

# 63| COVID-19: The Role of Neuropsychology – With Dr. Chaya Fridman

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**Speakers:** Chaya Fridman, Ryan Van Patten, John Bellone



**Intro Music** 00:00



**Ryan Van Patten** 00:17

Welcome, everyone, to Navigating Neuropsychology: A voyage into the depths of the brain and behavior, brought to you by INS. I'm Ryan Van Patten...

**John Bellone 00:25**



..and I'm John Bellone. Before getting into today's episode, we would like to take a moment to thank a few people who help us make NavNeuro possible. We'd like to thank our advisory board Drs. Steven Correia, Tanya Nguyen, and Beth Slomine. Everyone at INS who we are working with as part of our partnership. And finally, Leslie Gaynor, our wonderful production coordinator who does great work for us behind the scenes. If you want to hear Leslie's podcast episode, go to [navneuro.com/ 53](https://navneuro.com/53).

**Ryan Van Patten 00:56**



Today we're speaking with Dr. Chaya Fridman about the neuropsychology of COVID-19. Chaya is an associate professor and the director of neuropsychology at Cornell. She recently published a paper in The Clinical Neuropsychologist, TCN, on neuropsychological functioning and severe acute respiratory disorders caused by the coronavirus, so she's a great person to talk to about this topic.

**John Bellone 01:21**



This is a unique NavNeuro episode for a variety of reasons, and it's also been a challenging episode to do well. We are all aware of the huge impact of COVID-19 on the entire world in the past year. But this episode is about the neuropsychology of COVID-19. It's important to remember that we are not physicians or epidemiologists, and we will not attempt to cover all of the nuance of the virus - we don't cover the history of the early spread of the pandemic, the incidence or prevalence data, the biological structure of the virus, or anything about vaccine clinical trials. Instead, we hone in on the neurological, psychiatric, and cognitive effects of SARS-CoV-2. Even in this relatively small COVID-19 niche, the speed of scientific advancement is really just astounding. New papers are published every day, every week, which is obviously a fantastic thing. The scientific community should be pouring time and resources into this topic. However, it does make it difficult to keep up on the current state of knowledge to the point where, you know, we started sorting papers from our literature review by month of the publication and prioritizing papers that were published in the fall or winter of 2020 over those that were published in the spring and summer. So really just lightning fast literature coming out here.

**Ryan Van Patten 02:51**



Yeah. I've not experienced anything like this before. It's great in terms of scientific advancement, we need it. It's also hard to read the literature and know that if I read something from two months ago, it might be outdated already.



**John Bellone** 03:04

Right.



**Ryan Van Patten** 03:05

It's just... Yeah, it's bizarre.



**John Bellone** 03:06

By the time the paper is published, it's already a couple months old, it's gone through the peer review process. It was incredible. There's already a meta-analysis in JAMA, I think it was like last month I saw it, on household transmissions. So not pertaining to cognition, but the fact that a meta-analysis came out in the same year as the rest of the literature is just phenomenal.



**Ryan Van Patten** 03:28

People are pouring time and energy into this. I read papers from like, April or May of 2020, and I think, "meh." [laughs]



**John Bellone** 03:35

That's too old. [laughs]



**Ryan Van Patten** 03:38

Typically if it's within the last 5 or 10 years, a paper is pretty new, but not here.



**John Bellone** 03:43

Yeah, it's very different. So, undoubtedly, things are going to change in the next few months and years. So, we plan on updating this episode as needed or amending it. But as neuropsychologists begin contemplating our roles in the care of COVID-19 patients, we want to provide some information about the topic. Before going into the nuts and bolts of the interview, Ryan and I are going to do a brief review of some important terms and concepts so that we're all on the same page before we get started.



**Ryan Van Patten** 04:13

Yeah, for sure. So, again, like you said, John, today's episode is a snapshot, especially in terms of cognition, emotion, and neurology of COVID-19. But I think COVID-19 will be a major part of our jobs for years, so we should definitely talk about it. Along those lines, severe acute respiratory syndrome coronavirus-2, or SARS-CoV-2, the coronavirus that causes the COVID-19 disease. So, if you're not

familiar with this naming convention, it's similar to how we have the HIV virus and then AIDS, which is the disease or syndrome caused by the virus. So in a very general way, SARS-CoV-2 is analogous to HIV, while COVID-19 is analogous to AIDS. SARS-CoV-2 was initially identified in late 2019 and was labeled as a pandemic by the World Health Organization in March of 2020. It's primarily a respiratory illness, which is similar to other coronaviruses but it can have systemic effects including on the central nervous system. Symptoms vary widely including fever, chills, shortness of breath, cough, body aches, headaches, anosmia, loss of the sense of smell, sore throat, congestion, nausea and vomiting, diarrhea, and many others.

A few terms to be aware of related to SARS-CoV-2 are "neurovirulent", which is the propensity for leading to disease in the CNS. This can be through systemic effects, such as peripheral inflammation. A second term is "neuroinvasive", which is the ability to penetrate and move directly into the central nervous system. So this is the most direct route that a virus might take into the CNS. Early evidence suggests that SARS-CoV-2 causes neurological symptoms in some people. Both neurovirulent and neuroinvasive processes could be at work in some people. Importantly, and discussed in our upcoming conversation, SARS-CoV-2 is often compared to two other coronaviruses. SARS-CoV, this was the original SARS pandemic in 2003 that was first detected in Asia before spreading to Europe and North and South America. So, before March of 2020, if someone said SARS, they were probably referring to this virus. And MERS-CoV, the Middle East respiratory syndrome, which is a zoonotic virus that's transferred from camels to humans and spread around the Middle East, Africa, and South Asia beginning in 2012. These two coronaviruses are particularly relevant to us right now because there's a great deal of genetic overlap between them and SARS-CoV-2 - approximately 80% genetic overlap for SARS and about half, 50% for MERS. Because each of these viruses was discovered years ago, unlike SARS-CoV-2, we have empirical research on them. What researchers are doing is applying the research on them to the COVID-19 pandemic so that we can have a sense in these early days as to what we might expect in terms of long term outcomes from the virus.

**John Bellone 07:47**



Another way to consider potential cognitive and emotional effects of COVID-19 is by looking at the literature on respiratory illnesses broadly. The lungs and the brain are connected, so it's not surprising when pulmonary illnesses have effects on the central nervous system. Obviously, the lungs are needed to provide oxygen to the brain. With this in mind, we want to be aware of acute respiratory distress syndrome, ARDS, which is a severe pulmonary condition that can be secondary to

other physical health conditions. There's pneumonia, which is an infection in the lungs. There's chronic obstructive pulmonary disease, or COPD, which is a respiratory illness caused by airflow disruption, and there's different aspects of COPD. In each of these cases, there can be associated cognitive effects, with the most common identified etiology being hypoxia, or hypoxemia, meaning a lack of sufficient oxygen that impacts the brain. Broadly speaking, we can apply this knowledge to COVID-19 and expect there to be potential for cognitive effects of COVID-19 as a result of these respiratory syndromes, particularly in the most severe forms of the illness.

