or 3.8 but many more like 43, for instance.

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00:08:40.710 --> 00:08:43.020

Robert George: Is that something about him or her, or is it just that

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00:08:43.050 --> 00:08:52.200

Nicholas Christakis : Just yeah so some of it is just chance. There's a variation and how many you know some people when they get infected. Infect no one else. Maybe they're a hermit, or maybe they

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00:08:52.770 --> 00:09:04.980

Nicholas Christakis : Don't contact anyone or maybe they don't their lungs, they're rare airways aren't as irritable and they don't cough is much like you get it and you don't cough on your friends, but I get it, and I do cough on my friends.

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00:09:05.370 --> 00:09:11.700

Nicholas Christakis : Even though we're otherwise similar. So there's chance. There's something about our bodies. Maybe the environment we're in

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00:09:12.150 --> 00:09:21.300

Nicholas Christakis : So there are lots of different explanations for why sometimes you get this so called super spreading event, for instance, we had a similar event in the Biogen conference in Boston.

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00:09:21.990 --> 00:09:35.820

Nicholas Christakis : A month ago where one person can affect many other people anyway Italy's was kicked off in that fashion, whereas in Seattle, the epidemic was kicked off by an outbreak at a nursing home, which we can also come to

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00:09:36.870 --> 00:09:50.280

Nicholas Christakis : So the point is this pathogen starts and begin spreading by the middle of January, we know from genetic studies. So there's this international consortium of scientists that are sequencing strains around the world. It's an RNA virus.

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00:09:51.210 --> 00:10:00.720

Nicholas Christakis : This is a rival virus that has at its core, a little RNA in it and they are sequencing the RNA around the world. And then through genetic analyses, they can tell

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00:10:01.230 --> 00:10:14.880

Nicholas Christakis : You know the outbreak in New York. Let's say started. I'm making this up because I don't know offhand started because of the Italian strain came, but the outbreak in Seattle started because of an earlier introduction from the Chinese strain, let's say,

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00:10:15.180 --> 00:10:24.450

Nicholas Christakis : So we know that this pathogen was already in circulation in Seattle. By the middle of January so well before anyone any person.

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00:10:25.350 --> 00:10:31.140

Nicholas Christakis : Had zeroed in that there were outbreak, the germ is spreading and this incidentally speaks to one of the reasons why.

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00:10:31.590 --> 00:10:35.970

Nicholas Christakis : Closing borders typically does not work. And this has been studied at length.

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00:10:36.510 --> 00:10:43.650

Nicholas Christakis : By modelers and other mathematical scientists, because by the time the human beings become aware of the pandemic and try to close the borders.

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00:10:44.010 --> 00:10:54.120

Nicholas Christakis : The germ is loose so you gain very little by border closures when dealing with epidemics, so we can talk some of the mathematics of what's known about this later if you want

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00:10:54.720 --> 00:11:00.450

Nicholas Christakis : So the germ comes to the United States. It's already spreading in January Italy's beginning to collapse.

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00:11:00.660 --> 00:11:12.060

Nicholas Christakis : Iran is collapsing from the pathogen. They have mass graves and Qom because so many people die so fast, which is very similar to what happens in Milan and very similar to what happens in Lombardy

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00:11:12.300 --> 00:11:24.030

Nicholas Christakis : And there's no reason to imagine they won't be similar to what happens in the United States, like we can talk about some of the things that are different about our country that may help us. For example, we have lower population density

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00:11:24.630 --> 00:11:34.350

Nicholas Christakis : And we're richer. But there are other things which are no different, or worse in our country. So, so this kind of complacency, we had in February, where we thought, well,

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00:11:34.770 --> 00:11:40.410

Nicholas Christakis : It's happening in China, you know, and then maybe when it happened in Italy were like, Oh, that's a rich European democracy.

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00:11:40.620 --> 00:11:50.220

Nicholas Christakis : Maybe it'll happen to us there's there's not a lot of reason to imagine that what happened in those other countries won't happen here. Honestly, this is why I was so alarmed in February when I

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00:11:51.240 --> 00:11:58.860

Nicholas Christakis : Was trying to get people's attention and I couldn't believe that people weren't taking this me and many others couldn't believe that people weren't taking this more seriously.

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00:12:00.000 --> 00:12:01.140

Nicholas Christakis : So we got

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00:12:01.170 --> 00:12:10.830

Robert George: Nicholas let me interrupt there to ask you mentioned different strains of the virus. Are they of the same lethality and

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00:12:10.830 --> 00:12:11.910

Robert George: Yes, yeah.

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00:12:12.480 --> 00:12:24.390

Nicholas Christakis : The virus has not mutated in a way that would make it so far more or less lethal typically viruses become less lethal. They don't want to kill us want from a Darwinian point of view.

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00:12:24.750 --> 00:12:33.360

Nicholas Christakis : It's better for them if if milder strains that that you walk around and transmit it to many other people. Whereas if it kills you rapidly, then you don't transmit it

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00:12:33.630 --> 00:12:44.910

Nicholas Christakis : And this is one of the reasons the SARS one pandemic died out it was perhaps 100 times as fatal as this condition. So the flu kills about. I'm sorry.

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00:12:46.080 --> 00:12:54.720

Nicholas Christakis : Let me rephrase that, that number was not exactly right. Let me state this again the flu kills about one in 1000 people. So the case fatality rate of the flu.

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00:12:54.930 --> 00:12:56.850

Robert George: Want one in 1000 people who get it.

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00:12:56.880 --> 00:12:57.540

Nicholas Christakis : Who get it.

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00:12:58.140 --> 00:13:06.810

Nicholas Christakis : So the flu is has kills about one in 1000, it varies older people are more likely. These are approximate numbers about one in 1000 this condition.

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00:13:07.590 --> 00:13:18.570

Nicholas Christakis : We think we don't know yet. This is the case fatality rate or the infection fatality ratio. So the infection fatality ratio is the fraction of people who are infected who die, but

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00:13:19.080 --> 00:13:28.770

Nicholas Christakis : Only about half of the people who are infected ever come to medical attention. Most people, or at least half have no symptoms or mild symptoms if they're infected by this germ.

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00:13:29.160 --> 00:13:38.610

Nicholas Christakis : So the case fatality ratio or the symptomatic case fatality S little s CFR or the capital C capital F capital R case fatality ratio.

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00:13:39.150 --> 00:13:48.720

Nicholas Christakis : Is we think about 0.5 to 1% so it's between five and 10 times as deadly as the flu. We think we don't yet know and

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00:13:49.050 --> 00:14:00.390

Nicholas Christakis : This is another topic. I know we'll discuss, which is that we're flying blind in this pandemic we we don't have the data we need to really know but we we know it's or we're very close to certain that it's more deadly than the flu.

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00:14:01.320 --> 00:14:02.370

Nicholas Christakis : Nicholas

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00:14:02.730 --> 00:14:07.200

Robert George: Why does it kill some people and other people don't even notice symptoms.

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00:14:07.290 --> 00:14:18.630

Nicholas Christakis : We don't know exactly. We know there's certain risk factors that have to do with older age a co-morbid illness. It's, it's, we don't think there's any

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00:14:19.770 --> 00:14:27.600

Nicholas Christakis : natural immunity. We don't think although probably there's some people who have some genetic variants that make them a bit more able to rebuff the germ.

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00:14:28.470 --> 00:14:35.130

Nicholas Christakis : But SARS one just to finish where I was SARS one had a case fatality ratio of about 10%. It was very deadly

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00:14:35.520 --> 00:14:43.860

Nicholas Christakis : And so that that was too high to sustain a pandemic, it just extin-- it burned out. It would kill its victims before they could transmit it

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00:14:44.310 --> 00:14:55.500

Nicholas Christakis : So what we have in the case of SARS co V2 or COVID-19 the current pandemic is a pathogen that has intermediate reproductive rates R.E.

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00:14:55.950 --> 00:15:04.410

Nicholas Christakis : It's neither too transmissible nor too non transmissible and intermediate lethality it's it's it kills it as a

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00:15:04.950 --> 00:15:19.830

Nicholas Christakis : case fatality rate of about 0.5 to 1% SARS, the original SARS was too fatal. The 1918 pandemic was more fatal, but it's not as mild as the H1N1 outbreak of 2009 which is an influenza germ.

