

What We've Learned So Far:

Identification, Management
and Impact of Covid-19 on
Chronic Lung Disease

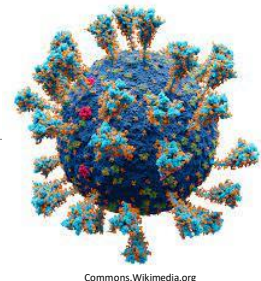


Nancy Nathenson, RRT

Respiratory Care/Health Educator & Consultant
Community Asthma & COPD Expert
-Allergy & Asthma Network

Coronaviruses

- First identified a human coronavirus in 1965
- It caused a common cold
- Later that decade, a group of similar *human* and animal viruses were found and were named coronavirus after their “crown-like appearance”
- Primarily cause infections in birds and mammals but have shown to be capable of infecting humans



Severe Acute Respiratory Syndrome (SARS)

- China's Guangdong province
- Horseshoe bats-natural reservoir of SARS-CoV
- Spread by civets and other animals in wet markets
- 2003 SARS – atypical pneumonia
 - 1/3 fever, dyspnea, cough, watery diarrhea and needed mechanical ventilation
- Nov 2002-July 2003 -WHO reported 8,098 SARS cases from 29 countries,
- 774 SARS-related deaths (case-mortality rate: 9.6%)
- 29 cases in U.S. with “0” deaths



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Middle East Respiratory Syndrome (MERS-CoV)

- Demonstrated the lethality of CoV's when they cross the species barrier and infect humans
- First known cases appeared in Jordan in April 2012.
- Largest outbreak 2015 in the Republic of Korea
- WHO reported > 2400 cases linked to the Arabian Peninsula
- Transmitted by camels
- Similar symptoms to SARS but 50-89% required mechanical ventilation
- 35% Mortality



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Severe Acute Respiratory Syndrome SARS CoV-2

- Term COVID-19- **CoronaVirusDisease-19**
- SARS-CoV-2 due to similarity to SARS-CoV
- 1st case- December 12, 2019 in Wuhan, China
- Declared a pandemic (WHO) on March 11th 2020
- Variety of NEW symptoms dyspnea, neurological disturbances, nausea, headache, vomiting



SARS CoV-2 Mortality

- 65 years and \geq 80% of Covid deaths
- Residents in LTC < 1% of the population-35% of ALL deaths
- Fatalities 10-fold higher in US high population counties
- Racial and ethnic minority groups die at younger ages
- Highest % of increases in mortality among adults 25-44 years of age Hispanic or Latino
- Older adults and males higher mortality risk



COVID-19

Contributions to Worsening Outcomes

- Co-morbidities
 - Cardiovascular Disease
 - Diabetes
 - Chronic Pulmonary Disease
 - Kidney Disease
 - Liver Disease
 - Obesity
 - Genetics
 - Immune Disorders
- Racial and Socioeconomic disparities
- Population Density



Transmission SARS/MERS vs. SARS CoV-2

SARS-MERS

- Transmission from recognized disease (**symptomatic**)
- Grows on standard tissue epithelial cells in the **lower** lung

SARS CoV 2

- Transmission from **asymptomatic, mildly symptomatic and super spreading**
- Frequently transmitted 1-2 days prior to symptoms when most contagious
- Complicated the identification of cases and prevention of spread
- Grows better on epithelial cells of the primary or **upper** airway
- Upper airway continuously exposed to pathogens and pollutants



Angiotensin Converting Enzyme-2 (ACE-2)

SARS CoV-2- **10 x's higher** affinity to bind with ACE 2 than SARS

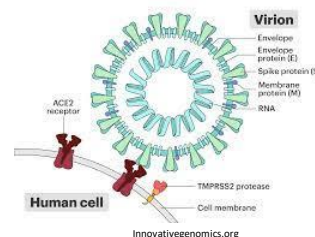
- Limiting factor in initial infection

ACE-2 expression varies and affected by chronic inflammatory diseases, Asthma & COPD