**Ryan Van Patten 09:07**



Finally, before moving on, we want to mention that there's some evidence for a bi-directional relationship between psychiatric syndromes and COVID-19. This evidence comes from COVID-19 itself, not from SARS or MERS. It suggests that having a pre-existing mental health diagnosis may put people at higher risk for COVID-19 and that having COVID-19 also increases the risk for mental health problems, in particular anxiety, insomnia, post-traumatic stress and dementia. These data that I'm referring to come from a recent large study in The Lancet Psychiatry. The study included over 60,000 COVID-19 patients whose data were pulled from electronic medical records. We, again, just want to emphasize that the current data we present are early and preliminary but there's a lot to learn and I think we, as neuropsychologists, want to start getting up to speed on this because it will have a very big impact on our careers going forward. So, with that, we give you our conversation with Chaya.



**Transition Music 10:12**



**Ryan Van Patten 10:21**

Well, we know that you're not a physician and we don't expect you to be an expert on the biology of the virus, of course, but we do want to cover important information on cognitive and emotional symptoms in COVID-19. Let's start with basic mechanisms and neurological manifestations. In your TCM paper recently, you differentiate between what we might call primary or biological mechanisms by which SARS-CoV-2 impacts the CNS such as neurovirulent or neuroinvasive processes, and then what we might call secondary or indirect mechanisms, such as those associated with ICU admissions. So let's start with the former. Tell us about the biological mechanisms by which SARS-CoV-2 could cause neurological and neuropsychiatric symptoms.

**Chaya Fridman** 11:12

So, as you noted, when we talk about primary mechanisms, we're referring to two different characteristics that a virus can have. There are the neuroinvasive properties, the ability to directly enter that nervous system, and then neurovirulent properties, the ability to cause disease within the nervous system. So just as with the other known human coronaviruses, there's a lot of evidence, mostly coming from case studies, that SARS-CoV-2 presents with neurological sequelae that could be secondary to either of those mechanisms.



How does it invade? Well, we know that the CoV spike glycoprotein, those S proteins that are covering the surface of the virus binds to the ACE receptors that are on the cell membranes. Those ACE receptors are expressed in organs throughout the body, including the brain, where it's found in neurons and in glia. In terms of the mechanisms that have been proposed to cause neurological and neuropsychiatric symptoms, there have been several - autoimmune sequelae, hypoxia mediated injury. Cytokine storms have gotten a lot of attention and those are essentially when there are high levels of activation in the immune cells and excessive production of all of the inflammatory cytokines and chemical mediators. And that can cause a fatal immune response. So that's been now considered one of the main causes of disease severity, of death in patients with COVID-19.

There are also other discussions of factors like systemic proinflammatory state, coagulopathy, or vascular dysfunction that's associated with the virus itself. And the possibility of the blood brain barrier that's disrupted secondary to the SARS-CoV-2 binding with the ACE-2 receptor. That's particularly concerning to us given just the widespread nature of the ACE-2 expression in the brain, and the potential to then impact neurons and glia throughout the CNS. So those, I would say, are the primary topics that have been discussed recently.



**Ryan Van Patten** 13:24

That ACE-2 receptor is most common in the lungs, correct? That's why, or part of the reason why, SARS-CoV-2 tends to be respiratory but it is also elsewhere.



**Chaya Fridman** 13:33

Correct. It's primarily in the lungs, but it's represented in the brain, in the olfactory mucosa, in the kidneys. So we're now seeing downstream effects of this throughout many of the organs of the body.

**John Bellone** 13:49



I know this is early days in terms of collecting data, but I'm wondering roughly how common neurologic symptoms are acutely in these patients? I've seen one report suggesting that maybe about one-third of hospitalized patients with COVID have neurological symptoms, but this paper was from late spring of 2020, Natoliet al. So, I'm wondering what your impression is.

**Chaya Fridman** 14:14



Part of the challenge of something like this is everything's new. And there's a delay from the initial collecting of data to when material becomes more available. But it's definitely true. I know the paper that you're referencing that discusses the neurological manifestation. One of the attempts that has been done recently to characterize these symptoms or these different manifestations, because there have been several, came out of the University College of London's Queen Square National Hospital for Neurology and Neurosurgery's COVID-19 Study Group. They basically identified a variety of different presentations - so encephalopathies, inflammatory CNS syndromes. So ADEM, encephalitis, ischemic strokes, PNS disorders, and then a whole host of miscellaneous signs and symptoms that can't otherwise be characterized. We're learning more and more about this. I think initially knowing that sometimes the only symptom, or at least the initial symptom, is the loss of smell really tipped people off to the fact that we might expect neurological manifestations and more and more information is coming out about this. I think we're still relying on some of those early studies, but with greater frequency we're seeing reports of these various presentations.

**Ryan Van Patten** 15:42



Right. So neurological symptoms are not uncommon in COVID-19, which based on our initial understanding of it as a respiratory illness may be surprising to some people, but I think the literature has quickly evolved. You mentioned a lot of the big neurological symptoms. The common ones are anosmia, ischemic stroke. encephalopathy, delirium. I've seen Guillain-Barré. Some peripheral nervous system disorders are not as common, I believe, but they do happen. As neuropsychologists, what do you think we should know about these neurological symptoms?

**Chaya Fridman** 16:16



As neuropsychologists we interface with so many different disciplines, and neurology is obviously one of the primary ones. With each of the different disorders you discussed, even not related to COVID-19, we know that they could have a

significant impact on brain functioning. So it's really important for us to follow this, to follow this carefully and to contribute to those studies to better understand the long term impact that it can have on cognition, on emotional functioning. So I think that this is a very important emerging literature for us to follow so we have a better understanding of how to support our patients and how to think about neuropsychology on top of COVID-19. How this now influences the trajectory of neuropsychology moving forward.

**Ryan Van Patten** 17:12



Right, yeah, that's great. Of those neurological symptoms or conditions we've been talking about, I've seen ischemic stroke come up a lot, like even in comparison to influenza, for example. There's a study, Merkle et al. from July, where they compared the prevalence of ischemic stroke in COVID-19 versus another respiratory illness, influenza, and it was much higher in COVID-19. So clearly, there's something about this virus that is more likely than other respiratory illnesses to impact the brain. And stroke, obviously, is very relevant to us. What's your understanding of the literature on stroke and COVID-19 currently?

