



## COVID-19: Neurocognitive & Psychological Effects

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### Objectives

- Participants will learn about the Neurological and Neuropsychological effects of COVID-19.
- Participants will learn and understand the recovery process and complications that may occur.
- Participants will learn about uncontrolled stress associated with the COVID pandemic and how this parallels the chronicity of traumatic brain injury, and other neurological diseases.
- Participants will learn about stress management techniques for acute stress and chronic stress response.



### Summary of Presentation

The purpose of this presentation is to provide an update regarding COVID-19 in the United States. The **current rate of COVID infection and deaths** will be discussed with some emphasis on various states or locations.

Now that COVID has been evident for almost a year, we are beginning to see subtle differences in how COVID may impact any individual. The initial focus on patient well-being was related to pulmonary status leading to secondary neurocognitive impairment. However, there may also be **primary neurological changes from COVID** with predictors such as loss of taste and smell suggesting neurological injury.

Finally, the pandemic has led to many medical complications ranging from very mild symptoms to death, and has raised the issues of living in **isolation and fear**. *Up to 73.4% of healthcare workers reported post-traumatic stress symptoms during outbreaks with symptoms lasting 1-3 years in 10-40% of those sampled (Preti et al. 2020)*

The presentation provides considerations for everyone regarding coping with acute and chronic stress.



## Self-Evaluation – Are you Ok?

What we currently know is the following...

**Taking one's temperature** is a good indicator of potential positive COVID, especially if following known exposure. Like any virus, COVID will typically produce changes in temperature that indicates the immune system has been triggered.

**Reduce risk by wearing a mask** when outside of your home. Any time you come in contact with the public, then wear a mask. This has been show to reduce the spread by at least 80%.

**Minimize exposure** – engage in remote activities with family, work from home with remote access if possible.

**The incubation period is from 5-9 days.** If a person has to travel or be in a higher risk for potential exposure, then isolating for 14 days following the exposure is recommended. The first 5-9 days is when symptoms are expected to become evident in many cases.



## COVID Statistics

### Global and United States trends

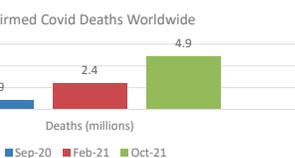
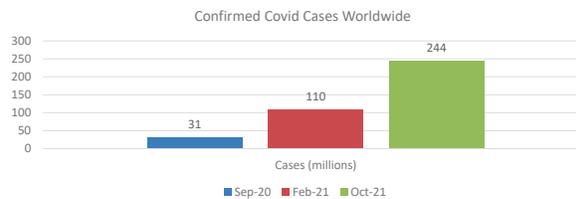
... As of 10/2021, there have been 6 Billion total vaccinations doses administered ...



## COVID Statistics

Current Data – United States and the World Health  
(as of October 25, 2021)

World Health:



References:  
\* US Census Bureau, 09/2020  
Johns Hopkins Corona Virus Resource Center, 10/2021



## COVID Statistics

Current Data – United States and the World Health  
(as of October 25, 2021 updated from February 18, 2021)

United States in 09/2020...

U.S. accounted for 4.25% of the world population  
U.S. is ranked 3<sup>rd</sup> in population size compared to other country sizes

U.S. Confirmed:

09/2020: 27,854,389 (25% of the world cases [at that time])  
10/2021: 45,546,281 (18% of the world cases presently)

U.S. Deaths:

09/2020: 491,411 (9% of the world death cases [at that time])  
10/2021: 737,371 (14.8% of the world death cases)

References:

\* US Census Bureau, 09/2020  
Johns Hopkins Corona Virus Resource Center, 02/2021



## COVID Health Risks

### Signs and Symptoms



## COVID Signs and Symptoms

*Clinical symptoms (Singhal, 2020)*

Acute Symptoms

Fever (not in all), cough, sore throat, headache, fatigue, myalgia (muscle pain) and breathlessness, conjunctivitis

Chronic symptoms

Can progress to pneumonia, respiratory failure, Severe Acute Respiratory Syndrome (SARS), hypoxia/anoxia, neurological impairment (primary or secondary), and death



## COVID Signs and Symptoms

*Clinical symptoms – Center for Disease Control, 2020*

Symptoms may appear 2-14 days after exposure to the virus:

Fever or chills  
Cough  
Shortness of breath or difficulty breathing  
Fatigue  
Muscle or body aches  
Headache  
New loss of taste or smell \*  
Sore throat  
Congestion or runny nose  
Nausea or vomiting  
Diarrhea

