Dr. Anthony Suffredini
Behind the Mask
April 28, 2021

Barr: Good afternoon. Today is April 28, 2021. My name is Gabrielle Barr. I'm the archivist for the Office of NIH History and Stetten Museum, and today I have the opportunity to speak to Dr. Anthony Suffredini. Dr. Suffredini is the deputy chief of the Critical Care Medicine Department, medical director of the Critical Care Therapy and Respiratory Care Section, and the director of the Critical Care Stat Laboratory at the NIH Clinical Center, and today he's going to speak about some of his experiences carrying for COVID patients as a clinician as well as his COVID research. Thank you for being with me.

Suffredini: Thank you very much for the invitation.

Barr: Absolutely. To begin with, I think we're going to start with your role as a clinician. What was your experience like in treating COVID patients especially at the beginning of the pandemic?

Suffredini: So I think we were very fortunate that we had taken care of Ebola patients, Ebola virus patients, several years before, so we were quite familiar with the need to have appropriate personal protective equipment [PPE] to be able to do the appropriate donning and doffing of the equipment. So we were pretty much, this includes the nurses, the therapist, the pharmacist, as well as the physicians, in terms of being quite familiar with it. It wasn't new territory. That was good. I think that really did help us to transition to this, and I think that was very helpful. I don't think there was any fear factor. The other thing I would also say is that we were fortunate that we had, unlike many places in the U.S, we had wonderful resources, and so the Clinical Center, the individuals who would get supplies for us were really quite detail-oriented and quite aggressive about being able to help us get all the appropriate things in terms of masks and gloves and gowns, etcetera. And they really were on top of the case during the entire period where we really had the three different surges, and so that's been a real confidence booster. Because I think when we speak to our friends and colleagues outside of the Clinical Center, you would hear these horror stories. If you speak to people in New York where they wore the same N95 mask for weeks or you speak to people where they had a PAPR for their PPE and they would have to use it for two months straight, three months straight. They'd wipe it down and that was it. We really consider ourselves very fortunate to have all the resources we needed to stay safe and that makes it much easier to do the things you need to do to take care of patients.

Barr: How were they able to acquire all of this PPE and equipment for NIH when other institutions really had to scrounge or do without?

Suffredini: Yeah, I think we had some that was in place from Ebola, that was number one, and I wish I knew their trick, but they were very good about using different resources to obtain it. There were times, I think, our N95 masks, we would have to keep them, because we wouldn't have to wear them all the time because we had a PAPR when we were going into the patient's rooms. And we also, again I think when we started, we didn't realize, or no one realized, how grave the event was going to be. We were originally in what was called the Special Studies Care Unit which is where we took care of the Ebola patients which really has room for one ICU bed and two or three other beds that can be used for your

very seriously ill patients, but it was not really set up to be an intensive care unit. I think we transitioned from there down to the current unit which is next to the intensive care unit. It's really an overflow unit. And so I don't know. We were lucky. I wish I knew their secret, but it was wonderful that they were able to obtain the necessary things for us to keep safe.

Barr: That is really great. As an administrator of sorts, what was your experience like in coordinating logistics and guiding your staff during such a period of uncertainty?

Suffredini: Well, I think we had we had our previous training, in essence, from Ebola and that included everything from going on the ambulance rides to pick up patients, to transporting them within the hospital in a stretcher device that is a stretcher that is completely covered in a tent that pulls the air in and puts it through a HEPA filter that's called a demistifier, and having the experience using that made it safe to move the patients in the hospital, made it safe to move them to areas where if you wanted to get any imaging, for example, we were able to do that. Because again I think people started to gear up for understanding that we needed to be able to not just give—we needed to give the best care possible to these patients which includes imaging with CT scans and if necessary, brain MRIs and things like that. And so it took some processing for those particular things to take place, but we were able to successfully get it done. Obviously since we're a research hospital, we want to take advantage of the moment to be able to learn as much as we can about a new infection and get as much information as we can for it as we're conducting research.

Barr: Has your approach for caring for COVID patients evolved since the spring of 2020?

Suffredini: Well, it's evolved in the sense that I think we are much more, what's the word I want to use? I guess we're much more confident. I guess we can say we're more confident because there's more data now. When we look back, we say, “Okay, should we give an anti-inflammatory? Do we have an antiviral drug (Remdesivir hadn't really become available at that point in time when we had our first patients)? Should we worry about anticoagulation? Should we intubate patients faster?” This was a big deal, because many centers, they were literally overwhelmed with patients and did not have the luxury of being able to sit and watch a patient and say, “I think you're deteriorating, I think you need supplemental oxygen, I think you need high flow oxygen, oh, I think we need to intubate you” over several hours. They had some patients where they would rapidly deteriorate and they would go from a walk to a run, to a sprint within hours.