**Chaya Fridman** 17:50



We know that the SARS-CoV-2 virus binds to the ACE-2 receptors and there's some theories that that might cause increases in blood pressure and cerebral vascular events more generally. There have been a bunch of cases that have been reported about large vessel stroke, especially in younger patients, which is particularly concerning. Proposed mechanisms have been coagulopathy, vascular dysfunction that might be associated with the virus itself. There was also a recently published study suggesting that SARS-CoV-2 might directly impact platelet functioning and result in platelet hyperactivity and that could result in thrombosis observed in the patients with COVID-19. So I think it's really important for us to consider this given that patients with cardiovascular, metabolic disease face greater risk of developing severe COVID-19. And so these vascular events are really important to continue to follow.

**John Bellone** 18:50



You mentioned earlier, the neuroinvasive nature of this virus and the fact that it has direct access to the brain crosses the blood brain barrier to some degree. I'm curious if you're aware of how the virus might enter through the olfactory system.

**Chaya Fridman** 19:06



Many viruses are known to impact taste, known to impact smell. What seems to be interesting about COVID-19 is, again, the fact that it is oftentimes the initial presenting symptom, sometimes the only presenting symptom. So what it seems to be, or at least what we know from SARS-CoV, is that in, mice models, there is transneural present - sorry, transneuronal penetration. I'm going to say that again for you... [laughs]

**Ryan Van Patten** 19:39



It happens to us all the time. [laughs]

**Chaya Fridman** 19:42



Wow. In SARS-CoV, we know that there is transneural penetration [laughs], as models through the olfactory bulb. And so, we're thinking that is the same thing with SARS-CoV-2. That there's potential penetration through the olfactory bulb. We know that there's a large presentation of these ACE-2 receptors. They're really widely expressed in the epithelial cells of the mucosa, of the oral cavity. So the thinking is that that is an entry point for the virus.

**Ryan Van Patten** 20:19



Yeah, that's helpful for us to start understanding how the virus has access to the brain. We've talked primarily about neurological symptoms so far, I'd like to move into cognitive and emotional symptoms now. In terms of cognition, I haven't seen any published papers in large samples studying cognition. There's one preprint - this is Hampshire et al., where they administered a computerized cognitive battery, unsupervised to a few hundred people and showed that people with COVID-19 were more likely to have cognitive deficits or perform more poorly than controls. Again, it's a preprint not peer reviewed yet. You had mentioned SARS-CoV. In lieu of COVID-19 data, let's talk about SARS-CoV and MERS-CoV. Not SARS-CoV-2, but two genetically related coronaviruses. So I'm curious as to what we know about the long term cognitive symptoms in SARS and MERS with an eye toward applying that research to SARS-CoV2, COVID-19. First, how confident do you think we can be when generalizing from SARS and MERS to COVID-19? And then, what do you think we know about acute and especially the long term cognitive effects of SARS and MERS that can help us learn about SARS-CoV-2?

**Chaya Fridman** 21:41



You mentioned SARS-CoV and MERS-CoV and those two viruses and SARS-CoV-2 are all part of a human coronavirus category, or class, that's referred

to as the betacoronaviruses. The genetic similarity between SARS-CoV-2 and SARS-CoV has been reported to be approximately 80%. So there's quite a bit of similarity. Much less so with MERS-CoV, that's approximately 50%. SARS-CoV and SARS-Cov-2 both bind to the same ACE-2 receptor. MERS-CoV binds to a different receptor. So, again, less confidence there in terms of similarities. What's emerging is that the CoV spike, that glycoprotein that we were talking about earlier that binds to the ACE receptor, that spike protein is longer in SARS-CoV-2 than it is in SARS-CoV. The thinking is that that might then result in a higher affinity with the ACE-2 receptor, which might then make it more infectious. And that might then result in these higher neuroinvasive potential properties that we were discussing earlier. It's certainly important, especially in the absence, as you were mentioning, of updated literature, or literature at all, on SARS-CoV-2 to apply the lessons that we know from these other related viruses because that's the closest information we have right now.



**John Bellone** 23:15

In terms of the long term cognitive outcomes for SARS, is there a good understanding of whether it causes problems?



**Chaya Fridman** 23:24

With SARS-CoV, there's definitely some evidence of persistent both psychiatric and cognitive concerns. There have been follow up studies that are at this point about 20 years old, but from SARS-CoV that indicate that there's really increased concern with things like concentration memory, in particular. The largest meta analysis that was done reviewed about 70 studies that provided data on acute and post illness neuropsychiatric effects of different coronavirus infection. Obviously not SARS-CoV-2 but predominantly SARS and MERS. Those studies ranged from being 6 weeks out to about three and a half years out from infection. About 15% of patients continue to experience emotional lability, impaired concentration, impaired memory, insomnia and fatigue. What's really noteworthy about that is - I don't know if you saw the recent Lancet paper that came out just a couple days ago that spoke about anxiety and fatigue as being present in 20 or 25% of the sample of patients who are now 6 months post infection with COVID-19. So we definitely need to continue to monitor [this] just because what we're seeing is some reported similarities in the long standing symptoms and complaints.



**John Bellone** 24:49

I'm glad you mentioned the psychiatric symptoms too because clearly there are some symptoms across the board related to post-traumatic stress. I'm curious if there's any specific importance of PTSD and related symptoms in COVID-19.



**Chaya Fridman** 25:05

We know from SARS survivors in Hong Kong, that there were very high rates of psychiatric symptoms. PTSD was a big one. Anxiety, depression, and just the high levels of psychological distress in survivors are present a year after infection. So we definitely know that there's a persistent burden of illness on survivors. We're hearing a lot of anecdotal reports of this in COVID-19 as well. Some of this might be due to just standard ICU admission or having a very significant life-altering illness. Some of it might be more specific to COVID-19, and we might end up finding out that the prevalence rates are greater than what we expected from other illnesses. But it's certainly something to be mindful of as we move forward in seeing these patients, even on an outpatient basis long term.



**John Bellone** 26:01

Do we have a sense of how the severity of illness might alter the cognitive and emotional symptoms?



**Chaya Fridman** 26:09

At least with other betacoronaviruses, the cognitive symptoms appear to be associated with disease severity. So it seems like there's some link between viral infection and CNS function. One thing that we need to remember with many of these studies, though, is that the patients who are followed are the ones who had the severe form of the illness, right? The ones who are hospitalized or the ones who are in the ICU. So I think moving forward with COVID-19 patients, one of the important things will be to follow individuals who had mild forms of illness - maybe people who never showed up in the hospital or weren't admitted - to know whether or not the presentation or the long term sequelae are similar or different.



**John Bellone** 26:52

Yeah, my understanding is we don't have great datasets yet about emotional and cognitive symptomatology in patients with just mild illness who were not hospitalized. Is that right?



**Chaya Fridman** 27:06

Certainly not great data. I mean, we're having anecdotal reports amongst people described as having "long COVID" - of having some of these difficulties. But nothing that's strong data about the mild presentation, really of any of these viruses.



**John Bellone** 27:21

Right. That "long data" is a term that's kind of surfaced, especially in the popular media and groups.