\* Neurological signs



## COVID Signs and Symptoms

*Clinical symptoms – Center for Disease Control, 2020*

Emergency warning signs for COVID-19 requiring immediate medical attention:

Trouble breathing  
Persistent pain or pressure in the chest  
New confusion \*  
Inability to wake or stay awake \*  
Bluish lips or face

\* Neurological signs (disorientation)



## COVID Signs and Symptoms

*Clinical symptoms (Singhal, 2020)*

Additional Symptoms listed in the Massachusetts Dept. of Health Testing

Fever, chills, or shaking chills  
Signs of a lower respiratory illness (cough, shortness of breath, lowered oxygen)  
Fatigue, sore throat, body aches,  
Myalgia, headache, loss of sense of smell or taste

Less common symptoms:

Gastrointestinal and inflammatory

Elderly: Alterations in mental status or blood glucose control



# COVID Signs and Symptoms

## Medical complications of Covid

### Pulmonary disease

Pro-inflammatory cytokine release is known to cause severe pulmonary damage through over activity of the immune system in COVID-19. It is termed “**cytokine storm**”, and likely affects the CNS as well due to the **stimulation of the immune system**. Indirect CNS damage, through cytokine storm, can cause high mortality rates, encephalopathy, and posterior reversible encephalopathy [PRES] (Leonardi et al., 2020).

### Lung lesions

Acute lung injury, acute respiratory disease syndrome, shock, and **acute kidney injury** have been noted (Servick, 2020; Singhal, 2020).

Hypoxia has been hypothesized to be a common cause of long-term **cognitive impairment** in patients with acute respiratory distress syndrome (Hall & Fenton, 2020).

### Other organ systems

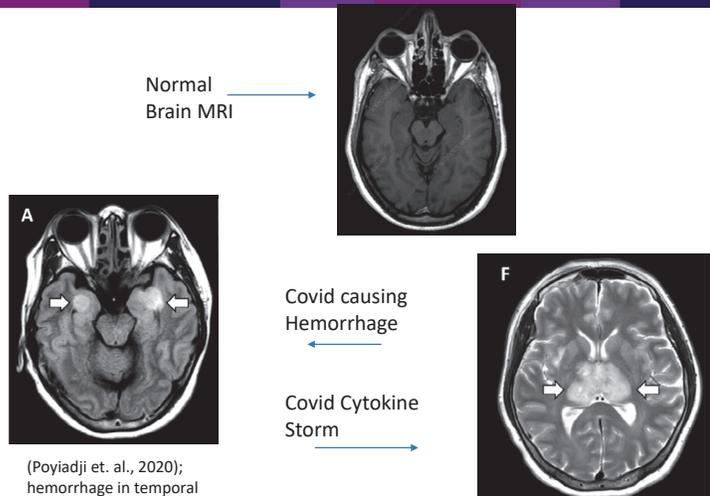
Liver (mild transaminitis), and cardiomyopathy (Servick, 2020).

Brain hemorrhages (Poyiadji et. al., 2020)



## COVID Health Risks

### Neurocognitive Features



(Poyiadji et. al., 2020); hemorrhage in temporal thalamic region

Radiology, 2020; Immune system damages organs.

Neurological & Neurocognitive Features



## COVID Neuropathology

### Risks of strokes

In case series from (Mao et al., 2020) it is unclear whether individuals with stroke had vascular risk factors or if the strokes came from viral vasculitis. Increased risk of stroke post SARS infection (Umapathi et al., 2004)

### Risks of brain hemorrhages

Acute cerebrovascular disease, both cerebral occlusion and hemorrhage have been noted as consequences of infection (Hall & Fenton, 2020).

Overproduction of immune cells and/ or release of cytokines, increases the risk of these complications.

### Risks of ischemia for vascular problems (ischemia - blockage)

6 of 214 Covid patients had ischemic or hemorrhagic strokes (Mao et al., 2020)



## COVID Neurological and Neurocognitive

### Other Neurologic complications of Covid

In a retrospective case series from three designated COVID-19 hospitals in Wuhan, China (January 16-February 19 2020, *not peer-reviewed*), 70 out of 214 individuals (36.4%) with lab-confirmed COVID-19 showed neurological manifestations (Mao et al., 2020).

(a) Central Nervous System (CNS) symptoms (24.8%; headaches, dizziness, impaired consciousness, ataxia, acute cerebrovascular disease such as ischemic stroke or hemorrhage, and seizure),

(b) peripheral nervous system (PNS) symptoms (8.9%; hypogeusia [a reduced ability to taste things; the complete lack of taste is referred to as ageusia], hyposmia [reduced or loss of smell], and neuralgia [intense and intermittent pain along the nerve]), and

(c) skeletal muscle symptoms (10.7%; myalgia and CK>200 U/L).