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00:15:20.130 --> 00:15:22.470

Nicholas Christakis : Which burned out, because it was so mild

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00:15:22.800 --> 00:15:31.350

Nicholas Christakis : People, it was, it was half as deadly as the flu. So, so these parameters, remind me of the 1957 pandemic.

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00:15:32.220 --> 00:15:38.760

Nicholas Christakis : That pandemic was a different pathogen. It was an influenza pathogen not a rival virus, but it also began in China.

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00:15:39.150 --> 00:15:47.220

Nicholas Christakis : And that pandemic had some other features it killed the young whereas this pathogen. The COVID-19 seems to spare the young, which is very interesting.

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00:15:47.760 --> 00:15:54.630

Nicholas Christakis : But this pathogen reminds me of the historical precedent of the 1957 pandemic, which had a similar

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00:15:55.110 --> 00:16:02.040

Nicholas Christakis : lethality. I think this one's a bit more lethal and the similar transmissibility so if you made a plot.

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00:16:02.280 --> 00:16:11.280

Nicholas Christakis : On the y axis, the transmissibility and on the x axis the lethality and you plotted all the pandemics we've had in the last hundred years they would occupy different spots.

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00:16:11.700 --> 00:16:29.970

Nicholas Christakis : Up at the upper right, we have the 1918 pandemic, which was very deadly and very infectious and then you have all the others. And in the middle, you would have the '57 pandemic. And I think this one is in that middle range so serious that 1957 pandemic killed 110,000 Americans.

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00:16:31.470 --> 00:16:37.980

Nicholas Christakis : And at a time when we had about 150 million population. So that'd be 250,000 Americans today.

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00:16:38.400 --> 00:16:44.850

Nicholas Christakis : And there's some interesting reasons we can talk about why at that time, the American public sort of took it on the chin.

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00:16:45.180 --> 00:16:56.670

Nicholas Christakis : And people just died. And we, we, you know, there's some family histories, where people remember what happened, but most people don't even remember that pandemic. I mean, historians and epidemiologists know it.

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00:16:57.390 --> 00:16:58.260

Nicholas Christakis : So that is

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00:16:58.320 --> 00:17:05.400

Robert George: Virtually Nicholas did, did we do the social distancing was there a shut down in '57 there was

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00:17:05.610 --> 00:17:07.440

Nicholas Christakis : There was some of that. But remember,

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00:17:08.010 --> 00:17:19.080

Nicholas Christakis : Yes, there was some of that. But there were a couple things that were different about that 1918 we did the social distancing and the banning of public gatherings and the school closures and all of that stuff in in spades. We did it.

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00:17:19.530 --> 00:17:27.840

Nicholas Christakis : 1957 was the polio was raging as well. So there was already a lot of avoiding of, you know, crowded places because of the polio epidemic.

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00:17:28.380 --> 00:17:31.380

Nicholas Christakis : And also at the time the media environment was very different.

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00:17:31.710 --> 00:17:42.180

Nicholas Christakis : So it was, I don't know. I don't know the answer to this, but I don't think people were as aware of what was happening in nearby regions in '57 so as to try to get ahead of the curve.

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00:17:42.510 --> 00:17:50.400

Nicholas Christakis : And close, you know, implement social distancing procedures, but it is a very standard thing to implement social distancing

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00:17:50.850 --> 00:18:02.340

Nicholas Christakis : Honestly, the Athenians Thucydides describes this and in the plague that afflicted Athens in 430 BC. I mean, it's not rocket science. And here I'll say one more thing and then maybe I'll shut up and we can have a conversation

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00:18:03.990 --> 00:18:16.230

Nicholas Christakis : There are two kinds of ways that we can respond to pandemics, pharmaceutical interventions drugs and vaccines for which we don't have any for this condition although we hope to have some in the future.

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00:18:17.400 --> 00:18:29.670

Nicholas Christakis : And so called non-pharmaceutical interventions and non-pharmaceutical interventions are in turn have two types individual stuff like washing your hands self-isolating not touching your nose and face.

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00:18:32.100 --> 00:18:40.230

Nicholas Christakis : Keeping the social distance from others and collective interventions like school closures, or the governor banning public gatherings.

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00:18:41.130 --> 00:18:44.670

Nicholas Christakis : And all of these have been described.

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00:18:45.570 --> 00:18:58.920

Nicholas Christakis : Forever. I mean, you can look at the medieval woodcuts of how the people in Europe in the cities cope with pandemics and you see people spaced out in the public squares. You know, like there's keeping their distance from each other. So this is a very

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00:18:59.580 --> 00:19:11.730

Nicholas Christakis : fundamental human experience that we're having. It's been described for long periods of time. It's just we're not used to having it. It's not in living memory that we've had such a pandemic.

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00:19:11.970 --> 00:19:31.560

Nicholas Christakis : And this is why, in part, I think it's catching everyone, everyone is shocked you know shocked to discover that we are still subject to plagues, but we are and you know it's a little unclear. Still, whether we will escape with a mild version, or we will, we're in for a much more serious version.

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00:19:32.160 --> 00:19:34.020

Nicholas Christakis : Anyway, that's an introduction to COVID-19

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00:19:34.560 --> 00:19:41.280

Robert George: Well, that's very helpful. Thank you. Nicholas if we, if we look back at those historical experiences.

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00:19:41.760 --> 00:19:48.360

Robert George: In ancient Athens. Obviously, they didn't know what germs where they didn't know what viruses were

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00:19:48.900 --> 00:20:00.990

Robert George: They somehow I suppose were just figuring out that if you got too close to a person who was sick, you ended up getting sick so they had worked that out and and introduced the kinds of policies like social distancing

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00:20:00.990 --> 00:20:01.530

Nicholas Christakis : Yeah, and

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00:20:01.650 --> 00:20:14.100

Nicholas Christakis : What's amazing is I just recently stumbled on a passage from Thucydides where he talks about how doctors were dying from it and he writes about how healthcare workers were ignorant of the cause.

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00:20:15.210 --> 00:20:18.120

Nicholas Christakis : But they were dying because they had contact with the victims.

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00:20:18.420 --> 00:20:29.400

Nicholas Christakis : Just like now like we're all surprised that healthcare workers. One of the reasons healthcare workers are so vulnerable, quite apart from the lack of personal protective equipment which is a national travesty that we

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00:20:29.640 --> 00:20:37.770

Nicholas Christakis : Know, just as a side I'm a physician myself I was clinically active during the HIV, the peak of the HIV epidemic in the 1990s.

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00:20:38.430 --> 00:20:46.500

Nicholas Christakis : We were rightly expected to take personal risks when caring for patients. You know those days that you can get a finger stick, you'd have to put gloves on two pairs of gloves.

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00:20:46.680 --> 00:20:54.660

Nicholas Christakis : And hope you didn't accidentally doing a bloody procedure on a patient. Get a lot on your face or your eyes or sticker your finger and

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00:20:55.860 --> 00:21:05.280

Nicholas Christakis : But we took care of the patients. They were our patients. It's a calling to be a doctor, you're expected to take some risk when you do this, just like if you're a fireman or a police officer.

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00:21:05.700 --> 00:21:14.310

Nicholas Christakis : But we don't send those people into battle without equipment. Right. I mean, we don't we don't send the firemen into a house naked, you know we give him or her a

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00:21:14.580 --> 00:21:19.320

Nicholas Christakis : Hat and an axe and oxygen tanks and water hose and we say, okay, now you take a risk of dying.

141

00:21:19.710 --> 00:21:27.360

Nicholas Christakis : But right now we're expecting our healthcare workers to take these extraordinary risks without adequate equipment and it is it is wrong. So

142

00:21:27.690 --> 00:21:32.610

Nicholas Christakis : So, so, but but the Athenians appreciated this too. And, and the reason healthcare workers.

143

00:21:33.330 --> 00:21:41.820

Nicholas Christakis : Are more likely to die, is that they get what's known as a higher inoculum. So if I touch a subway car and get COVID-19

144

00:21:42.360 --> 00:21:53.790

Nicholas Christakis : From a fomite, which is a smooth surface. So some of the germs there, I get a small dose of it or if I'm at some distance from you and you sneeze and I get a small dose.

145

00:21:54.270 --> 00:21:57.180

Nicholas Christakis : But if you're a healthcare worker and you're intubating a patient

146

00:21:57.630 --> 00:22:02.730

Nicholas Christakis : You get a big dose of the virus. So the virus takes root in you with a big dose.