One of the issues became this whole question of how many people really need to be intubated? I would say that early in the pandemic we had many patients who were intubated in our ICU, and since about maybe November or so, we didn't have any people intubated. We were using high flow oxygen. We were using proning, and proning is this idea that you can redistribute blood flow and ventilation in the lung by putting you on your stomach, and then you put you on your back, and you rotate back and forth, and back and forth, and it sounds kind of silly, but when that idea came about, it was done with people who had a severe lung injury called ARDS (Acute Respiratory Distress Syndrome). The idea with that was when people were on ventilators all of their consolidated lungs, the areas of the air sacs being filled with fluids and things like that, all of those were all in the back because you're lying flat. And so some investigators came up with the idea of why don't we flip you over and move you back and forth so that it

doesn't accumulate like that. And it really had dramatic effects on improving outcomes. It sounds so silly, but it improved the management of secretions and improved the ability to get on lower levels of oxygen.

And all of those, yes, are supportive care—they don't get to the underlying problem—but if the supporting care injures you further, you don't want that to happen obviously. I think our practices changed considerably in terms of someone comes in, and they'll have their entire course [in the] intensive care unit on high levels of oxygen but not intubated. They'll have a high flow oxygen up to 60 liters a minute. That keeps people out of trouble, and it keeps them from getting intubated. And that is, that's a real change that really doesn't affect just COVID, but people are looking at it in patients who have other kinds of severe lung injuries, so that they can avoid being intubated, which is beneficial, but it comes with a whole bunch of problems associated with it.

Barr: Yeah. What is one aspect in caring for COVID patients that you would like to see further explored or refined?

Suffredini: Well, I think probably simply because I'm a clinician and a scientist, I want to learn more about—which is why we're doing the study, this feeds into the study, of course—is why is it that some people [who are the] same age, same predisposing factors as ethnicity, race, etc., why do some people get COVID, and I won't say they laugh it off, but it's like okay, it's not a big deal. They get a little sick. They get the symptoms. They get a little bit of inflammation, and then they get better. And their twin essentially, their identical kind of person, has a fundamentally different response in terms of developing pneumonia and getting very gravely ill. And some people even dying obviously. Trying to figure out what is the [difference]: is it the amount of virus you got exposed to? Is it your intrinsic host inflammatory response? Are those the things that are causing [it]? Are those are the variables that are kicking in, that maybe we can modulate those. And I think we do a good job at modulating them with our interventions right now, but understanding what the underlying problem is, I think, is really quite interesting. it's quite fascinating.

Barr: So that leads right into your role as a researcher. You spoke a little bit about it, but can you talk a little bit more about the premise behind your study that's looking at cardiopulmonary inflammation in multi-system imaging during the clinical course of COVID-19 infection in both asymptomatic and symptomatic people?

Suffredini: Isn't that a mouthful?

Barr: It is quite a lot to say.

Suffredini: We changed it to COVID ARC, because it stands for Acute Recovering Convalescence and so when we wrote this, I was writing it in April when things were moving forward, and one of the administrators—

Barr: Is that when you began your thinking of this study, or you started a long time ago?

Suffredini: Well, we started…Part of the tension in the Clinical Center was that all of the surrounding area was being overwhelmed with cases. And our hospital was essentially closed down. I mean we'd have maybe 50 patients, 60 patients in the hospital, and we had a few, we'd have anywhere from three to five COVID patients in our unit, but we didn't have an ICU of all COVID patients obviously, and I think one of the administrators said, "Well, if you want to bring in" –because part of the federal mandate for doing research is that you only bring patients in who are on a protocol, a natural history protocol or interventional protocol—and so they said, "Well, you want to bring in patients." It was like they threw down the gauntlet. They said, "You want to see patients, write a protocol." So I said okay. I'll write a protocol, and that's how it came about truthfully.

I think part of it was also the frustration that we weren't helping with what was going on in the community as well as nationwide. We certainly had, some of our physicians went up to New York and spent time up there, for example, but you'd like to work certainly in your own hospital and also contribute to scientific knowledge obviously. We spoke among ourselves and talked to a variety of colleagues who agreed with us. Well, what is something we can do here that other people can't do? What can we do here? We can do things like bronchoscopy. So bronchoscopy is a procedure where you numb up the airways of the lung, and you can put a flexible tube in that's about the size of a small cable, I guess. It's fiber optics, and you put it down into the lungs and you take samples of the lung lining fluid which has the cells, and presumably virus too, from the lung and you're asking questions. Okay, how is the host fighting the virus? So that's something that no other place could do or very few other places could do because they're literally overwhelmed with patients, number one.