**Ryan Van Patten** 27:26

"Long COVID", you mean?



**John Bellone** 27:28

Yeah. Long COVID. Yeah.



**Ryan Van Patten** 27:30

Yeah. So another related question here is, might a previous SARS-CoV-2 infection put people at greater risk for later neurological diseases by impacting cognitive or brain reserve, or some other mechanism? Things like neurodegenerative or cerebrovascular demyelinating conditions?



**Chaya Fridman** 27:50

Right now, it's not really possible for us to predict the specific impact that COVID-19 is going to have on cognitive functioning, whether it's now or in the long run. But given what we know about other respiratory viruses, including chronic neuroinflammation, COVID-19 patients might develop late neurological complications like demyelination, neurodegenerative disorders. It's certainly reasonable to hypothesize that we're going to aggravate the underlying neuropathology because of viral infection and that could cause further deterioration or potentially hasten the emergence of cognitive deficits. It's something that the Alzheimer's Association has been discussing. It may be particularly important for those who have neurological involvement in their acute phase of the illness. We don't know if it's going to be different depending on the signs and symptoms of COVID-19. What's been pretty remarkable to see is that the presentation of the illness is just so varied. So predicting the long term course, I think, is very challenging. But given the neuroinflammation and some of these other factors that have been discussed with this virus, it's certainly seems to be a reasonable

hypothesis to think that this might impact someone's cognitive reserve or enable the viral loading to have a greater impact on these things downstream.

**John Bellone** 29:11



Especially in the more severe cases, I would imagine. And we'll talk about some of the secondary mechanisms, respiratory issues, that result from all this in a second, but I'm wondering, before we get to the secondary mechanisms, on the other end of the spectrum, do we know if children can be impacted cognitively or developmentally by COVID-19? This is a hot topic, I know. [laughs]

**Chaya Fridman** 29:32



It's a hot topic. There's this great article that Louis Condie wrote several months ago about the concerns in the pediatric population. I think it's a must read for every pediatric neuropsychologist, and frankly, for every neuropsychologist because I think there are a variety of considerations that are listed there. I think that certainly the kids who are presenting with severe symptoms of COVID-19, we need to be very concerned about. We don't really know much at all about individuals who are asymptomatic or have mild disease burden. But, frankly, everybody's lives have been altered so significantly, whether it be the increased rates that we're hearing about of anxiety or depression - so the secondary factors, I know we're going to potentially discuss later. But I do think that we need to be concerned both of the cognitive impact for kids and also just the emotional toll that children are experiencing whether or not they're the ones who directly were impacted by the virus.

**John Bellone** 30:44



I'm also wondering if we know if there are any demographic moderators of the prevalence of severity in COVID-19? The severity of neurologic or cognitive or psychiatric symptoms? We know that age is clearly one potential moderator. I'm wondering if you could talk about that. And maybe whether gender, racial background, or SES - do any of these play a role? Do we know?

**Chaya Fridman** 31:08



So the Lancet paper that came out the other day mentions a higher rate of anxiety in women relative to men. So that's something that I think there's documented evidence of. There's certainly a lot of discussion about race and SES and access to treatment and medical care. And the genetics, right? We don't really know why different individuals are presenting with different signs and symptoms. The virus can look drastically different in two different patients of the same age and same

gender and coming from the same SES. So even patients matched on all those variables, their presentation can be so markedly different that I think that this is going to require ongoing, very careful scrutiny. And it makes it a real challenge to study in terms of coming up with your groups and how you generalize your findings.

**Ryan Van Patten** 32:05



Right. I think we know that people of low SES and people of color are disproportionately likely to get COVID-19 compared to other groups. What we don't yet know, I believe, is in people with COVID-19, are those of lower SES or people of color, for example, or women or any particular group more likely to develop psychiatric symptoms or cognitive symptoms. Aside from age, we know that age would be a risk factor there. Is that accurate?

**Chaya Fridman** 32:36



That's correct. What I would say is even in prior literature - we were discussing before MERS-CoV SARS-CoV, a lot of those studies don't include discussion of SES at all. They don't discuss IQ. They don't discuss race or ethnicity. So we're actually lacking a lot of that data, even from the related coronaviruses in the older studies. I think it's much more of an emphasis and a discussion now, and will be carefully followed and studied here. But we don't yet have information as to the long term potential psychiatric or cognitive effects given those variables.

**Ryan Van Patten** 33:19



Got it.

**Ryan Van Patten** 33:30



You've both alluded that we'll move forward and talk about secondary mechanisms, I think it's a good time to go there now. In your recent TCM paper, I believe it was published late this summer, you discuss the potential negative impact of ICU admissions on cognition, which can be iatrogenic. Not always but, for example, if a patient's sleep is disrupted, that prevents recovery and healing, and sleep can be disrupted in the ICU. Of course, this is not to say that patients shouldn't go to the ICU if they need it, but it's important for us to know about possible side effects cognitively, emotionally. So why do you think ICU admission is associated with greater cognitive problems and what might be the mechanisms?

**Chaya Fridman** 34:15



We know that patients who have been discharged from the ICU, many of them don't return to their baseline levels of cognitive functioning. Baddeley and Wilson coined the term "dysexecutive syndrome" that's been used to describe the degree of executive dysfunction that we see. It does vary in severity across these patients, but many individuals who have been in the ICU for really any reason end up having complaints about problem solving skills, decision making, memory. There are a variety of different factors that have been proposed as to the reason why this is the case - hyperglycemia, hypotension, the treatment interventions used. So I think that there are a variety of different factors. For some patients, it's all of the above. But it's certainly the case that ICU admission for a subset of the population is associated with greater cognitive difficulty.

**John Bellone** 35:17



And of course, they're in the ICU because they're the sickest. I guess if you do a comparison of people in the ICU with COVID-19 versus something else, I'm not sure if we've actually seen a direct comparison yet, but I guess that would be one way to parse it out.

**Chaya Fridman** 35:33



Correct. I definitely know that that is on the minds of many reviewers of publications. When things initially came out it was sort of just fast and furious. A lot of studies were being published with very small Ns, you know, very little data. But now that there's been more time and more data coming out, I do think we're going to get analyses that include the comparison groups of other people in the ICU. I think that's very important to have a better understanding of what is COVID-19 doing that is above and beyond what we might expect for the typical ICU patient.

**John Bellone** 36:10



There's probably a higher degree of people on mechanical ventilation who have COVID-19 in the ICU. Obviously, this is an important, life saving treatment for patients who can't breathe on their own. A ventilator, just for listeners might not know, is a bedside machine that breathes for the patient, allowing their lung function to recover to the point that they can hopefully once again breathe on their own. Similar to what we've done with SARS and MERS, we can look at the literature on the impact of mechanical ventilation on those patient outcomes and hopefully generalize to COVID-19. So what do we know about the cognitive and emotional effects of mechanical ventilation just by themselves? And then how can we assume that people with COVID-19 might be affected by ventilation?