## COVID Neurological and Neurocognitive

### Mental Status

Altered mental status is when a person has difficulty knowing what is happening in the moment with confusion and disorientation. There are many causes of mental status impairments, but mental status changes indicate neurological impairment.

Increasing reports of delirium in covid-19 patients (Leonardi et al., 2020)  
22% with delirium died (Chen et al., 2019)

Altered mental status in patients with encephalopathy (Filatov et al., 2020)



## COVID Neurological and Neurocognitive

### Encephalopathy – generalized impairment without etiology

Central nervous system symptoms include disorientation, loss of consciousness, headache, delirium and coma. These symptoms may appear separately or collectively in patients diagnosed with COVID-19, and they are most commonly seen in patients who develop encephalopathy and/or cerebrovascular disease (from White paper Hall & Fenton, 2020). COVID-19 possibly associated with acute necrotizing hemorrhagic encephalopathy (Hall & Fenton, 2020). ANE features symmetric, multifocal lesions within the thalamus on CT imaging and MRI often shows internal hemorrhaging.

### Encephalitis – generalized impairment due to inflammation

Reports of neurological impact have been limited but there is concern about encephalitis (presence of the virus in CSF), and meningitis (Ando et al., 2020). Three processes are gaining attention as key contributors to neurologic manifestation including viral encephalitis, infectious toxic encephalopathy, and acute cerebrovascular disease (Hall & Fenton, 2020)



## COVID Neurological and Neurocognitive

### Cognitive impairments

Increased risk because of lack of understanding to take on preventative measures; important to have vigilant caregivers (Courtenay, 2020)

### Memory disorders

Clinical relevance of alveolar stretching appears to cause production of various cerebral actors (cytokines, chemokines, microglia, immune system activation) that often lead to neuroinflammation as well as beta amyloid production, which is typically exhibited in Alzheimer's disease (Hall & Fenton, 2020)

### Neuropsychological deficits

Neurological findings fall into three categories: central (headache, dizziness, impaired consciousness, acute cerebrovascular disease, ataxia and seizures), peripheral (hypogeusia, hyposmia) and musculoskeletal (Leonardi et al., 2020)



## COVID Neurological features

### Vulnerability

*Individuals with the underlying neurological disease may be more vulnerable to neurological manifestations of COVID-19 via the exacerbation of the typical stress-response mechanisms (Servick, 2020); prior research has shown that multiple injuries produce a cumulative effect.*

With respect to coronavirus in general, there is a relationship between coronavirus infections and

- (a) CNS damage related to encephalopathies and encephalitis,
- (b) status epilepticus (Bohmwald et al., 2018),
- (c) the development of multiple sclerosis,
- (d) brain injury associated inflammatory processes including hemorrhage
- (e) brain damage associated with febrile seizures (Principi et al., 2010) and afebrile seizures (Bohmwald et al., 2018), and
- (f) progressive multifocal leukoencephalopathy (Desforges et al., 2014)



## COVID Neuropsychological features

### Cognitive Vulnerability

Just like in any condition, there are cognitive risks.

*The cognitive functions can be equally or differentially affected. It is important to evaluate if there is suspected dysfunction.*

*Loss of taste / smell are the best predictors of cognitive dysfunction from COVID.*

#### Cognitive functions / domains:

Attention and Concentration

Information Processing

Memory

Language skills

Visual-Perceptual skills

Executive Functions



## COVID Neuropsychological features

### Chronic impacts

Neurological conditions tend to be chronic, with few exceptions.

What is interesting is that those who have survived a brain injury and have been living with the effects, like social isolation, have been ahead of the game when dealing with this pandemic.



## COVID Health Risks

### Neuropathology



## COVID Neuropathology

### Brain Tissue Changes

Severe cases of COVID-19 are more likely to develop neurological symptoms than patients who have a mild manifestation of infection (White Paper regarding Neurologic Problems associated with COVID-19 Infection).