Number two is not having the appropriate safeguards in place of the negative flow room, of resources necessary to keep everyone safe. We had that ability and plus we have these wonderful resources in the Clinical Center where we can do MRI of the brain. We can do a very new technique which is the MRI of the heart and lung simultaneously, and very few people do that because it's quite experimental as a method, not that it has anything associated with it bad. And CT Scans, high resolution CT Scans, where you can really begin to see the architecture of the lung in a very unique way. If you link that with the ability to get blood samples, urine samples, lavage samples, to do things in the heart—looking at [electrocardiograms] of the heart—ultrasounds of the kidney, you suddenly have the ability to say, "Okay why is it that a young person can be totally asymptomatic? How do their cells in their in their bloodstream and in their lung, how do they different from the people who have a full-blown infection?" And it doesn't even have to be young. And we have the luxury of [this ability].

We set this up and we have some colleagues at Washington Hospital Center, which you know is down in DC, and it serves a very broad community in terms of not just people from the suburbs but people from the city. And there's an African-American, a Hispanic community that uses that as their primary hospital. Of course, they were unfortunately really hit hard by COVID for a whole variety of reasons. The issue is they really got hit hard, and so we have a research study that can study the gamut of people who had limited symptoms if any, to people that were really sick and in the ICU. By having the patients at Hospital Center, they were able to be enrolled from day one because they have an emergency room and they could be enrolled there directly, and we could get blood samples early on. And those samples would be processed independently from the hospital. And so we had by working with the NIAID [National Institute of Allergy and Infectious Diseases], because they helped fund the study, we were able

to get samples taken there. They were driven up to Frederick, Maryland where they were processed. They would do a very broad variety of tests looking at separating out the cells, cryo-preserving the cells, doing Cytokine assays, flow cytometry, lots of things, right. And so that was great because we're getting in on the ground level. And then some of the patients, or some of the patients that we had in the Clinical Center, they would be co-enrolled and so they were on some of the ACTIV [Accelerating COVID-19 Therapeutic Interventions and Vaccines] trials that tested Remdesivir, Dexamethasone, Baricitinib, Fostamatinib, so they would be co-enrolled in my study as well. Which was great. We sort of complimented each other in terms of the things we could do. We were quite attentive about you can't draw all the bloods that you can get in one study, you're not going to get on the other study, but it doesn't matter because you're going to share the samples ultimately anyway. So that worked well, I think.

Barr: Have you completed enrollment, like your desired enrollment, for this study?

Suffredini: Not quite. The enrollment is interesting. You know, we got it finally approved in May, and everything was incredibly slow, and so we made these postcards up. We gave talks. We did a bunch of things, and then the second wave hit. And I mean literally I think we had enrolled I think three or four patients during that several week period. It was like, what's going on? But it's really hard. In other words, what would be the incentive for someone to come to NIH just to get usual care, if you will. At the time usual care was still kind of vague. We didn't really have all the answers about Remdesivir and Dexamethasone and things of that nature, so when the third wave hit, we really got a deluge. We enrolled 83 patients now. The trial size is supposed to be up to 150. Of those, it's split about half and half in terms of patients that we've had at NIH and then patients at Hospital Center.

It's in three phases. The first four weeks is the acute phase, the next four to twelve weeks is the recovery, and then twelve weeks to twelve months is the convalescence. So we have patients who may have recovered at home or may have done their acute phase at home. They didn't need to be hospitalized. We still will look at them in the recovery [phase], four to twelve weeks after they were diagnosed, and then at twelve weeks to twelve months. As probably you know, right now we're looking really more for like about nine months, because we want to see two time points: how do things change during that period of time? We have, I think, in terms of acutely ill people that were tested and processed that did all the imaging, we probably have about 20. Then from the other hospital we have about 30 or so, because they don't do all the imaging at Hospital Center because any time you do something extraordinary, like we want a CT scan, [they are asked] are you doing it for clinical reasons? Well, not exactly; we're doing it for research. Well, you have to pay for it. It becomes complicated there because they're overwhelmed with cases. We're happy to just get the blood samples and the patient information and their participation.

But one of the things I wanted to tell you and really emphasize, which I find really fascinating, is that we've enrolled patients really across the spectrum of age. Anywhere from 18 up to, I think, eight or nine people that are above 70 years of age, but every decile, we have patients race and ethnicity. We've got everything covered broadly. I asked people, I said, “So why did you decide to do this study?” I mean, in other words, we give them a little stipend for participating, but like why would you have…

Barr: Go through all that?