**Chaya Fridman** 37:03



So the prior literature examining non-COVID-19 mechanically ventilated patients definitely suggests that even in those who were non-delirious - delirium was ruled out by a brief neuropsych assessment - about two-thirds of them have memory impairment. All of them demonstrated executive dysfunction during their ICU treatment subsequent to being on a ventilator. And difficulties remain throughout the hospital stay. So even in step down units, there was a lot of trouble. About half of those patients demonstrate difficulties a couple months later, 6 months out about a third. So things get progressively better over time. But in the interim, the impact that it has on daily functioning, performance of activities of daily living, and then as an outgrowth of that, mood, is very important. Some of the patients experienced difficulties well beyond the 6 months post-hospitalization. There was a prospective study that was done by Lee and colleagues in 2005 that showed 91% of individuals had cognitive impairment at discharge, and about 40% continued to have problems across multiple domains several months later. So things like attention, processing, speed, executive functioning - all the frontal subcortical skills. And, across studies, we're also hearing that attention/executive functioning and, likely as an outgrowth of that, memory is frequently reported as an area of difficulty. So given all of the data that we have, it's certainly reasonable to assume that at least a subset of COVID-19 patients will experience sequelae.

**John Bellone** 38:52



Listeners might also be wondering what potential mechanisms might be there. Obviously, this is maybe a little controversial. Is the ventilation actually causing some of these issues? Or are there the underlying factors? In terms of direct mechanisms, I've seen maybe the alveolar stretching - so there may be changes in those air sacs in the lungs, or O<sub>2</sub>, or CO<sub>2</sub> abnormalities or some cytokine, other inflammatory marker expression changes. So I think those are just some mechanisms potentially, that I've seen as well.

**Ryan Van Patten** 39:25



Related to mechanical ventilation would be ARDS, acute respiratory distress syndrome. Can you talk briefly about what that is and why it can be caused by COVID-19 and related to ventilation?

**Chaya Fridman** 39:40



Sure. As you mentioned at the outset of the discussion, we initially really thought of COVID-19 as a respiratory virus or a virus that impacts primarily the respiratory system. So we do have information, a lot of information, on patients who have long

term or even short term cognitive difficulties secondary to having respiratory distress from other sources not related to COVID-19. That population is an important one because many individuals require mechanical ventilation. So, knowing the acute respiratory distress syndrome literature is helpful in that there are many people who present similarly to our COVID-19 patients who have respiratory issues and then require mechanical ventilation.

I think what we saw in the first wave seems to be different than what we're seeing in the second wave of the illness where we had a much higher number of individuals who were being treated with ventilation than we do now. The numbers were certainly different in China than they were here. So I think that the literature is a little bit all over the place, in part because the approach to treatment has changed, the presentation of the illness has been different. So different health systems are approaching this in a variety of different ways, depending on the strain of the virus that they're dealing with, or just what we've learned now from prior data over the past several months. But it's certainly important, as you mentioned, to learn whatever we can from the ARDS literature. There, we know that, again, during the first 6 to 12 months post discharge a subset of people who were mechanically ventilated because of these respiratory symptoms that they experienced experienced chronic neurocognitive impairment and depression and reduced quality of life. You could talk about chicken or egg, right, but the reciprocal interaction between all of those is really important to consider. A quarter of them, again, experience difficulties where they're performing around the 5th percentile. So they're really impaired in memory, executive dysfunction, processing speed up to 6 years later. The numbers are pretty similar, actually, in terms of percentages of individuals who consider to experience difficulties as they were with the other literature we were talking about before. As a result of all this data, I think it's really important to think about our most critically ill COVID-19 patients. So the ones who required mechanical ventilation or had the most severe symptomatology as being at least at increased risk for these long term cognitive dysfunction and disability.

**Ryan Van Patten** 42:41



Another neurological syndrome that is relevant to ICU admissions, and certainly COVID-19 broadly, is delirium. I'd like to talk about that for a few minutes now. The most recent data I've seen on prevalence of delirium comes from a Kennedy et al. paper that was published in November, where about a quarter, about 200 of 800 older adults who presented to the emergency department with COVID, had delirium. These numbers are changing all the time, but that's just somewhere for us to launch off from. If we think about a quarter of people with COVID-19, older adults go into the ER who have delirium, it's significant. In addition, delirium is made more

likely by social isolation, which we know is common in COVID-19. How do you think about the risk for delirium in hospitalized COVID-19 patients? And then if you have anything to say about the risk in people in assisted living facilities, these older adults.

**Chaya Fridman** 43:41



You mentioned that a quarter approximately of individuals - the numbers have really varied, I mean, I've seen papers that say as high as 84% of individuals on the ICU with COVID-19, the most severely ill, have presented with delirium. That's approximately similar to what we see in a lot of ICU admissions. And again, I think it's variable depending on where the study is coming from. But extreme isolation experienced by hospitalized patients and those in assisted living facilities certainly can contribute to disorientation, feeling disconnected and a lack of awareness, and that further fuels delirium, right? Just not feeling as grounded and the complete disorientation. Waking up not really sure where you are. Not having those people who you could reach out to and be connected to. And so that's really a factor not just individuals in the ICU, but anyone with COVID-19, frankly, hospitalized or not, because of the need to socially isolate. So there's a real importance to make sure that we're using technology to the extent that it is available to connect patients with loved ones, and to make sure that they have that face to face time, time to hear people's voices and opportunities to feel connected because otherwise, the potential for disorientation is just so great.

**John Bellone** 45:15



We know that people who have an acute episode of delirium in the ICU, in the hospital, they are at increased risk for dementia, for persistent cognitive problems. Not all of them, but some percentage of them. So, this doesn't bode well for the future.

**Chaya Fridman** 45:34



Certainly not.

**John Bellone** 45:35



Do we know about the long term psychological health of ICU survivors?

**Chaya Fridman** 45:50



Psychological health concerns, namely depression, anxiety, PTSD, are frequently experienced by ICU survivors. In the months post hospital discharge, a large

minority of patients who were treated in the ICU for really any condition report depressive symptoms. Almost 40% will report symptoms of anxiety. PTSD is not quite as common, but it's certainly still a sizable minority. And it presents in different populations differently. So the younger patients seem to be the ones who are at the higher risk for PTSD. Same thing with those who have pre-existing mental health conditions. Depression is the biggest issue in the geriatric population. So depending on the age range of the patient you're dealing with there are definitely different factors that we need to think about in terms of mental health, and to be aware of and make sure that we're screening for.

**John Bellone** 46:50



Of course we know that psychiatric symptoms have the potential to disrupt cognitive functioning, and poor cognitive functioning can be a stressor that can lead to or exacerbate mental health symptoms. I'm wondering how you think about this sort of bi-directional relationship in the context of ICU admissions and ARDS and ventilation?