147

00:22:03.000 --> 00:22:15.480

Nicholas Christakis : And you can't quite mount an immune system fast enough to cope with it. Whereas if you've gotten a small dose it wouldn't be so bad. And this is, incidentally, one of the reasons that intra household transmission of coronavirus

148

00:22:15.750 --> 00:22:22.050

Nicholas Christakis : Tends to be more serious than than community transmission. Because if you're in a household with a loved one.

149

00:22:22.560 --> 00:22:35.580

Nicholas Christakis : You're an intimate contact with them. So if you get it from them, you're going to get a higher dose than if you get it, let's say, because you went to the grocery store and you know you touch the the the credit card, you know, thing.

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00:22:36.990 --> 00:22:37.200

Nicholas Christakis : Now,

151

00:22:38.130 --> 00:22:42.540

Robert George: Nicholas. Let's get this one out on the table. I almost am afraid to ask.

152

00:22:43.950 --> 00:22:49.860

Robert George: What can we expect the number of deaths in the United States, roughly to be

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00:22:50.940 --> 00:22:53.610

Nicholas Christakis : Well, the problem with answering a question like that is

154

00:22:55.230 --> 00:23:04.230

Nicholas Christakis : That there's a range of estimates and what I'd love to do is give you like a probability distribution, you know. So there's this percent probability of 35,000 deaths and

155

00:23:04.710 --> 00:23:14.910

Nicholas Christakis : And this percent probability of 100,000 deaths and this percent probability of 200,000 deaths. So each of those will have will different probability estimate I it's hard to pick a point estimate, but

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00:23:15.600 --> 00:23:28.560

Nicholas Christakis : I would say, you know, there's a 99% chance will have at least 35,000 deaths and a 75% chance will have at least 50,000 deaths and

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00:23:29.040 --> 00:23:38.610

Nicholas Christakis : A 50% chance will have at least 100,000 deaths and there's a 25% chance we'll have 300,000 deaths and there is a 5% chance we'll have a million deaths.

158

00:23:39.000 --> 00:23:50.490

Nicholas Christakis : You know, or 2% chance of a million deaths. There's some low but non zero probability that will have quite a lot of death and destruction. So there's like a whole range you see of numbers.

159

00:23:51.120 --> 00:24:00.300

Nicholas Christakis : And it's so it's very hard to know what to do. And it's hard to speak about this. And incidentally, part of the reason that epidemiologists are so uncertain, we have to remind ourselves.

160

00:24:00.720 --> 00:24:04.110

Nicholas Christakis : Is that this thing has only been on the planet for two or three months. I mean,

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00:24:05.040 --> 00:24:13.800

Nicholas Christakis : We have a lot of knowledge about coronaviruses and a lot of knowledge about pandemics. But this particular pathogen left to humans, as we discussed in November, the fact that we

162

00:24:14.250 --> 00:24:18.630

Nicholas Christakis : Can even have such a conversation as we're having is a testament to our scientists and our doctors

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00:24:18.870 --> 00:24:26.820

Nicholas Christakis : And international cooperation and sharing information about this disease geneticists around the world, people working on all kinds of aspects of this so

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00:24:27.360 --> 00:24:37.290

Nicholas Christakis : So we should be patient. In other words, that we can't know exactly what's going to happen. But we have some ability to guess. And so

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00:24:37.740 --> 00:24:42.000

Nicholas Christakis : And it's unlikely we are going to dodge a bullet. And incidentally,

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00:24:42.360 --> 00:24:46.950

Nicholas Christakis : It was obvious we weren't going to dodge a bullet back in early February. I mean, this is

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00:24:47.190 --> 00:24:56.490

Nicholas Christakis : This is not suddenly we're discovering this and we have no way of knowing that is false. It was clear to experts from February that this was a very serious threat.

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00:24:56.730 --> 00:25:02.580

Nicholas Christakis : And that it was going to come to our shores and there was no reason to suppose that it would be different in the United States than anywhere else.

169

00:25:02.760 --> 00:25:12.300

Robert George: So would it be fair to say, Nicholas that if the death toll ends up being under 100,000 you will be surprised if it ends up being more than say 350,000 you'll be surprised.

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00:25:12.690 --> 00:25:19.890

Nicholas Christakis : Yes, no I won't be surprised. I'll definitely be surprised if it's under 100,000 although happy.

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00:25:20.520 --> 00:25:33.960

Nicholas Christakis : Yeah, and it's possible, but I won't be totally surprised if it's above 300,000 I mean I will be upset and you know that will be in the up. But yes, I think I, you know, and I have been saying this.

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00:25:34.470 --> 00:25:41.160

Nicholas Christakis : I've been awkwardly revising my estimates. So I think in February. I said I thought several million Americans would get infected and

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00:25:41.640 --> 00:25:57.360

Nicholas Christakis : 35,000 at least would die and by March, the fourth or fifth I was of the opinion that it would be like the 1957 pandemic, which means about 250,000 will die. So, but there's they're moving targets still

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00:25:57.720 --> 00:26:08.070

Robert George: Do we have any serious danger that the virus will mutate in a way that will make the situation worse by, for example, nullifying whatever

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00:26:09.420 --> 00:26:09.690

Nicholas Christakis : It.

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00:26:10.020 --> 00:26:10.980

Nicholas Christakis : is unlikely.

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00:26:11.130 --> 00:26:13.290

Robert George: To be most promising. So that's unlikely.

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00:26:13.410 --> 00:26:17.370

Nicholas Christakis : It is unlikely that is unlikely. It's not typically what happens in 1918

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00:26:18.390 --> 00:26:28.530

Nicholas Christakis : The second wave. We haven't talked about this yet, but what's gonna what happens typically with these respiratory pandemics is the we're just being hit by the first wave okay and and this is

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00:26:29.010 --> 00:26:40.200

Nicholas Christakis : I'll say two things. First, I'll talk about flattening the curve. So what we're trying to do here is if they're going to be 100,000 deaths in the United States. What we're trying to do is avoid having all hundred thousand of those deaths occurred this month.

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00:26:41.520 --> 00:26:44.370

Nicholas Christakis : By engaging in social distancing we flatten the curve.

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00:26:44.610 --> 00:26:56.340

Nicholas Christakis : So maybe still 100,000 deaths will occur, but they will occur over time, which allows our healthcare system to take care of them 10,000 patients a month, instead of 100,000 patients this month. So we don't overwhelm our healthcare system.

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00:26:56.820 --> 00:27:00.090

Nicholas Christakis : Right. And furthermore, we push out some of the deaths into the future.

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00:27:00.270 --> 00:27:10.380

Nicholas Christakis : By which time we may know better how to treat the condition. So we eliminate some deaths, for instance. Maybe by then there's a vaccine, so we can cut off the tail of the distribution out in the future.

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00:27:10.710 --> 00:27:15.720

Nicholas Christakis : So there are a number of advantages of flattening the curve which is why we're engaging in the social distancing

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00:27:15.960 --> 00:27:26.250

Nicholas Christakis : We could have taken it on the chin and just said, all right, 300,000 Americans are going to die sooner or later. Let her rip let's let them all die now and then get it over with.

187

00:27:26.970 --> 00:27:38.340

Nicholas Christakis : But that's inhumane and politically very difficult. And I think when those deaths started happening. People would be clamoring for it to stop. But by then it would be too late to engage in the social distancing

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00:27:38.640 --> 00:27:41.880

Robert George: And we will vote in that case would have overwhelmed the healthcare system right now as

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00:27:41.880 --> 00:27:43.110

Nicholas Christakis : Well, yes, we'll have

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00:27:43.980 --> 00:27:53.520

Nicholas Christakis : Yeah, completely as Yeah, as happened in Lombardy, and in Wuhan and is quite possibly going to happen in New York and in other cities, by the way, I think, Florida.

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00:27:54.210 --> 00:28:04.260

Nicholas Christakis : Louisiana those cities, those, those states are just lagging. I mean, I think the the behavior in Florida has been from my point of view as a public health expert utterly irresponsible.

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00:28:05.040 --> 00:28:11.250

Nicholas Christakis : You know, but anyway, let me just finish on the flattening thing. So what's happening now is, is we're just having the first wave

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00:28:12.270 --> 00:28:18.930

Nicholas Christakis : Typically what these respiratory viruses do is they then go in our summer they spend the winter in the southern hemisphere.

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00:28:19.380 --> 00:28:25.320

Nicholas Christakis : They go to the southern hemisphere and the afflict it there we typically get a little relief in the summer weather.