Suffredini: Yeah. Pop and pro, you know, and take your blood and do the bronchoscopy and all this other stuff. And I would tell you the majority, without question, independent of their backgrounds, they say, “I just want to help.” “I just want to help,” and I heard that repeatedly. It makes you want to—like, “Oh, my God, you're wonderful people.” I have to tell you that when they come in, I thank them. I thank every single one of the patients who come in. I say, “I want to thank you for volunteering to participate in this. You may not realize it, but you're really adding to our knowledge about what this disease does.” And I said, “It's really important.”

We just did a bronchoscopy this morning on a young woman who was in her 40s. She's got two children, and her CT scan was normal, so she didn't have pneumonia or didn't have evidence of prior pneumonia. I told her exactly that. Your CT looks good, but I said you're really important because I want to know why you did so well and someone else did not do so well. What is the difference? And one of the consequences of inflammation in the lung is it gets scarring, and that's called fibrosis. That's a big problem. There are some patients, and you may have read about them, it's only a small percentage of patients who get COVID and severe pneumonia. A small percentage of them will survive, but they survive with severely scarred lungs where they're really dependent on a ventilator, and some of those patients have gone on to get lung transplants. That's how bad it is.

Barr: But that's bad.

Suffredini: Yeah, of course. So the next question is, okay well, how can you avoid the scarring that occurs? And that's one of the things that we're trying to figure out looking at this broad spectrum of patients. We probably have six or eight patients who have evidence of fibrosis on their CT scan, and some of it's gotten better but in all these people it hasn't gone away a hundred percent so they become—

Barr: Were there any similarities amongst those people?

Suffredini: Good point. That's what we're looking at. We have people of the same age, same background, no previous smoking, etc. One person is doing great; the other one has really bad lung disease, and it's like, why did this happen? So that's one of the things that we're–we've gotten a lot of imaging CTs, all that good stuff, right. Literally in the last couple weeks we're beginning to do the other part of the science where we're doing the assays to look at the cells that are there, the kinds of cells, what genes are they expressing, what proteins are there. Can we find a pattern that is associated in the group that had fibrosis? Are things there that are different than the people who don't? Well, if there are, maybe we can target those. We've been in discussions with collaborators in another study that I think you talked with. Did you speak with Jeff Strich about the Fostamatinib study?

Barr: Yes.

Suffredini: We worked together, and the people at Inova Fairfax, which is a very big hospital, had over 3,500 COVID patients in the hospital. It was enormous numbers, and they're affiliated with a medical

school, VCU [Virginia Commonwealth University]. They have a lung research center, but they see patients with some scarring. We're planning to work with them in the future in terms of let's see if there's an intervention that can be done. One of the interventions that people are talking about are Antifibrotic agents that have been used for a different disease entirely called Idiopathic Pulmonary Fibrosis, and that disease isn't caused by an infection. It's caused by a lot of different factors: genetic, age, exposure to pollutants, smoking, etc. But those agents, they don't reverse the fibrosis, but they prevent the progression of the fibrosis. The question would be, well, wouldn't it be nice to know if we could use that in some of the patients that we're seeing with bad COVID? Can it be beneficial or not? So we're hoping this is going to go in that direction; that we can identify a biomarker or a series of markers that are associated with people who got fibrosis versus those who didn't and maybe we can then target that in a new study.

Barr: That's very interesting. Can you talk a little bit more in detail about your methodology? You've said that you have these different groups, and you did say that you're doing certain tests and imaging, but can you talk in detail? Because I did read that you all are doing a lot with the imaging, both MRIs and CT scans, when you're looking at many of these patients.

Suffredini: Right, well, so the imaging is again exploiting what we have at the Clinical Center and what is unique about the Clinical Center. It's somewhat unique because it's really multi-institute; so it's the Clinical Center plus NIAID plus NHLBI [National Heart, Lung, and Blood Institute] plus NINDS [National Institute of Neurological Disorders and Stroke] plus NIDDK [National Institute of Diabetes and Digestive and Kidney Diseases] and then the people at Washington Hospital Center. And so we have a lot of stuff that is collaborative between institutes, because everyone wants to do something. Because we're all scientists and clinicians. Everyone wants to say, "Okay can we do something."