*High number of patients with hyposmia, anosmia and varying patterns of possibly centrally mediated symptoms including respiratory manifestations (Leonardi et al., 2020) have neurological complications otherwise.*

Plasma biomarkers of CNS damage are increased in patients with COVID-19 and associated with disease severity (Kanberg et al., 2020)

### Neurochemistry Changes

Potential to cause nerve damage via diverse pathways (Wu et al., 2020).  
Neurochemical evidence of neuronal injury and glial activation in patients with moderate and severe COVID-19 (Kanberg et al., 2020)



## COVID Neuropathology

### Metabolic rate; metabolic encephalopathy

Covid-19 patients suffer from severe hypoxia and viremia (virus in the blood stream) as well as **metabolic disruption associated with diffuse organ involvement**, any of which can result in infectious toxic encephalopathy (Hall & Fenton, 2020)

### White matter disease or subcortical disease following Covid study

The results of this study indicate that **astrocytic activation/injury** (GFAP measurements) may be a common feature in moderate and severe stages of COVID-19, while **neuronal injury** (NfL) occurs later in the disease process and mainly in patients with severe disease (Kanberg et al., 2020)

*One may hypothesize that astrocytic activation/injury is a first response to CNS insult and that plasma NfL increase reflects a progression to neuronal injury in severe cases.*



## COVID Intervention from neurological impairment

### Treatment with neurological impairment

*Treatment is designed the same as it is with other neurological impairments for brain trauma, stroke, hypoxia, anoxia, and respiratory impairment leading to deconditioning.*

The focus is on improving functioning at the base level during hospitalization. As deconditioning begins to improve, then other functions may be assessed and treated accordingly.



## COVID Intervention from neurological impairment

### Treatment with neurological impairment

For neurocognitive impairment, the focus is on cognitive rehabilitation strategies with speech therapy and neuropsychology, as well as application of skills in real-world settings.

#### Care levels for treatment following Covid-19:

Hospital acute care,  
Inpatient rehabilitation programs,  
Post-hospital rehabilitation programs,  
Outpatient,  
Home & community integration.

Post-hospital care may be more important because of the deconditioning effects of this condition.



## COVID Health Risks

### Psychological Effects



## Psychological Effects of Covid-19

**Increase of suicide potentially related to Covid-19 and stressors associated with the virus (Thakur & Jain, 2020).** Social isolation often will produce worry, anxiety and fear, which then leads to feeling hopeless and helpless which then increases the risk of suicide potential. Hopelessness for change and feeling that one is unable to change their situation are the predictors of suicidal ideation.

Significant psychological distress was experienced by hospitalized COVID-19 patients (Guo et al., 2020). The distress can be in the form of typical hospital stress and/or not knowing if one may live through the experience.

Levels of depressive features may be related to the inflammation markers in these patients. There is a strong association of two conditions... depression due to a medical condition and anxiety due to a medical condition... with COVID-19 being the medical condition.

**Mood is strongly associated with neurological status.**



## Psychological Effects of Covid-19

### Where did everyone go???

Adhering to social distancing guidelines as opposed to doing things like handwashing but not adhering to those guidelines predicted lower coronavirus anxiety (Milman et al., 2020).

The reason is that one is exerting **control over conditions** that feel out of control. If you exert control, then you reduce anxiety because anxiety is about not having control and not knowing the future.

Stress and psychological distress 1 year after experience of non-covid SARS virus (Lee et al., 2007)



## Psychological Effects of Covid-19

Covid-19 seems to have a circular relationship with PTSD and immunosuppression where persistent stress related to Covid impacts PTSD which impacts immunosuppression leading to increased susceptibility to the virus (Liang et al., 2020).

*Research has shown that high stress produces cortisol response in the body. This is the “stress hormone” that is used for flight or fight! PTSD triggers the cortisol. When cortisol levels are elevated and remain elevated, then the immune system becomes compromised, thereby increasing the risk of COVID and many other viruses.*

Covid-19 increases psychological stress among the general population and health care workers, increasing demand of mental health interventions (Talevi et al., 2020)



## Psychological Effects of Covid-19

Coping – Who is ready for a drink?

Covid stress syndrome severity was correlated with preexisting psychopathology and with excessive COVID-19-related avoidance, panic buying, and coping difficulties during self-isolation (Taylor et al., 2020).

Psychological distress related to the COVID-19 pandemic was consistently related to **alcohol use** indices (Rodriguez et al., 2020).

The main reason is that alcohol naturally relaxes the system including muscles and central nervous system. Therefore, in a pandemic, alcohol is more readily available in a moment than getting a prescription for anxiety.



## Psychological Effects of Covid-19

“The COVID-19 outbreak has had a significant psychosocial impact on children and adolescents.

Findings of current levels of anxiety and depression not only highlight the need to address emotional distress for children and adolescents during the epidemic but also provide researchers with scientific fundamentals to formulate targeted interventions based on the significant influencing factors.”

(Duan et al., 2020)



## Psychological Effects of Covid-19

COVID-19 patients, when compared to non-COVID controls, manifested higher levels of the following psychological conditions:

Depression ( $P < 0.001$ ),  
Anxiety ( $P < 0.001$ ),  
Post-traumatic stress symptoms ( $P < 0.001$ )  
(Guo et al., 2020)

Covid-19 is also related to acute stress disorder (Yu et al., 2020).