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00:28:26.100 --> 00:28:35.880

Nicholas Christakis : People aren't indoors. They go outside ventilation is better. Maybe the heat makes a little bit of a difference. We're not as compact your population density goes down.

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00:28:36.450 --> 00:28:41.010

Nicholas Christakis : People spread out. And so typically with respiratory pandemics, we get a little break in the summer.

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00:28:41.490 --> 00:28:50.850

Nicholas Christakis : Most people do not think for various reasons that that will happen in this case we make it a small break but study so far suggest that we're not going to get a weather cure.

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00:28:51.240 --> 00:28:56.730

Nicholas Christakis : But anyway, typically what happens is they go to the southern hemisphere. And then when people go back to school.

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00:28:57.300 --> 00:29:05.340

Nicholas Christakis : And return to work in September and the winter approaches the epidemic comes back and you get the second wave in the fall.

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00:29:05.610 --> 00:29:13.650

Nicholas Christakis : So that's what's likely to happen in this case as well we're likely to see a second wave in the fall and then a third wave and then eventually what will happen is

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00:29:13.830 --> 00:29:20.430

Nicholas Christakis : The disease will become endemic in our population, that is to say, it's going to become like the flu or the common cold. If we're lucky.

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00:29:20.730 --> 00:29:31.320

Nicholas Christakis : And it'll just be one of those pathogens that circulates in our species and we'll have herd immunity enough of us will be immune that the pathogen cannot easily spread through us.

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00:29:31.950 --> 00:29:33.990

Robert George: You know, we're just at the beginning of the first wave

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00:29:34.470 --> 00:29:38.460

Nicholas Christakis : And there is likely to be a second wave. And then the end game is we'll get used to it.

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00:29:39.480 --> 00:29:46.890

Robert George: On Nicholas. Am I right that in the in the Spanish flu case in the 1918-19 case. The second wave was actually deadlier than the first

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00:29:46.920 --> 00:29:54.930

Nicholas Christakis : Yes, it was four times deadlier for reasons we don't fully understand. I remember your question. Now it's uncommon.

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00:29:56.280 --> 00:30:01.590

Nicholas Christakis : That the pathogen the reason for that deadliness is that the pathogen is mutating to become more deadly

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00:30:03.600 --> 00:30:06.510

Nicholas Christakis : The pathogen might mutate to become more transmissible

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00:30:08.070 --> 00:30:17.850

Nicholas Christakis : Which is a different thing. But, uh, but I, and it could mutate to become more deadly but that's typically not what's happening. There's, this is a whole complicated area, why we have to have

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00:30:18.120 --> 00:30:29.880

Nicholas Christakis : New kinds of flu vaccines every year, will we need to do this with a coronavirus or will we just have one off vaccination. There are vaccines for coronaviruses that afflict pets.

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00:30:30.240 --> 00:30:35.970

Nicholas Christakis : I think dogs and cows have certain coronavirus infections and there are effective veterinary vaccines for those

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00:30:36.390 --> 00:30:50.490

Nicholas Christakis : So my understanding is that the people that are developing vaccines are fairly optimistic that we will be able to have an effective vaccine against coronavirus maybe in 18 months if everything goes smoothly.

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00:30:51.450 --> 00:31:01.020

Robert George: Nicholas I want to ask a couple more questions on my own. And then I'm going to start giving you some questions that are coming in from members of our audience.

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00:31:01.650 --> 00:31:13.110

Robert George: First, what can you tell us about the status of things when it comes to a an actual vaccine and b effective treatments. Perhaps using the malarial drugs.

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00:31:14.340 --> 00:31:19.170

Robert George: have been considered and talked about or other other therapies or pharmaceutical products.

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00:31:21.270 --> 00:31:34.770

Nicholas Christakis : So, so the vaccine. They're going to be many, I mean they'll be commercially very valuable. And we have lots of wonderful scientists around the world working on this, and we have a lot of experience developing vaccines now this is not a particularly easy vaccine to develop

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00:31:35.850 --> 00:31:43.890

Nicholas Christakis : But, but I think we will be able to develop one. If I had to bet, probably we will. And as I said, I think we'll have one in about 18 months, we may have more than one

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00:31:44.550 --> 00:31:58.500

Nicholas Christakis : By competing manufacturers and that'll be great. There are different strategies for doing this. There is a relatively uncommon strategy, which is you immunize people with the actual RNA in the virus and

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00:31:59.580 --> 00:32:06.660

Nicholas Christakis : Or fragments of it and and people seem to think that that might be more effective, although that has certain risks.

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00:32:06.960 --> 00:32:13.500

Nicholas Christakis : And then there are proteins that the virus expresses on its surface which are very logical targets for a vaccine.

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00:32:13.680 --> 00:32:27.750

Nicholas Christakis : Basically, in a vaccine, what you're doing is you're giving someone one way or the other, whether it's whether it's an inactivated virus or it's parts of the virus, you try to elicit an immune response from the host with something you give them which cannot actually make them sick.

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00:32:29.100 --> 00:32:38.100

Nicholas Christakis : And we typically we need to have tests of animal testing and then careful human testing for this and some of these steps may be in our rush may be aborted right now.

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00:32:38.820 --> 00:32:40.260

Robert George: Is that okay, in your view.

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00:32:40.890 --> 00:32:51.720

Nicholas Christakis : I'm not the right person to ask. I'm wary of it. I think that's a difficult, difficult calculation. I'm wary of getting a vaccine that we think works that actually does more harm than good and

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00:32:52.680 --> 00:32:58.410

Nicholas Christakis : I think you would have to do a mathematical calculation on potential lives saved versus potential lives lost

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00:32:58.710 --> 00:33:04.830

Nicholas Christakis : Most of these decisions ultimately wind up being utilitarian, I mean that's triage that's public health, you know, you

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00:33:05.040 --> 00:33:11.790

Nicholas Christakis : You take a collective opinion and you say, What can I do that saves the most lives. I'm going to lose lives, no matter what I choose

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00:33:12.060 --> 00:33:19.920

Nicholas Christakis : What's the choice that reduces it, like for example tanking our economy. People are rightly pointing out that we're going to lose lives due to poverty or suicide.

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00:33:20.250 --> 00:33:32.190

Nicholas Christakis : And that you know it's bad for our health to tank our economy and and so you have to decide. Are we going to lose fewer lives doing that, then we would have taken if we had just had the disease run rampant.

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00:33:33.090 --> 00:33:39.180

Nicholas Christakis : These are not easy decisions to make, let alone the decision of weighing the loss of life against money.

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00:33:39.450 --> 00:33:46.170

Nicholas Christakis : Right right now talking about lives versus lives like deaths due to suicide versus deaths due to coronavirus deaths due to poverty.

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00:33:46.410 --> 00:33:53.430

Nicholas Christakis : You know, because people are starving versus desktop coronavirus that is life versus life. But then what if it's life versus dollars. You know, like

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00:33:53.850 --> 00:34:04.740

Nicholas Christakis : How many deaths, will we want to prevent in order to have a trillion dollar disaster afflict us and as you know there are rules of thumb for how to value human life in terms of money and all of that.

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00:34:04.830 --> 00:34:08.040

Robert George: Oh yeah, I mean it's a kind of thing that in the normal course of things we

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00:34:08.370 --> 00:34:15.510

Robert George: We know is going on. We know we're making decisions, but we don't really pay that much attention to it. We know we could reduce the death toll on the highways by

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00:34:15.840 --> 00:34:26.220

Robert George: Moving the speed limit from 65 to 25 but that would of course cost efficiency and transporting of persons and goods that would have economic consequences. What about the

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00:34:26.430 --> 00:34:30.630

Nicholas Christakis : Hold on, hold on. You asked me about and then drugs.

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00:34:30.690 --> 00:34:31.440

Robert George: Yes, that was where I was going

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00:34:31.950 --> 00:34:42.930

Nicholas Christakis : So drugs. I mean, I have not done a deep dive on the whole chloroquine thing I did see the studies out of China and January that show that chloroquine and zinc seem to have some efficacy in their hands.

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00:34:43.320 --> 00:34:52.980

Nicholas Christakis : These are typically things that are tried late in the course. So I don't. I haven't seen any evidence that suggests that if you take these things prophylactically, they have any effect or early in the course.