So the imaging, I want to say, it's the most straightforward thing to do. You bring the person down, get the imaging, analyze it, do things like getting pulmonary function testing done to say, okay, how does the imaging relate to your recovery of your lung function? The thing that I think will tie it all together is doing some of the biochemical molecular biology, the gene expression testing that we're just about to start doing right now. And that includes single cell RNA sequencing of cells from the lung. Why is that important? Well people have done that, and they've done it in a smaller number of patients. We have about 60 cases of bronchoalveolar lavage where we have cells, and so that provides a good bank of information. The single cell RNA sequencing of the lung lavage cells tells us information about what kinds of cells are there and what is their function more or less in terms of what their potential function is. And then simultaneously with that we have blood cells; we have the T cells in the blood; we have neutrophils in the blood. We're looking at those T cells and neutrophils in the lung lavage as well as in the blood simultaneously, and we're looking at things globally with this single cell RNA sequencing. And then we're doing things with what's called proteomics, and proteomics is targeted or agnostic. "Agnostic" means I don't know, let's see what we find, we're not coming in with any hypothesis. And then we're also doing some tests that are much more directed. The good news is when they're directed like you say we're going to test 500 analytes in the bronchoalveolar lavage fluid. Well, what happens if the one that's really important is 501? That's why you have to complement each method, and each approach was with some broader views of how to look at the inflammatory response, etcetera. One of

the things that is a complicating feature is how do you do the samples? How do you analyze these samples?

Barr: Yeah. I was wondering, and I was also wondering do you do the same battery of tests and things like that for every single person in your study or do you pick and choose depending on people's conditions?

Suffredini: Yes, you focus on where is the money basically, but the even more complicating factor is if you have lavage, you know lung washings, from a patient who is COVID positive, and the lung lavage is COVID positive, how do you safely analyze it with a variety of tests? Can you send it to someone to do? Well, that's really complicated obviously, so we're working with people in NIAID and the Integrated Research Facility which is up in Frederick, Maryland. They're one of the few places that has the ability to inactivate viruses using irradiation. I would say it's tried and true, and it will inactivate the virus, but it doesn't alter the proteins that we want to measure. You can also get rid of the virus by what's called heat inactivation. You warm up the plasma or the water from the lavage, the saline from the lavage, to 60 degrees for 15 minutes or 45 degrees for 30 minutes, but the problem is that we know that the heating will affect the protein structure, and that will bias what you're seeing. You have to jump through all these hoops to figure out how to do some of these tests, so that you can feel like you're not missing something. And number one is that anyone doing the testing is not going to be fearful that they're going to get sick. You have to do it in appropriate setting, and then picking and choosing correctly what assays you do is really important.

Barr: Have you felt that the chemical tests have matched up with what you see on the imaging? Or have there been any cases where you weren't expecting that they'd be so different?

Suffredini: I don't know if we have enough information right now to know that. It is interesting that, again, we have had a few patients enrolled who have some defects in their immunity because of an underlying disease, so they were receiving a monoclonal antibody not for COVID but for their underlying disease itself. That was a problem because if they don't make antibodies, that's a problem because that's a fundamental part of the antiviral repertoire that humans have against viruses. In fact, he needed to get antibodies to make him better. There're a few confounders in there like these patients got one drug, this patient's got some other drugs, but those can be worked out with appropriate controls which is which is what we're working on. I don't think we have enough information yet to say we're seeing discrepancies between one thing and the other.

We have some preliminary data. For example, with the lung MRI you can see the ventilation, the air entry, into the lung because you can use oxygen as a contrast agent, and you can see where the blood flow is in the lung and how it's controlled basically and that's called perfusion. They give a dye called Gadolinium intravenously to look at that perfusion. We have some really interesting data about how the pulmonary blood vessels are controlled acutely and in time of recovery, and we're looking at that much more closely. I wish I could tell you more about it, but we're still kind of exploring some things. So yeah, there's a lot of like, I don't want to say unexplained, but not understood phenomena that are occurring, and it's fun. That's why we did that. Are you familiar with NIH? Do you think it means National Institutes of Health? No it's Nerds in Heaven and that's why we enjoy this kind of stuff.

Barr: Are there any other angles that have come out of this that you have been very interested in? Like the perfusion you said, but have there been others?

Suffredini: I mean, all of those things are interesting. The things related to the viral load in the bronchoalveolar lavage, I am very interested in seeing some of our preliminary data, which we're really about to send out. We're looking at just a wide variety of things that happen with the cells that are in the blood versus the cells in the lungs. We already know from our previous work that when the lung is inflamed it recruits inflammatory cells from the blood. Maybe that's not so surprising. Of course, those cells like neutrophils, they have to cross a lot of a barriers. They have to get out of the blood vessel, they have to go through the interstitial space, they have to go through the alveolar space to get into the lung to do its function there. That is a fascinating thing in terms of what pathways are turned on in those cells. And is that important? Well, yeah. I'm sure it's important, and so that's one of the things we'll be exploring in more detail, but I don't have any data just yet.

Barr: Are you all analyzing your own data in-house? What are your metrics for doing so or are you having outside assistance with that part?