**Chaya Fridman** 47:12

Bi-directionality is extremely important to consider. For some individuals, psychological sequelae are possibly a direct effect of CNS dysfunction and the associated biological changes that they're experiencing. Other patients' psychiatric symptoms could be a reaction to living through a serious medical illness, or the difficulty adjusting to any cognitive impairment that they're experiencing in daily life, or the exacerbation of a pre-existing mental health condition. Depression, anxiety, PTSD, any of them alone, or certainly in tandem, can then contribute to cognitive deficits that patients experience in the months or even years after they're discharged from an ICU.



The reduced quality of life, I think, is really important to consider. Because difficulty performing activities of daily living, poor decision making, problem solving, whether that's secondary to cognitive impairment or whether it's an outgrowth of the mood state, it then fuels more of the internalizing problems. So we know that with ARDS survivors who have cognitive impairment, many of them, if not most of them, experienced moderate to severe anxiety. Those without cognitive impairment, the numbers are much lower. So I think it's about 60% to 30% in terms of the split. It's definitely the case that those who experience cognitive impairment are at greater risk of experiencing internalizing symptoms. The difficulties can also then limit the effectiveness of our interventions that we try and introduce. And so then we need to be concerned about treatment adherence or the types of psychoeducation that

need to be provided. I think we need to be cautious in ensuring, as we really do for any disorder, that we're evaluating that, we're thinking very carefully about the psychiatric symptomatology in addition to the cognitive presentation, and how those two factors might be impacting each other.

**John Bellone** 49:23



On that note, I want to talk more about the neuropsychological evaluation in COVID-19 patients. Given these cognitive and mood symptoms that we've been talking about, that they're common especially in hospitalized individuals with COVID-19, it's clear that neuropsychologists have a role to play on the interdisciplinary team in both inpatient and outpatient settings. So maybe we can start with the inpatient setting. Just as a point of clarification do you see inpatients?

**Chaya Fridman** 49:55



I have not been a member of our team to see [inpatients]. At the outset of the pandemic we met as a team to discuss all the pitfalls that we thought we might experience, what batteries we'd want to give, and two of our staff members were redeployed to the COVID-19 unit. Through ongoing communications and discussions about how to navigate all of it, I certainly at this point have a clear understanding of what they faced, but Dr. Abhishek Jaywant, who was one of my co-authors, took the lead on working with those patients.

**John Bellone** 50:37



Gotcha. Okay. But from your discussions and your understanding, in general, what do inpatient neuropsych evals look like? Especially given the need to physically distance from a patient?

**Chaya Fridman** 50:39



It's really difficult to distance [oneself] from the patients in the inpatient setting. Our team members have full PPE - you know, their N-95 and their face shields. We kept the batteries fairly brief. We took pictures of all of our raw data, so materials weren't leaving the room - everyone went in with iPads. But it was both a very challenging and an extremely rewarding experience. I think that the medical acuity and complexities of these cases were quite challenging. The profound isolation and the alteration in their functioning made these evaluations quite tricky. We also continuously faced individuals who English is not their primary language, and the inability to then have an interpreter present is certainly very tricky. Because you just can't have extra people on a COVID unit. So there are unique circumstances to conducting an inpatient neuropsych assessment on a COVID unit. As a result of

that we most frequently use the BMET. I don't know if you're familiar with the Brief Memory and Executive Test, but because it's sensitive to different types of deficits that we were seeing and has been validated in use in ICUs and similar kinds of settings, we focused mostly on that. And [we] did see weaknesses in attention and executive functioning, to a lesser extent in memory. It has short subtests of orientation, verbal learning, recall, recognition, symbol digit matching task, trail making. So it enabled us to look at a variety of the areas of cognition that we expected might be weak just given some of the literature we discussed previously. Then we would use clinical interviews supplemented by the Hospital Anxiety and Depression Scale and Positive and Negative Affective Schedule to get some of the additional psychological functioning information.

**Ryan Van Patten** 52:55



Earlier, we talked about the high prevalence of anosmia in COVID-19. So either for inpatient or outpatient evaluations, do you suggest neuropsychologists use tests of olfaction in their batteries?

**Chaya Fridman** 53:09



Because we're not really trying to diagnose COVID, we don't really find that to be necessary. It's also not really clear what the clinical utility or functional value of a smell test would have in a case like this. So even if someone is reporting and anosmia several months post their infection, we don't yet have an understanding of what that means. I've also certainly read and followed the discussion of just the safety of using the tools that we have to assess that across multiple patients. So right now, it's not something that I think would be standard practice or necessary.

**Ryan Van Patten** 53:47



That makes sense.

**John Bellone** 53:48



You'd have to throw it out or find a way to clean it every time. [laughs]

**Chaya Fridman** 53:51



Exactly. [laughs]

**Ryan Van Patten** 53:53



You mentioned taking pictures of the raw data, which I like. Obviously, it's important, very critical to be as safe as possible. In that regard, I've wondered about

teleneuropsych for inpatients. Many of us are familiar with teleneuropsychology for outpatients, but is that something your team considered? Or do you have thoughts about if it's possible to do a remote room-to-room neuropsych eval? If the patient is high functioning enough, I guess. What do you think?

**Chaya Fridman** 54:20

We definitely tried it at the start of redeployment for people into the COVID units. It was very tricky there just in part because of the lack of staff to help with the technology on the patient's ends. So we haven't used it very much on our site for that purpose. We have used it for non-COVID inpatients. Some of the challenges are the same that you typically face with an inpatient assessment. So like private space, right, which you really don't have in an inpatient unit. You also need to be able to quickly contact staff members on the unit should there be issues with safety, if any safety concern arises, but internet connectivity like other factors that you might need to troubleshoot if you are not in that space.



The advantage relative to home telehealth that you were describing is that there are staff members who can provide and collect response booklets. It's easier to maintain test security when it's not a patient who's in their home. In our practice, we ended up using a combination on the outpatient side of in-office telehealth and then a modified in-person assessment, specifically for reasons like that - collecting response booklets, maintaining test security. So certainly when there are staff members available on the inpatient side who can participate, there are ways that you can do it that enable you to administer most of what you typically would have. But you need to be more reliant on other practitioners and that's not always so feasible.

**John Bellone** 54:27

Given the difficulties of inpatient testing at the bedside for patients with COVID and all the confounding variables that you mentioned earlier, do you have any pearls about the bedside exam or the importance of behavioral observations for evaluating these patients?



**Chaya Fridman** 56:15

Behavioral observations are always so important in an inpatient setting, in part just because we have limited time available to do formal assessments. So it's certainly very important to monitor behavior. The COVID-19 assessments, I think, also due to the level of fatigue of many of the patients, you're talking about really brief assessments at times. So any information you can glean that way is very helpful. I



think there's also a real need to rely on information provided from other members of the medical or rehab teams. So PTs, OTs, speech language pathologists, the other people who are interfacing with the patients also are seeing them for short snippets of time and their observations, their measures provide some supplementary information that I think it's helpful to integrate with the data that we collect just to look for some of the subtle cognitive or emotional manifestations that we might not be able to pick up on in the limited time that we have.