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00:34:53.340 --> 00:35:03.120

Robert George: But as a treatment my understanding is that New York is now treating quite a large number of people with some sort of mix of hydroxy chloroquine

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00:35:04.920 --> 00:35:05.700

Robert George: Azithro

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00:35:05.790 --> 00:35:07.740

Nicholas Christakis : Azithromycin

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00:35:08.490 --> 00:35:11.970

Robert George: And zinc. So does that mean we'll know pretty soon, whether it's working or not

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00:35:12.060 --> 00:35:26.190

Nicholas Christakis : No, because unfortunately we're not doing it in a randomized control trial. So the one tiny RCT that's been done of chloroquine and azithromycin that came out of France that I've seen was tiny didn't show any benefit.

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00:35:27.960 --> 00:35:31.320

Nicholas Christakis : That there's another unrandomized control study.

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00:35:32.100 --> 00:35:39.450

Nicholas Christakis : That has been done, which is also in France, which shows some benefit, but the problem is you don't know if you're giving the relatively

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00:35:39.690 --> 00:35:53.190

Nicholas Christakis : Well patients who otherwise would have done better anyway, this combination of drugs and so you think that what's happening is your drug is helping. But actually, those people were in unobservable ways you know better off so

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00:35:53.940 --> 00:35:54.840

Robert George: Yeah, go right ahead.

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00:35:55.200 --> 00:36:04.740

Nicholas Christakis : Nothing. So we need a lot more studies. I'm not prepared to make a statement on the utility of those drugs I can say that the Chinese doctors seem to think that they were helpful.

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00:36:04.980 --> 00:36:12.090

Nicholas Christakis : And I have a lot of confidence in frontline clinicians who are carefully observing patients and noticing.

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00:36:12.540 --> 00:36:22.650

Nicholas Christakis : Things that help and you know I don't want to second guess them right now. But I, and if the New York doctors are doing it. And if we talked to 10 of them. And they said, you know, I think it helped

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00:36:23.460 --> 00:36:29.850

Nicholas Christakis : I think there's something there. But a lot of times, doctors have said that and they were wrong. It had no effect or even hurt people.

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00:36:30.120 --> 00:36:34.290

Nicholas Christakis : There are many many examples of things that were widely adopted and rise, what

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00:36:34.590 --> 00:36:38.010

Robert George: I assume, you'll be keeping your eyes on what's happening in New York. That's one of the things you're going to be look

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00:36:38.010 --> 00:36:38.490

Nicholas Christakis : Yes.

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00:36:38.880 --> 00:36:46.860

Nicholas Christakis : But anyway, the point is just, it's, it's good to pay attention to what the doctors are telling us about their clinical observation, but I wouldn't assume that it's true.

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00:36:47.340 --> 00:36:56.820

Robert George: Okay. Now, unfortunately, our time is racing by and this is so informative and useful Nicholas. I'm going to now move to questions from our audience.

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00:36:58.080 --> 00:37:10.830

Robert George: First one is from Kevin W. and he asks, should the public were non N95 masks when doing essential errands. Are bandanas and homemade masks okay.

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00:37:11.850 --> 00:37:18.750

Nicholas Christakis : So there's a huge debate about this right now about masks. In general, the answer is yes. I think we should be wearing masks.

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00:37:19.980 --> 00:37:30.780

Nicholas Christakis : There's a couple of provisos one proviso is some people think if you're sick and you're wearing the mask. While you might help others. You might make it worse for yourself by reinhaling the viroid particles.

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00:37:31.380 --> 00:37:37.890

Nicholas Christakis : So maybe if you know you're sick with a pathogen and you shouldn't go out at all like, you shouldn't like put on a mask and go out

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00:37:38.460 --> 00:37:43.560

Nicholas Christakis : But if you're not sick and you wear a mask or you're asymptomatic. It will reduce the

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00:37:44.250 --> 00:37:52.050

Nicholas Christakis : Your tra... So the best is both of us wear a mask it reduces the propulsive force of the particles leaving my nose and mouth.

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00:37:52.470 --> 00:38:04.350

Nicholas Christakis : And you're wearing the mask also reduces your ability to inhale it. The N95 masks that everyone talks about are quite good, but a bandana, I think I saw somewhere. Some studies is like half as good

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00:38:04.740 --> 00:38:16.980

Nicholas Christakis : So it's better than nothing, but, and also it's, it will by wearing a mask sending a signal to other people that you're taking it seriously. The other advantage of a mask is that it stops you from touching your nose and mouth.

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00:38:17.310 --> 00:38:22.230

Nicholas Christakis : Which is we know that's bad. So if you touch stuff and you pick up the virus particles and then

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00:38:22.590 --> 00:38:34.770

Nicholas Christakis : Put them right in your nose and mouth. That's bad. So one of the ways of mask works is by preventing you from touching your face by reminding you, not to touch it. So a bandana can serve that purpose, as well as a better mask.

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00:38:35.490 --> 00:38:45.000

Robert George: Good. Okay, so thanks for that. Now, we have a question. I don't have a name for the question or by the way people in the audience, please go ahead and send your questions in

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00:38:45.360 --> 00:38:54.060

Nicholas Christakis : I, I'll just mention that I'm on Twitter and I send out as best I can. Long threads that described many things that were some of the things we're discussing today.

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00:38:54.360 --> 00:39:10.860

Robert George: Oh and while we're at it, let me say what I have myself said on Twitter. I've urged all of my own Twitter followers to follow Nicholas Christakis. He is the most reliable and insightful source of information known to me on this terrible epidemic. So please do.

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00:39:10.890 --> 00:39:17.850

Nicholas Christakis : And I'll make one other pitch. It's a bit self serving because it's sort of ironic. I wrote this book, which I know you know called Blueprint.

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00:39:18.000 --> 00:39:20.340

Nicholas Christakis : The Evolutionary Origins of a Good Society.

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00:39:20.700 --> 00:39:27.660

Nicholas Christakis : It was it came out in hardcover, a year ago was a New York Times bestseller. I'm very proud of the book I spend a year 10 years of my life writing this book.

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00:39:27.870 --> 00:39:34.440

Nicholas Christakis : It's a book about the origins of goodness and why we're good. And incidentally, there's a loose connection with the coronavirus because

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00:39:34.770 --> 00:39:42.930

Nicholas Christakis : I talk in the book about how we evolved to form groups and to kiss each other and to have friends, you know, all these wonderful qualities and

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00:39:43.320 --> 00:39:50.730

Nicholas Christakis : And the virus, of course exploits those human natural qualities to transmit. So I'm finding myself in this crazy position.

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00:39:51.150 --> 00:40:03.330

Nicholas Christakis : Of having to spend my life studying friendship and love and now advising people to stay away from each other. But anyway, but the paperback just came out on March 10 and promptly died because it fell into the coronavirus void.

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00:40:03.540 --> 00:40:07.140

Nicholas Christakis : So if anyone is interested in my other life when I'm not talking about viruses.

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00:40:07.410 --> 00:40:09.420

Nicholas Christakis : I have this book, which is a nice book.

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00:40:10.110 --> 00:40:10.590

Robert George: And I know a

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00:40:10.680 --> 00:40:11.070

Nicholas Christakis : Lot.

283

00:40:11.310 --> 00:40:14.130

Robert George: Being one myself. I know we like to plug our most recent book.

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00:40:15.150 --> 00:40:20.700

Robert George: But I want to point out a book that I think is very important is Professor Christakis his book Connected his book on

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00:40:21.180 --> 00:40:32.940

Robert George: Connections, which was published, what maybe a decade ago. Yes, something like that. So that's a go to text as well. Anyway, so my question or asks how trustworthy is the data from China.

286

00:40:33.330 --> 00:40:42.270

Robert George: Especially the information we ourselves are using to make policy decisions concerning infection rates severity of illness and mortality. Do you have the answer to that question, Nicholas

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00:40:42.300 --> 00:40:44.280

Nicholas Christakis : I think a lot of the data.

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00:40:44.340 --> 00:40:49.320

Nicholas Christakis : Is reliable. I don't, I don't, I think it's important to note that

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00:40:50.940 --> 00:41:01.920

Nicholas Christakis : The Chinese Communist Party is not a reliable source of information very often. I think that like many authoritarian governments, there's a premium on secrecy.

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00:41:02.400 --> 00:41:07.620

Nicholas Christakis : I should say that, in fairness, a lot of the information coming out of our government has not been accurate either

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00:41:07.890 --> 00:41:16.530

Nicholas Christakis : And there's been a lot of falsehoods that have been said at the highest levels of our government that this is like going to be like the flu and stuff like that which you know are also not true.