Suffredini: We have some within our department, we have some with some of the collaborators in NIAID for example. One of the scientific directors who is from NIAMS [National Institute of Arthritis and Musculoskeletal and Skin Diseases] was incredibly generous and kind. He says, “I just want to help.” He purchased for us a relatively expensive machine to do the single cell processing, and he said, “When you get the data, tell us and we have a guy who all he does is this the analysis of single cell processing.” In contrast to the kind of studies that I was used to doing in the past where I have a small team of like six or eight people, if I told you how many people are involved in this you would just kind of go, well, that's just NIH. Yeah, there are a lot of people, and it would be incorrect to say the pharmacist who is recording all the clinical data into a database, is their contribution any less than someone, maybe a technician, doing a test? It's really this teamwork thing because you can't do otherwise without getting everyone involved and everyone contributing, and it's a luxury. It's a lot of fun so we really have the benefit of doing that.

Barr: That's wonderful. That was actually going to be one of my next questions. Can you talk a little bit about who comprises your team? You can even mention some main people and then what has your role been in this process?

Suffredini: Yeah, so my role is I sit in my chair and just…no. I'm very actively engaged. There's kind of different levels of the team. We have people in our department. We have Jeff Strich. We have Dan Chertow. We have Joe Kovacs. One of the things that's really interesting in it, you have to know a little bit about Critical Care Medicine, is that Joe Kovacs was one of our first fellows in the department a long time ago. I won't tell you how long , but a long time ago, and he is really an infectious disease critical care doctor and focused almost entirely on infectious disease—almost entirely on HIV and Pneumocystis Pneumonia—and because of his relationship, and because all the other research was closed down in the Clinical Center, he said, “I want to help.” He had his research nurse Doris Swaim come and work with me.

Then we have four other study coordinators who are from the OPA clinic who have come to work with us, and then I have my own research nurse. My original one retired, and then I hired a new one who was one of our former ICU nurses who's wonderful and she's bilingual. That's Gloria Pastor. So that's kind of the core people that are doing the daily stuff that—it would boggle your mind in terms of when someone comes in. If they're acutely ill, you have to get it cleared through hospital epidemiology to say, Okay, do they need to be on high contact isolation?" If they do, they have to come in a special way, go to the fifth floor which has a special unit, or they go to the ICU if they're quite ill. And then coordinating all the other things. So we have people in Radiology: Ashkan Malayeri, Liz Jones. He's a radiologist. He's outstanding. We have people in NHLBI; Rick Childs is involved. A guy named Han Wen who is really a Ph.D., but he's an expert in MRI and what's called a high-resolution CT Scan which the other word for it is the zoom CT which is kind of a cool word, where if you zoom it, you can get even more clarity in terms of the microarchitecture of the lung. It's really quite amazing. Then we have Adrienne Campbell who is a Ph.D., but she's a tenure-track person. She is the pioneer of the low-field MRI, and so she's a wonderful collaborator and we're really doing some really cool stuff. The nice thing is there's only two of these machines in the United States right now: one at the Clinical Center and one at NYU I think it is. Or Mount Sinai. One of the hospitals in New York City.

We're doing these studies with acutely ill patients. We're following up at different times, and so you can get the things I told you about the perfusion, about the architecture, about the ventilation, as well as you get a simultaneous cardiac MRI. Now it's not as elegant, perhaps, as the high-resolution MRI, but it tells you lots of information. So Marcus Chen is another scientist; he's a cardiologist who does a lot of imaging studies and he is in NHLBI as well. Then we have Brian Smith who's a neurologist, and you'd be amazed at the number of people who've recovered, who come in and say, "I just can't think straight. I have fuzzy thinking." This is a real problem. Brian is an outstanding neurologist. He's very smart, and he works also with Dima Hammoud; I don't know if you know her name. Dima is in the Clinical Center, but she is a neuroradiologist, so they really work together to help. We've had a few, I would call them, surprises on the brain MRIs in terms of unexpected findings of adenomas in the pituitary gland. We've had some people that have had poorly controlled hypertension who had little multiple mini strokes, and this is in a young person. And we've gotten that person to get his blood pressure under better control.

But again this is not a one-man show for sure. This is something that really requires taking advantage of the resources we have here. In terms of how do we move things forward, then we established this collaboration, and we were able to help to fund a research coordinator at the Hospital Center who is a wonderful physician from Ethiopia who's switching from Ethiopia. He's going to do his residency in the United States, but he's got this job in between and he enrolls the patients, draws the blood, he's a wonderful person. He's working with Chris Barnett, the PI [principal investigator] down there, and he's a cardiologist who was one of our fellows many years ago. And so I'm naming all these people, it's like, oh, you got a lot of guys here. You know, Rick Davey from NIAID, Michail Lionakis, John Decker, and these are all wonderful people who are really smart. When you rely on smart people, it makes your job much easier. The other thing I would just tell you is that you take this for granted, but it's like, okay, so we have someone who is a person who lives down in DC. They may not have a lot of resources. They just got out of the hospital, and they want to do the study. So how do they come up here? If they don't own a car, they take metro. Well, if you're still COVID positive…

Barr: That would be bad for you and everyone else.