**Ryan Van Patten** 57:16



In your TCM paper, you advocate for the importance of psychological interventions in these settings, You've alluded to it earlier. So how might neuropsychologists be involved in psychological treatment for COVID-19 patients?

**Chaya Fridman** 57:29



So that's when I think we need to draw on our training as clinical psychologists before or as part of our road to becoming neuropsychologists. There's a real need to implement brief CBT, teach mindfulness skills. We found that to be really effective in this population on the inpatient and the outpatient setting. And more importantly, I think, what we found on the inpatient unit is that because of the isolation, because of how life changing this experience has been, even just being a listening ear so that someone can talk about the experience in a safe, compassionate space, can be really helpful. So just taking the time to sit and listen to patients' experiences, even if it's part of an assessment. I think the feedback that we've gotten is that it's been an extremely helpful role that we can play during our brief interactions.

**John Bellone** 58:31



And really on any inpatient unit, but it sounds like especially pertinent to COVID patients, these psych interventions.

**Chaya Fridman** 58:39



Correct. I think even on the outpatient side [for] people with COVID, everyone's just so isolated. And frankly, for society in general, everyone going through quarantine periods, staying further apart, the degree of isolation, and then how magnified that becomes when somebody does become ill. Normally, they would have had a loved one potentially in the hospital room with them, and that's just not permitted, it's not safe. Or the fear that's associated, even if you're at home, of getting somebody else sick. I think there are a lot of factors that are unique to COVID-19 that we need to be very sensitive to in terms of the impact that it's having on the illness process.

**John Bellone** 59:33



I want to maybe, as we move towards the end of the conversation, briefly mention the outpatient setting and more long term, what this might look like for a neuropsychologist. So over time, as more and more people are infected with SARS-CoV-2, they develop COVID-19 symptoms, they eventually recover, neuropsychologists are, I'm sure, going to begin seeing more and more of these patients as outpatients. Some people are going to attribute their perceived cognitive and emotional symptoms to COVID-19, whether or not there's a direct biological link between the virus and the cognitive complaints for every person. So we really have a fine line, I think, to walk as neuropsychologists. I can envision something similar to post-concussion syndrome in some people with COVID-19, which could unnecessarily lead to worse outcomes if, again, people are maybe mistakenly attributing symptoms to the virus or having some sort of symptom expectation. But we also don't want to invalidate what those people are experiencing, or ignore the fact that there might be a causal relationship for certain people. So I'm wondering - I know, that's a lot. I'm wondering how you are thinking about this issue?

**Chaya Fridman** 1:00:53



I think it's such an important issue, and something that we're going to need to continue to ask for quite some time. It's going to start with educating ourselves. Really getting an understanding of what this looks like, how prevalent some of these concerns really are. That's necessary for a variety of reasons. One is because psychoeducation is such an important tool in the population you reference when there are potential concerns post an illness or the emergence of a syndrome. That's really one of the ways that we address this, is we work with patients on providing psychoeducation. So the lack of knowledge and data right now makes this very challenging. But given what we know so far, it's certainly reasonable to accept that a subset of individuals is going to indeed experience cognitive difficulties, mental health problems that could linger for quite some time. Again, the early evidence of COVID-19 is that we are seeing some discussion of attention and processing speed, executive functioning, these complaints that are going to need to be studied very carefully. It's not surprising, given prior literature that we've discussed today, and we'll need to get a better handle on what exactly that looks like and how to then provide scalable treatments or interventions to help people through that. I think there's going to be a real need to understand this in kids and in adults. And also with kids then think about the long term trajectory of what that might look like. The impact that it might have on schooling, and then the academic burden has downstream effects as well. So I think there are a whole host of factors and with a particular patient, a lot of it's going to depend on not just age, but severity of infection, what comorbidities we're seeing right - were there seizures?

How long did the illness last? How high were the fevers? Like, what were the manifestations? And how severe was the illness? And then in that population, in that literature, what do we know about cognitive sequelae? So a patient who had respiratory presentations will look different from someone with seizures or cardiac issues. So we need to really pull on all of our knowledge and all of our literature potentially to work with these patients. So I think it's going to be a really interesting and important challenge for our field to figure out how to walk that tightrope. Being able to identify the individuals with true weaknesses, and then also to be able to help individuals who do have more of a PCS like syndrome work through that in a way that's more typical to the tools that we would otherwise use.

**Ryan Van Patten** 1:03:50



Right. This is going to be a big part of our jobs for years to come, which I know in April of 2020 I didn't expect. But, what you're saying is very, very helpful. So I'm wondering, another question about clinical evaluations in an outpatient setting for COVID-19. When you see these patients or if some of our listeners do, I'm curious about if you think there are special considerations for test battery, neuropsych report, feedback. Obviously, the clinical interview will include questions related to ICU admission, how severe the infection was, stuff like that, but at this early stage to caveat it, what are your thoughts?

**Chaya Fridman** 1:04:32

I'll reference Dr. Condie's article again from Child Neuropsych. She lists a variety of questions to ask about clinical history, course of illness. I think those are going to be important things to include in the clinical interview. And, given the discussion we were just having, effort measures I always think are an important part of any battery, but we're definitely going to want to include multiple effort measures in our assessment battery.



I think we need to be careful when providing feedback if we don't have enough information yet not to overreach in terms of conclusions that we draw. But there's definitely going to be a need to conduct serial evaluations, I think, to detect some of these subtle difficulties, potential regression over time or emergence of things that might not be as sudden. So I think there's going to be a difference between patients who are coming in fairly soon after diagnosis, or even let's say within the first year, versus what this might look like over time. I think all of that information is going to be extremely important in terms of how we integrate this information in treating the patients we've historically treated, but never had to consider this variable.

Then more globally, post feedback, I think we need to figure out low cost, scalable cognitive interventions. There are a lot of people with no means or the number of people who are potentially going to need support and interventions, we're going to need to be creative in coming up with ways in which to support this population. So the feedback is obviously not just the diagnosis, but also what do we do once we've identified some of these challenges. And I think, again, we're going to need to pull from our expertise in different aspects of this field and really integrate our knowledge to be able to come up with solutions that are not very costly and that we're able to provide on a potentially larger scale. So whether they be use of technology or can be done in more of a group setting. But it's definitely going to tap into our creativity, I think, as a discipline.

**Ryan Van Patten** 1:06:45



Without a doubt. Yeah. There'll be a lot of our patients who will have COVID-19 as a comorbidity or as part of their background medical history, just based on the case numbers. But then, in addition to that, we might see people where the primary referral question is COVID-19, possibly.