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00:41:17.610 --> 00:41:27.690

Nicholas Christakis : But in terms of the data. I think many of the studies are quite reliable and have now been validated by Italian studies. So things like the mortality rate the clinical presentation.

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00:41:28.470 --> 00:41:36.660

Nicholas Christakis : The reproductive effective reproductive number. These are all things that the Italians have also been looking at. And we have quite reliable information from them.

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00:41:37.290 --> 00:41:42.720

Nicholas Christakis : If, if, on the issue that's been very much in the news are the Chinese hiding their

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00:41:43.320 --> 00:41:51.360

Nicholas Christakis : Their mortality rates. I think probably yes in Wuhan early, but I think they themselves had a powerful incentive

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00:41:51.690 --> 00:42:04.260

Nicholas Christakis : For truth telling in order to track the epidemic certainly by the middle of January, because they themselves don't want to fly blind and they don't want their people to die, they lose legitimacy and they do have some concern for their people. So

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00:42:04.590 --> 00:42:14.400

Nicholas Christakis : So accurate reporting was essential if you're going to combat this infection. So I do believe those numbers and we in some of our research which I can't discuss yet. I have a

298

00:42:15.330 --> 00:42:25.590

Nicholas Christakis : Kind of crazy way that I know that their fatality numbers are almost certainly accurate after the initial shock in Wuhan

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00:42:26.820 --> 00:42:35.520

Robert George: Okay, here's a related question Nicholas from Richard W. He says, I've been watching the reports of the virus path in China and in South Korea.

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00:42:36.570 --> 00:42:46.200

Robert George: With it, peaking and dwindling within 60 to 90 days. How is it possible that China has quote contained unquote this to a single province. Wuhan.

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00:42:46.800 --> 00:42:55.290

Robert George: Where's their national spread and perhaps the upshot of that question is can you relate that to what's likely to happen here in terms of number of days and peaking and so forth.

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00:42:55.890 --> 00:43:09.690

Nicholas Christakis : Yeah. So what you need to understand is what the Chinese did beginning January the 25th. They basically deployed a social nuclear weapon to stop this virus, they passed regulations that kept 930 million people.

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00:43:10.620 --> 00:43:20.070

Nicholas Christakis : In home confinement. Since then nothing of this kind, has ever been done before a billion people on our planet. This one of the reasons I was so alarmed.

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00:43:20.400 --> 00:43:27.150

Nicholas Christakis : Because I was saying, Oh my God, look what the Chinese are doing. They're not doing this for fun. They're doing it because they judged it to be necessary.

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00:43:27.360 --> 00:43:39.150

Nicholas Christakis : Therefore, in all probability, the adversary, the virus was very powerful they put a billion people under lockdown. You could one person in the household could leave once or twice a week for essentials and they're still that way.

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00:43:39.510 --> 00:43:41.730

Nicholas Christakis : That's why they have reduced their, their

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00:43:42.210 --> 00:43:49.050

Nicholas Christakis : Cases to nearly zero, but they have not let me be clear what the Chinese have succeeded in doing is stopping the spread of the virus.

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00:43:49.260 --> 00:44:01.050

Nicholas Christakis : They have not eradicated the virus. The virus will come back to China, as it will everywhere else. But what the Chinese have done is bought themselves time, just as we must to get their defenses in order

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00:44:01.140 --> 00:44:03.270

Nicholas Christakis : To get the personal protective equipment or

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00:44:03.660 --> 00:44:04.770

Nicholas Christakis : The hospitals ready

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00:44:04.800 --> 00:44:10.620

Nicholas Christakis : To get the public ready to get every elevator in the country in China. They have these little clay.

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00:44:11.580 --> 00:44:20.040

Nicholas Christakis : Pin cushions with toothpicks in every elevator and when you go in the elevators cleaned and then they put this in. And when you go to the elevator you're supposed to take a toothpick.

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00:44:20.370 --> 00:44:26.430

Nicholas Christakis : Hit the button for your floor and then throw away the toothpick so that you reduce transmission, you see.

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00:44:26.640 --> 00:44:29.040

Nicholas Christakis : And you have to get the people ready for this type of thing.

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00:44:29.400 --> 00:44:38.190

Nicholas Christakis : So that's what the Chinese have done for themselves and they're going to slowly release their cities from quarantine now in an organized way. I suspect to cope with it.

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00:44:38.670 --> 00:44:45.630

Robert George: Nicholas before we went on live you and I were chatting about the importance of the development of a serological test

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00:44:47.220 --> 00:44:47.700

Nicholas Christakis : Test.

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00:44:48.690 --> 00:44:54.810

Robert George: For antibodies. Can you talk about why that's so important. And can you give us a sense of when we might actually

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00:44:54.990 --> 00:45:04.800

Nicholas Christakis : Yes. So the lot of the testing we, the United States flubbed the testing for the virus and we still need to do it, but we're kind of really behind now.

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00:45:05.130 --> 00:45:11.460

Nicholas Christakis : That's a test where they put a swab into your nose or throat and swab the back of your throat to get some

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00:45:12.120 --> 00:45:17.580

Nicholas Christakis : Some secretions from your body that hopefully have the virus in it, and then they do a test.

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00:45:17.910 --> 00:45:31.440

Nicholas Christakis : Called PCR polymerase chain reaction for the viral RNA itself. They're trying to detect the virus, incidentally, you won't believe this, but one of the reasons we're having difficulty with this test right now, quite apart from the fact that we flubbed

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00:45:32.370 --> 00:45:38.910

Nicholas Christakis : Some of the probes, the RNA probes that are needed, is we don't have enough of these fancy Q tips like the richest nation on earth.

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00:45:39.360 --> 00:45:43.980

Nicholas Christakis : We don't have the damn swabs we need to do this test. So it's, again, just

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00:45:44.220 --> 00:45:56.400

Nicholas Christakis : To someone like me I gets, you know, gets me upset. Let's just put it that way. So, so those are the tests that we need to do for the virus, they could only however detect it if you're sick with it now. Once you are well once you clear the virus.

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00:45:56.820 --> 00:46:05.130

Nicholas Christakis : It's not in your body. So if you had the virus, a month ago and many listeners will have had a fever and a dry cough in February or January, even

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00:46:05.400 --> 00:46:17.430

Nicholas Christakis : And they'll or they had one of the worst flus of their life. And I think I bet you I had it if you went to the doctor and some of them didn't have it probably there are 700 participants I'm seeing. Probably 100 or more of them.

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00:46:18.900 --> 00:46:23.220

Nicholas Christakis : Yeah, I had this condition already and are fine and they're now immune

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00:46:23.550 --> 00:46:34.110

Nicholas Christakis : So, but if they went to the doctor and had this test, they wouldn't detect it. So we need a different test called a serological test which relies on blood from a pinprick or venipuncture

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00:46:34.440 --> 00:46:39.540

Nicholas Christakis : And then you test for your antibodies, we're detecting the human antibodies against the virus.

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00:46:39.960 --> 00:46:50.400

Nicholas Christakis : And these tests have been developed already in Singapore. As of January and in China in February and already in Mount Sinai and other places around the world Mount Sinai in New York.

332

00:46:50.850 --> 00:47:02.790

Nicholas Christakis : People have versions of this test, and we need this test as soon as possible, and we need desperately, random samples of Americans in different parts of the country to be tested. So we know

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00:47:03.240 --> 00:47:11.850

Nicholas Christakis : Who is immune. So we can estimate how many people were infected and therefore estimate how deadly is the pathogen and, furthermore, if people are known to be immune

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00:47:12.360 --> 00:47:27.450

Nicholas Christakis : They don't have to be at home, they can return to work and keep our economy going. So of the people there are 700 people on this call and they're all at home right now all the ones that are immune, they could leave their house. They don't have to be here. So it's a huge waste not to have this

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00:47:28.050 --> 00:47:44.520

Robert George: Nicholas. You said something to me also in our conversation before we went live, which is relevant to this, you said that even though people who've had the disease and survived it are immune and may be immune for some time, although I gather, we don't know how long the immunity

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00:47:44.760 --> 00:47:53.400

Robert George: They could still be vectors, they could still bring home the vice versa comes home on their skin or on their clothing or something like that.