Suffredini: Well so what ended up happening is Doris found this, it's basically a limousine company, that put up plastic guards between the driver and the back seat. Everyone wears a mask. They do cleaning, cleansing, whatever, and we pay them to pick up the patient and bring them in and take them home.

Barr: That's great!

Suffredini: It is awesome. I can't tell you because we would never have been able to do all the things that we do at the Clinical Center without having that resource. Because it's like "Wow, we really need to have this because it's really important." It's a safe way of bringing them in, and I think it also makes them feel like we value them as research participants. I think that's really important. As I told you early in our discussion, I thank everyone personally because I just said you're volunteering your time and your body, and you're really important. And we thank you, thank you, thank you. That's all, and it's also a good way to get them to come back I would say.

Barr: Would you continue doing something like the limousine service for future, like once COVID is over, for participants who have highly infectious diseases?

Suffredini: Well, I would think we would have to. Well, if they have the –

Barr: Economic resources?

Suffredini: Yeah. I mean I think it kind of depends on each basis. For example when we had Ebola, how do we get the Ebola patient from the airport to Clinical Center? Well, we, Dan Chertow and I, both went several times to pick up the patients. We had the PPE. The fire department would also have PPE, and we had everything covered up in the back of the ambulance and we went and picked them up in the demistifier. We had them on a special stretcher with the tent in it, so that there's no possibility of droplets getting out essentially. Or very limited. God forbid we have another thing like COVID. Who knows what's going to happen for the future, but yeah, I think we have to be thoughtful about how we do it. Now, fortunately we received the ITAC award from NIAID, and that has really been helpful in terms of supporting the ability to hire a company to do this. Because otherwise, you can't support the study, obviously, and so that becomes really important. Hopefully I didn't leave out any names. I probably did but they won't be mad at me if they ever hear this.

Barr: Okay. So you've spoken a little bit about some of the challenges you've faced. Have there been others with this study that you have encountered at this point?

Suffredini: No. I think early on everyone was incredibly fearful. I mean people that were not in the ICU were really quite frightened by the prospect because there was so much uncertainty, number one. Number two is we didn't have testing available easily early on, though the Clinical Center had a Cadillac version of testing in terms of anyone could go anytime to get tested, bingo. It was great and you know that is a wonderful luxury. I think gradually as people became used to it, and we had testing, clearly

with the vaccine—that's a major step forward—but even before that and with the appropriate PPE and appropriate precautions, and our hospital epidemiology service has been a huge resource. Wonderful people. Tara Palmore and all of her staff, outstanding people in terms of helping. They really serve to reassure people, and sometimes put up a red flag. Say don't do that because it's not safe you know. And obviously no one wants to be the cause of someone getting an infection, obviously, and in terms of nosocomial infections, it's usually that people have not followed recommendations. Like did you wear a mask when you were talking to a patient? Patient can have an asymptomatic infection (not particularly common in the Clinical Center). You walk in and you don't have your mask on? Well, that's a no-no, right? So everyone wears a mask, but you need to wear goggles or a face shield or something in addition and not go up and hug the patient. You have to keep at least six feet away. I mean that's small things, but it's really unusual because I'm used to even in the ICU shaking people's hands, holding their hands, you know, and you're not really supposed to do that so much.

Barr: Has that been hard? Was that very hard for you to have that kind of physical distance from the people?

Suffredini: Yeah. I mean to a certain extent though in the COVID unit because you have two pairs of gloves on and a PAPR and all the other stuff, it didn't matter. You could hold their hands and tap them on the shoulder. Tell them they were getting better and things like that. In the other parts of the hospital, it is a little weird sometimes, because we have patients who come in the recovery phase, their nasal swab is negative, but you're really not supposed to have physical contact with them unless it's very controlled. That's a little bit unusual in terms of, if you like to have contact to say, let me hold your hand because I really want you to feel okay and like we're doing everything we can for you.

Barr: Yeah, that's interesting. Well, you do a lot both as a clinician and with this study but are you involved in any other COVID initiatives at NIH or outside of NIH?