This disorder can only occur within the first 30 days of the stress occurrence (e.g., when a person becomes aware of the virus and the potentially deadly risk of the condition).



## Managing Acute & Chronic Stress



## Managing Psychological Stresses

### Take Perspective...

Stress is perceived. What is stressful to one person is not necessarily stressful to another.

Example, going to war overseas. If war caused a stress response for all soldiers, then all of them would develop PTSD. However, not all soldiers develop PTSD, even those in combat! Covid will cause a stress response for all of us, but not all of us will develop post-traumatic stress or long-term anxiety effects.

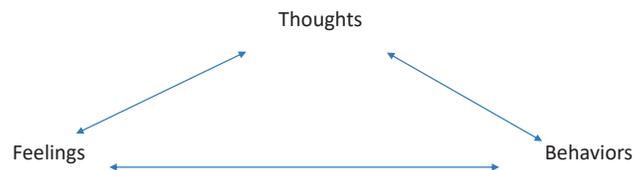
If you use cognitive skills to think through what is happening in the moment, then problem solving becomes more efficient and one will feel more control.



## Managing Psychological Stresses

### Perspective...

Use of a tool called the Cognitive Triad...



Step 1: identify what you are thinking, feeling, and doing when you are stressed with COVID.  
Step 2: identify what you would like to see with your thoughts, feelings and behaviors when you are less stressed.



## Managing Psychological Stresses

### Perspective...

Deep Breathing Relaxation. There are many types of deep breathing techniques.

A **simple technique** is to deep breathing by counting 1-2-3 in your head as you breath in, then count 1-2-3 in your head as you breath out.

A **more complex method** is to use the simple deep breathing technique and then pair this with a visual image or music that promotes calm (without words to the music), or sound that is soothing and repetitive.

A **very complex method** is to use simple deep breathing with guided imagery where you either take yourself to a place in your imagination that promotes feeling relaxed, or focus on relaxing each part of your body with tension and release until the whole body has been addressed.



## Managing Psychological Stresses

### Perspective...

#### Exercise.

Exercise promotes generally better health, but also promotes the use of **endorphins**.

Endorphins are the natural neurochemical that promotes feeling better. It is the brain's way of controlling pain in the body. When there is pain in the body, endorphins are released to feel less pain, but also helps to produce changes in dopamine (the chemical that manages your mood).

Releasing endorphins make you feel better, which makes you less anxious and less depressed, allowing you to make better choices with better thinking.

Exercise can include any activity that lasts as little as 15 minutes to 1-2 hours at a time. The goal is increased heart rate, circulation, mobility, and strengthening, and to do something different that causes a distraction.



## Managing Psychological Stresses

### Perspective...

#### Stimulating the senses.

We have five senses even though we don't always use what we have effectively.

**Taste** – have a favorite drink (non-alcoholic) or food (low carb or sugar) that will stimulate the taste buds like a smoothie, piece of fruit, or a favorite food.

**Smell** – The sense of smell is incredibly powerful. One of the most effective ways to change your mood is to light a candle with your favorite scent, or use a cologne or perfume that is your favorite to stimulate your senses that are associated with positive things.



## Managing Psychological Stresses

### Perspective...

#### Stimulating the senses.

**Tactile** – hold something that is soft, furry, or that you can grip. Tactile sensation like soft, furry, or smooth are positive sensations. Stuffed animals or a pet are great to use. Also, taking a hot bath or floating in a pool produces tactile sensations that are positive to the brain and body.

**Vision** – watch a favorite tv show or movie; look at family photos; search the internet for interesting pictures of places or people to stimulate the imagination. Do a video call or Zoom call to a friend or family member.

**Audition** – Listen to your favorite music, or for a change, listen to music that is somewhat new or different than usual to cause your brain to be distracted by the changes.



## Summary

Covid is an unusual event that has stirred many negative thoughts and feelings. This virus can cause many medical, neurological and psychological changes if contracted.

This is a pandemic that we can get through. The idea is to start to control what you can, while not focusing on things that are not controlled.

Think about people that you love, support that you have, or techniques discussed to get you through the pandemic.

Focus your thoughts on what you have learned from this pandemic... such as maybe things are not as important as taking time to be with people.

Focus your thoughts on what you want to do when the risk of the pandemic is over or controlled better... you may find that you want to live life a bit differently.

Anyone who has experienced something catastrophic knows that this is a great life lesson to put things into perspective.



## Relax with a Covid-Free Friend.



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## Questions

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