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00:47:54.060 --> 00:48:02.460

Robert George: A spouse, a child grandpa anybody in the house, anybody they come into contact with could end up contracting what then might be a deadly virus.

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00:48:03.060 --> 00:48:12.390

Nicholas Christakis : Yeah, I think, I think immunity. I think that's an important detail. So just because you're immune, you can't transmit it anymore because it's in your body, you know, you're not coughing it up because your immune

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00:48:13.860 --> 00:48:16.740

Nicholas Christakis : Subject to, you know, yeah. Bunch of other wrinkles, but

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00:48:16.770 --> 00:48:17.760

One of the wrinkles

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00:48:18.810 --> 00:48:19.470

Nicholas Christakis : Why

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00:48:19.590 --> 00:48:21.660

Robert George: We could touch the elevator button and bring it

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00:48:21.720 --> 00:48:26.670

Nicholas Christakis : Right. Well, that's the wrinkle we're talking about now. There are actually a few other wrinkles to, for example, the test could be a false

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00:48:26.760 --> 00:48:35.490

Nicholas Christakis : Positive you I can tell you you're muted, but you're not actually immune. But anyway, and other wrinkles. There are lots of little wrinkles. But, but the wrinkle we're talking about now is the wrinkle that

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00:48:35.850 --> 00:48:41.730

Nicholas Christakis : You could touch a surface and bring it home, but this is solved by washing your hands. I mean, one of the things about this virus that's so interesting is

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00:48:42.030 --> 00:48:51.960

Nicholas Christakis : It's very fragile. So like soap and water kills it. So if you're immune and you go to work and you come home and you wash your hands and you change your clothes, you're not going to give it to anybody. Okay.

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00:48:52.770 --> 00:49:07.680

Robert George: Alright, so let's move to another question. What is the appropriate exit strategy from current quarantine measures will testing play an important role. Yes, antibody testing. You've already said will um

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00:49:08.250 --> 00:49:09.750

Robert George: What about. Yeah.

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00:49:09.780 --> 00:49:21.720

Nicholas Christakis : Go ahead, everyone wants to know, when will this end. And the answer is, it will end when we are ready for it to end. When we are ready to adopt the kinds of practices that are common in South Korea and in Taiwan, where

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00:49:22.260 --> 00:49:31.110

Nicholas Christakis : We adopt some social distancing physical distancing still we have testing. So we can test people we do some contact tracing and some self isolation and quarantine.

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00:49:31.410 --> 00:49:43.380

Nicholas Christakis : When we have our healthcare system stabilized. So those of us that get sick can be cared for, right, like I would happily stay at home for three months if it meant that my neighbors are not going to die.

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00:49:43.830 --> 00:49:54.060

Nicholas Christakis : Right it but if you tell me. Okay, now we have all the ICU beds. We have all the equipment we know what we're doing. If someone gets sick, we can help them. Then I'll say, okay, maybe I'll leave my house now.

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00:49:54.930 --> 00:50:01.590

Nicholas Christakis : But we're not there right now. So right now we have a situation where we have rising fatalities still in many of our major cities and

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00:50:01.980 --> 00:50:12.150

Nicholas Christakis : And we're going to start having the hotspots around the country, there will be parts of the country that are spared. And that's going to happen, partly due to chance. Even in the 1918 and 1957 pandemics.

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00:50:12.600 --> 00:50:22.860

Nicholas Christakis : You know, Rhode Island was a hotspot in in '57. I don't know why. It just was but you know I'm making it up, Tennessee was not. I don't know what the status of Tennessee was but you know just going to vary.

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00:50:23.250 --> 00:50:29.130

Nicholas Christakis : And so some of that's going to be chance and some of it's going to have to do with the public response. So actually, with respect to Tennessee.

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00:50:29.400 --> 00:50:45.360

Nicholas Christakis : There's a very interesting contrast right now between Kentucky and Tennessee, where Kentucky took more rapid collective measure sooner and the epidemic is really rising in Tennessee, whereas in Kentucky. It's a much damper, course.

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00:50:46.050 --> 00:50:59.910

Robert George: Now I have a question from one of our most outstanding recent alumni Solveig G. and she has a question that I think is going to be of interest to students and to people like you and me.

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00:51:00.750 --> 00:51:15.630

Robert George: Professors, Nicholas, what is the likelihood that schools and universities are going to be able to reopen in the fall, as you know, most places now have sent their students home. Many graduations and commencement ceremonies have been canceled alumni reunions have been

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00:51:16.770 --> 00:51:23.400

Robert George: Canceled. Our, our campuses just have the few students who are unable to go home because they're international students. They can't travel or

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00:51:23.850 --> 00:51:32.850

Robert George: What have you, but will we be up and running in the fall, or will we still be teaching our courses and taking our courses on Zoom technology and other video conferencing technologies.

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00:51:32.970 --> 00:51:39.900

Nicholas Christakis : I don't know the answer to that. But I think there's a non trivial probability that we won't open. I think a lot depends on

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00:51:40.650 --> 00:51:47.070

Nicholas Christakis : It's hard to forecast. It depends on what happens between now and then. And I also think, even if we do reopen there's a

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00:51:47.880 --> 00:51:53.820

Nicholas Christakis : More than non trivial probability that we will have to close again. So I think

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00:51:54.390 --> 00:52:01.890

Nicholas Christakis : Some schools may decide why bother to open. We all the experts are telling us by then we'll know much more about the germ and the epidemic.

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00:52:02.310 --> 00:52:12.720

Nicholas Christakis : By August and so some people will say why we open all the experts are saying, we're just going to close in October. Others will say, I'll take our chances and will be better prepared for the closure now.

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00:52:13.380 --> 00:52:20.700

Nicholas Christakis : So I wouldn't be surprised if we did not reopen many schools. I also think schools will go different paths. I think it'll depend on

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00:52:21.150 --> 00:52:24.690

Nicholas Christakis : On local communities and the outbreaks there. I think there's going to be a lot of different

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00:52:25.380 --> 00:52:39.660

Nicholas Christakis : Variability on how this is handled, but it won't surprise me if we either don't open many schools or if we open then if we close them again. This happened in 1918 by the way the schools closed and then open and then immediately closed again.

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00:52:41.040 --> 00:52:49.770

Robert George: What's your own experienced Nicholas, are you teaching this semester as I am. I've been teaching by Zoom technology. I've been surprised at how first easy to learn that is

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00:52:50.580 --> 00:53:00.810

Robert George: We're using it right now, of course, and secondly how good it is. Now, I still believe perhaps the perhaps dogmatically that there's nothing like being in a classroom.

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00:53:02.070 --> 00:53:07.980

Robert George: Together and faculty and students together and I want to believe and I think I do believe that's irreplaceable.

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00:53:08.430 --> 00:53:18.990

Robert George: And yet, we've been able to have some excellent discussion seminar discussions, I know some of my colleagues are lecturing effectively online. Have you had any experience with teaching

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00:53:19.470 --> 00:53:24.720

Nicholas Christakis : So yeah, I'm teaching this semester too I don't share your optimism for this reason. First of all, I love

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00:53:25.140 --> 00:53:30.930

Nicholas Christakis : I love the classroom. I love the theater of it. I love seeing the students' eyes. I like looking out at a sea of faces.

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00:53:31.260 --> 00:53:40.410

Nicholas Christakis : I get feedback are they understanding what I'm saying. When I you know what it's like when you give a lecture, you can tell it's like a musical performance. You know, there's a kind of performativity which I enjoy

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00:53:40.890 --> 00:53:51.150

Nicholas Christakis : And a kind of a kind of call and response, which I think is extremely. It's like going to a religious service in person versus not in person. It's a totally different experience in my

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00:53:51.150 --> 00:53:51.390

Robert George: View.

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00:53:51.420 --> 00:53:53.190

Robert George: Is a big. It's also a big issue.

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00:53:53.460 --> 00:53:54.420

Nicholas Christakis : Yeah yeah

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00:53:54.600 --> 00:53:59.910

Robert George: Most at least large churches and synagogues and mosques have had to close.

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00:54:00.060 --> 00:54:07.680

Nicholas Christakis : Of course correctly so frankly, but so so I yes there's things you can do with distance technology like this.

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00:54:07.980 --> 00:54:18.660

Nicholas Christakis : There are things you cannot do the seminar. So I have a large lecture that I teach and I luckily had all my lectures taped from a few years ago, so I don't have to read deliver them in the kind of awkward way like standing in front of Zoom

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00:54:19.350 --> 00:54:21.720

Robert George: I'm in the same position. It's a real blessing.