Suffredini: No. I mean I'm a co-investigator, associate investigator, on some of the other studies being done, and I've told several people, this is not going to make anyone's career. This is not like suddenly you're going to be transformed into something. It's really important to cross fertilize, share resources, share patients, and so we refer patients to Leighton Chan in rehab medicine. He has an ongoing study where he's doing lots of things looking at the rehabilitation of patients post-COVID. We sent him patients. Brian Wallitt and Avi Nath. Brian is in the Nursing Institute. He's a rheumatologist in nursing, and Avi Nath is a Clinical Director of NINDS. They have a study that's really quite unique, and it originally, several years ago, was for Chronic Fatigue Syndrome. Trying to phenotype and understand what's going on with these people that clearly have symptoms. What is underlying it right. Well they've adapted it to the long haulers and so that's really important. So they're doing a lot of screening of patients and bringing them in and doing some of the tests are redundant to ours and we say, you don't need to do them, we've already done them. But for people who have long-term symptoms, it's a complex issue. No one understands it. I mean and you can imagine in places like in New York City where they have clinics that's all they do, and you know there's no like magical pill. Maybe antidepressants, maybe things to help you sleep and things like that, but getting to the core issue as to is there residual damage? What is going on? Those are unknowns. I'm associated with them as an associated investigator, but nothing else. I don't have enough hours in the day unfortunately.

Barr: With your own study are you looking at all of the variants and how that affects people?

Suffredini: We will be, and we will do sequencing on the viruses, but we haven't gotten those kind of patients yet. This one patient who in quotes had a breakthrough infection, we did her sequencing, and she had a common variant, not one of the new ones. Which is good news, bad news you know. It's a little bit daunting because I was looking at things today in South America. South America is just exploding with cases, and people dying and a lack of reliable vaccines, and that is a huge problem.

Barr: Well, now we will transition to you as a person during the pandemic, and we'll do this very, very fast, but what personal opportunities and challenges has COVID presented for you?

Suffredini: I guess the personal challenges are after the pandemic really was blowing apart in like March, I mean my two sons are physicians. They both work in COVID units. One's a cardiac anesthesiologist, and he was intubating patients daily at Johns Hopkins. The other is an intensivist, and he was intubating patients daily. He's at St. Agnes hospital in Baltimore. I have another daughter-in-law who's an anesthesiologist. She works at Howard County, and she was working in the ICU as well as the OR. We have six grandchildren, and we didn't really see them, or we would do what we call drive-by, because one of them lived in Baltimore, and one of them lives in Rockville, and we would drop by food, say hello in the car, and then we drive away basically. That was challenging because we're a very close family. Around June and July, everyone was healthy; everyone was asymptomatic and had been tested ad nauseam, so we were able to at least go to the beach, and we really maintained limited outside, other than work, we weren't really socializing with anyone. Clearly you know testing was good and having access to the vaccine is like dramatically better; that's really changed things a lot. I think on a personal level the lack of socialization is a big deal. I still have family members that I've been in contact with, that live in the region, but we haven't been visiting them. They're at a little bit higher risk and so because of age, etc, and so it's like oh yeah, we talked but we haven't visited. I think most people have had the same kind of misery.

Barr: These are two thought-provoking questions to end the interview with. The first question is how do you think COVID has permanently changed the way scientific research is carried out? And then a similar question is, how do you think COVID has forever changed administering medical care?

Suffredini: It's interesting. I spoke to someone who was from Boston, who's a very thoughtful scientist, and I really think that the whole world essentially is doing COVID research. Maybe a third or half is really cutting edge in terms of taking advantage of the technologies that we now have to sort of get to the heart of problems, in terms of why did this happen, why does this happen, etc. I think it's really, if anything, it's accelerated our understanding of infectious diseases, and how they affect the human beings, and how they've how they cause diseases, etc. I think it has big implications for other viral diseases, not just pandemic things, but even the common community-acquired coronaviruses, influenza, etc. Probably because no one was socializing, everyone was wearing masks, influenza, i don't know what the numbers are, but they're really down. People working in community hospitals their differential is COVID, COVID, COVID, influenza, you know? And co-infections with both are pretty uncommon, but they

do occur. I think the application of high-end science has really been dramatic, and I think it will have a ripple effect on how it's being applied to other infectious diseases and obviously other disorders.

Will it change the way we administer medical care? I guess, to a certain extent, it can. In the pre-pandemic, our big concern was about bacterial resistance and the inappropriate use of antibiotics and the spread of resistant organisms in the hospital. We have much better infection control methodologies into the most basic stuff: wash your hands constantly. That has implications for other infections that affect the hospitals themselves and so I think that has a ripple effect in terms of trickling down and affecting how we think about things. I don't want to say there's any good coming out of this, but the consequences are we have a really dramatic explosion of science, and I think the infection preventive measures have increased significantly. I think those are going to carry over for the future so that is good.

Barr: That is good. Is there anything else you would like to add?

Suffredini: I don't think. I've talked too much I'm afraid.

Barr: It's okay. Well thank you very much, and I wish you and your family all the best. And all the best with your study as well.

Suffredini: And you too. Thank you.