**Chaya Fridman** 1:07:03



Correct. I think we're going to start seeing that with increased frequency. And even remembering to think about when they got it in terms of the wave, where did they live in the country, or what country they came from - there are just so many variables that have an impact. And so, again, I think there's a real need for us to be involved in these studies to think about what measures we use, make sure that there are things that can be repeated over time so that we can track the course of this. And be able to pull from our knowledge of working with people with a variety of different disorders because I think we're in a somewhat unique position that we interface with lots of these different disciplines that now are involved in COVID-19 research and studies. So we need to educate ourselves about the cognitive impacts in all of these different patient populations because any of the patients we're seeing could present with those complications.

**Ryan Van Patten** 1:08:07



Right. Well, this has been a very useful conversation. Thank you for taking the time. None of us are really experts in COVID-19 because it hasn't just been around for that long, but you've answered our questions in a very useful way. So thank you.



**Chaya Fridman** 1:08:22

Thank you for having me.



**Ryan Van Patten** 1:08:23

Before we let you go, we have two quick bonus questions. These aren't necessarily about COVID-19. They can be but they're about the field of neuropsychology broadly, and we're interested in your opinion. The first question is, if you can improve one thing about the field of neuropsychology, what would that be?



**Chaya Fridman** 1:08:42

So I'm not one who is very tech savvy, but I do think that greater integration of technology in our assessment tools, whether that's some of the virtual reality literature or just using other ways of potentially improving the construct validity of our measures is important. This is a conversation always with things like executive dysfunction where, on our exam, some might be just fine even on the Rey or anything we throw at them, one of the hardest things that we might have to think that we're looking at planning or organizing, but it doesn't match what they're experiencing in daily life. So I think that we still have a ways to go with some of our measures in terms of construct validity. I think also the interface between imaging and our assessment tools is also a related area in terms of technology. About ways that we might be able to move forward as a field and tighten the nature of our assessment tools and their utility.



**John Bellone** 1:09:51

Great answer. I think, yeah, as technology continues to advance, I think our evaluations are going to look more and more different and incorporate more. I hope that they do. The last question is what is one bit of advice that you wish someone told you when you were training or maybe someone did tell you that really made the difference. Just an actionable step that trainees can take.



**Chaya Fridman** 1:10:11

So one of the senior students in the lab that I joined when I was in my first year of graduate school told me that for my externship - I don't know if that's what you call it on the west coast.



**John Bellone** 1:10:23

[laughs]

**Chaya Fridman** 1:10:23

But we call it an externship. To choose a supervisor based on the mentor, not based on the population that that individual works with. I found that to be very helpful advice. Firstly, because I then learned that there were lots of patient populations I didn't anticipate ever working with or that I would necessarily love to work with that I then found out that I did. But more importantly, because the supervisor was able to teach me so much beyond that specific patient population.



The advice and the ongoing mentorship that those relationships provided has really proven to be invaluable. So I think that that's one thing. I think people come into the field maybe having their sights set on a particular population, And there's reason to argue - I know within pediatric neuropsychology, some people will say, "Work with every different peds population you can to really specialize in that." But I've really benefited from working with people across lifespan and pulled from each of those experiences. In particular, the mentor and someone's ability to teach and to simplify and meet you at the level that you're at and make sure you're continuously growing and learning and moving in the right direction so that you can be a well rounded independent clinician down the road is extremely important.



**John Bellone** 1:11:52

Excellent.



**Ryan Van Patten** 1:11:53

Thank you for taking the time.



**Chaya Fridman** 1:11:55

Thank you guys. This was fun.



**Ryan Van Patten** 1:11:56

Yeah, I think this will be a really popular episode. It's obviously very useful to people, even though the literature is changing so quickly. We'll have to do a follow up with you, you know, in a year or so. [laughs]



**John Bellone** 1:12:08

In a week, we'll have to do a follow-up. [laughs]

**Chaya Fridman** 1:12:10

It's crazy. When we started working on this, it was in March. You know, New York, where I live and work, was hit hard and early. And right away, we started realizing this could really have a very significant impact on our practice moving forward. And from the time we started working on the paper to when the first draft went in, there was so much additional literature that we had to think about and include. Between, like, when we got to revise and resubmit and we resubmitted there was just a ton of additional papers to think about. And, even now, part of this conversation, I was pulling up some things - it's like, it's just amazing to be living at a time when there's just so much that we don't know and so much that's evolving. It will be interesting to see how this all looks 6 months from now, a year from now. Hopefully, there'll be really helpful, important studies that come out that could help direct us more.



Because I think right now there is a lot of, you know, just shooting in the dark and hoping that we're hitting a target. But I do think that we have a lot of information that's been valuable in directing us. We need to just continue to listen to our patients carefully and glean from their experiences and continue to conduct the studies, whether they even just be demographic. Getting a better understanding of what it is that we're dealing with here. Is it evolving over time and with different strains or in different regions? Can we integrate all of our literature? Do we have to keep things separate? I think they're just so many important questions. As a neuropsychologist, you don't envision something drastically changing the course of your career trajectory. But I think this is one of those events that's just changing everybody's life, and it's certainly going to impact us as a field.



**Ryan Van Patten** 1:14:04

Yeah. We found that in preparing for this episode, which is nothing like writing a paper. I'm sure it was 100 times worse for you.



**Chaya Fridman** 1:14:10

[laughs]



**Ryan Van Patten** 1:14:10

But we're reading, you know, last night I'm checking to see if there are any new papers. We're labeling our papers by the month they were published, typically just a year is sufficient.



**Chaya Fridman** 1:14:19

It's ridiculous. And then you're looking at these, like, "May, that seems really outdated. There's something new by now..." and then there's not. [laughs]



**Ryan Van Patten** 1:14:27

Yeah. [laughs]



**Chaya Fridman** 1:14:29

But, yeah, it's like nothing we've ever experienced before. So I agree. I think there'll be a continuous need for follow up. I hope this information proves to be valuable for a while. I think it at least gives us a good starting point.



**Ryan Van Patten** 1:14:43

For sure. Thanks so much.



**Chaya Fridman** 1:14:45

Thank you for reaching out. This was a lot of fun to do. I enjoyed listening to you guys since you contacted me. It's a great thing you're doing for the field.



**John Bellone** 1:14:55

Oh, thanks for saying that. All right. Take care.



**Ryan Van Patten** 1:14:57

Take care.



**Transition Music** 1:14:58



**John Bellone** 1:15:02

Well, that does it for our conversation with Chaya. We will likely bring more episodes on COVID-19 and cognition and emotion as more data come out, so stay tuned. As always, thanks so much for listening, and join us next time as we continue to navigate the brain and behavior.



**Exit Music** 1:15:20



**John Bellone** 1:15:43

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**Ryan Van Patten** 1:15:55

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