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00:54:21.990 --> 00:54:30.960

Nicholas Christakis : Yes. So realize okay okay the lecture, I was going to give you a slightly better I improved it had some updated readings and I perfected some things, but just watch the old version. So that's

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00:54:31.260 --> 00:54:32.700

Nicholas Christakis : That's okay. And then I have

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00:54:33.060 --> 00:54:42.330

Nicholas Christakis : Office hours for those students online which works. The seminar, I, I have not liked doing the seminar online, partly because

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00:54:43.020 --> 00:54:56.370

Nicholas Christakis : People tire in my really I just tired after an hour for two hour seminar, even if you can see everyone's faces. They can't see each other. They don't how to raise your hands, it's, it doesn't work. So we're, we've shortened my seminar from two hours to an hour, my seminar class.

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00:54:56.850 --> 00:55:07.230

Robert George: Yeah, I have a question from another alumnus from an earlier generation and a great friend and supporter of the Madison program Bob Murley and he says, what should

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00:55:08.010 --> 00:55:17.820

Robert George: Be the criteria that we use to know when it's reasonable and prudent to return to to a normalized way of life until reopen society on a assume

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00:55:18.120 --> 00:55:19.410

Nicholas Christakis : That means. Yeah, so I think

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00:55:19.800 --> 00:55:25.140

Nicholas Christakis : I think the I think Scott Gottlieb I'm blocking his first name, I don't think it's Scott

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00:55:25.170 --> 00:55:28.050

Robert George: Scott Gottlieb, the former FDA director

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00:55:28.110 --> 00:55:30.090

Robert George: Yes, Food and Drug Administration director

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00:55:30.240 --> 00:55:38.580

Nicholas Christakis : Yeah, I think, along with some colleagues, they just released from the American Enterprise Institute, a report which I've skimmed I've not read in detail, but which is very

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00:55:39.270 --> 00:55:46.170

Nicholas Christakis : Very sensible and very similar to what's being done in certain Asian countries and similar certainly to the German plan.

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00:55:46.500 --> 00:55:55.500

Nicholas Christakis : So the idea is we have to prepare our people for the fight. They need to be told, what's going to happen. They need honesty. They need to be told to sacrifices will be expected.

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00:55:55.920 --> 00:56:01.770

Nicholas Christakis : Behaviors will have to change. We need to spend. We spent a trillion dollars on this stimulus package.

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00:56:02.310 --> 00:56:17.760

Nicholas Christakis : I think a lot of that was treated as an economic problem. But I think more money needs to be targeted at our enemy, which is the virus and at the public education that's needed to track the virus drugs social distancing and vaccines.

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00:56:19.290 --> 00:56:26.280

Nicholas Christakis : And I think we need to get our health care system working like we need personal protective equipment manufactured, you know, beyond all imagination.

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00:56:26.850 --> 00:56:43.740

Nicholas Christakis : And when we get all of that stuff in order. I think as some other experts have been suggesting we can begin opening up parts of the country and begin returning to work and following the plan and then we'll do that for a couple of years, and then we'll return to life as normal.

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00:56:44.790 --> 00:56:59.220

Robert George: Let me mention that anyone who would like to read the report that Nicholas mentioned Professor Christakis mentioned from Scott Gottlieb the former FDA director and his colleagues at the American Enterprise Institute I tweeted it out this morning, so you can find it in my in

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00:56:59.850 --> 00:57:14.130

Robert George: Twitter feed and it's very interesting, and I think will be very useful. We're just about out of time, but I have time for one more question. It's an important one. And actually, one that's very central to my own scholarship and teaching Nicholas as you'll know when you hear it.

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00:57:15.240 --> 00:57:21.750

Robert George: And this is the question. Were there any serious long term implications for civil liberties.

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00:57:22.950 --> 00:57:41.460

Robert George: And here, let me enter interject to say perhaps from historical experience in our own country in 1918 1919 or in 1957 or from other countries implications for civil liberties that we can examine and learn any lessons from or learn to beware of anything from

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00:57:42.960 --> 00:57:51.270

Nicholas Christakis : I don't know the answer, maybe, maybe, you know, or someone at the James Madison Program knows, I want to quote James uh

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00:57:52.950 --> 00:58:01.890

Nicholas Christakis : Benjamin Franklin, I think, said he who would sacrifice a little liberty for some safety deserves neither or something like that. I think I bumbled the expression

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00:58:02.520 --> 00:58:12.570

Nicholas Christakis : I do not think despite the temptation that we should be abandoning our civil liberties and I'm very worried that the pandemic will be used by far left, and far right regimes.

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00:58:12.930 --> 00:58:17.070

Nicholas Christakis : To try to suspend civil liberties I probably many listeners saw what happened in

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00:58:17.490 --> 00:58:31.860

Nicholas Christakis : In Hungary, this morning, where the parliament suspended itself and gave Orban the right to rule by decree and imprison people for five years for rumor mongering and the, you know, passing information about about the virus.

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00:58:32.970 --> 00:58:37.800

Nicholas Christakis : It's very tempting in times of crisis to do that. I think history shows that that is very ill advised

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00:58:38.310 --> 00:58:51.510

Nicholas Christakis : And I don't think we are anywhere near that I hope and pray in the United States. So I don't think we need to suspend I can see no reason why we should have any desire to suspend civil liberties or acquiesce to their suspension.

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00:58:52.170 --> 00:59:01.920

Nicholas Christakis : Just because there's a pandemic. We're not even being invaded by foreign army where you might be able to make that argument. Maybe it's just a germ. You know, we can talk about it and figure out how to deal with it.

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00:59:02.940 --> 00:59:03.450

Robert George: As well.

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00:59:03.660 --> 00:59:04.110

Nicholas Christakis : Really

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00:59:04.170 --> 00:59:06.750

Nicholas Christakis : I support the power of the government for quarantine like I have

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00:59:06.870 --> 00:59:07.950

Nicholas Christakis : You know, if you're sick.

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00:59:08.160 --> 00:59:16.500

Nicholas Christakis : And you insist on going out the police should come to your door, or if you refuse you should go to jail. Like, you do not have the right to infect others. You just don't

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00:59:18.390 --> 00:59:25.410

Robert George: Well Nicholas. On that note, we're going to have to close, but since you mentioned that. And since civil liberties came up, I want to say that. Another reason

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00:59:25.680 --> 00:59:28.290

Robert George: For admiring Professor Nicholas Christakis at Yale.

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00:59:28.650 --> 00:59:38.100

Robert George: One that I admire him for his, his firm defense of civil liberties on campuses freedom of speech, respect for civil discourse viewpoint diversity is something that Nicholas has been a

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00:59:38.430 --> 00:59:44.490

Robert George: Champion of and I and I congratulate you, Nicholas for that, and I thank you and I know that Yale students are thankful for that.

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00:59:44.610 --> 00:59:52.770

Robert George: Thank you. Well, thanks to Professor Christakis and also to our cosponsors at the Elm Institute up in New Haven.

424

00:59:53.100 --> 01:00:01.770

Robert George: And thank you all for joining us. The Madison Programs next event of this nature will be a conversation, featuring the great Civil War historian

425

01:00:02.130 --> 01:00:13.800

Robert George: And biographer of Lincoln Allen Guelzo. And it will be on Statesmanship in a Time of Crisis, he'll be looking historically at the Civil War and other crises to talk about how statesman.

426

01:00:14.580 --> 01:00:27.990

Robert George: Managed or fail to manage affairs in those times that discussion will be next Thursday. I'm sorry, not next Thursday that discussion is scheduled for Thursday, April 9 Thursday, April 9 at 430

427

01:00:28.410 --> 01:00:40.260

Robert George: Eastern Time, please check the website, which is at jmp.princeton.edu JMP James Madison Program jmp.princeton.edu

428

01:00:40.800 --> 01:00:50.100

Robert George: And Twitter and our Twitter handle is @MadisonProgram for updated information as we get closer, and of course I'll be using social media accounts to

429

01:00:51.060 --> 01:01:00.180

Robert George: inform people about that opportunity as well. So please join us on that occasion, but thank you very, very much to Professor Nicholas Christakis such an honor to have you on Nicholas

430

01:01:00.330 --> 01:01:02.640

Nicholas Christakis : Thank you so much. Thank you all. Thank you.