- ACE-2 increased in COPD and Tobaccos Smokers

Inhaled corticosteroids (ICS) used to treat AR, Chronic Rhinosinusitis, Asthma and COPD

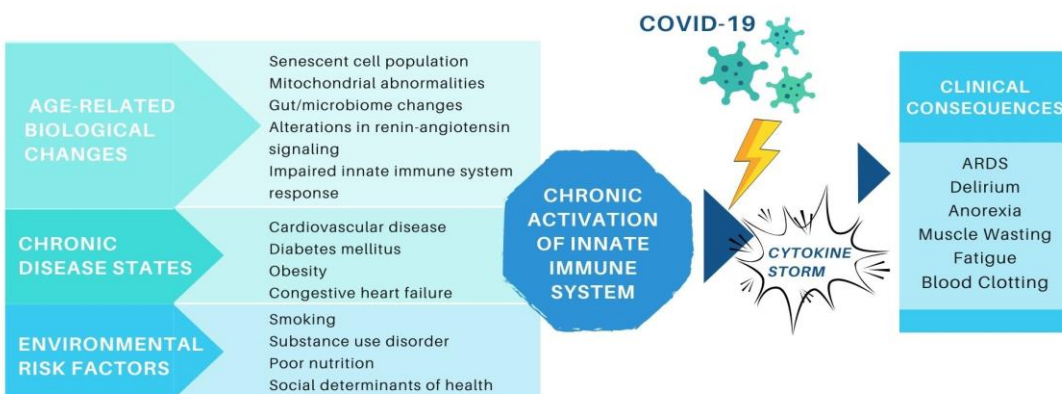
- ICS lowers expression of ACE-2
- Biologics upregulate ACE-2 and increase risk of SARS CoV-2
- ACE-2 Inhibiting agents can prevent the viral infection in vitro



The Aging Immune System

Covid Related Contributions to Cytokine Storm

And Observable Clinical Consequences

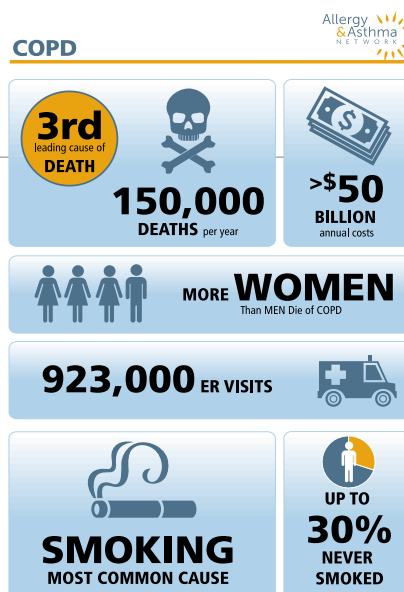


COPD

≈384 million people world wide

2nd most common cause of disability

What was the 3rd leading cause of death in 2020 and 2021?



COPD and COVID-19 - Risk & Severity

COPD patients **NOT** at increased risk of infection from Covid-19 Why?


- Fragile, more careful and utilized prevention measures
- Decreased air pollution due to the lockdown
- If ICS use- suppresses virus replication & cytokine production

Comorbid COPD and CLD In COVID-19


- Higher severity, complications & mortality
- Chronic inflammatory state and low respiratory capacity
- Poor lung function reserves, pnx, ARDS, Pulmonary Vascular Thrombolytic events lead to resp failure
- ACE-2 receptors are upregulated in the small airway epithelium and alveoli

Challenges in Asthma & COPD Dx and Monitoring

Reductions in face to face consultations, rehab and exercise programs and home care

- Overlapping symptoms
 - Access to care due to COVID patients
 - Disruption of global supply chain
 - Inability to afford medications with economic hardships
 - Exacerbation events expose individual to increased risk
 - Inability to assess inhaler technique
 - Infection risks with certain meds
 - Lack of telemedicine/Technology unavailable to the patient
- 

Challenges in COPD Care in COVID-19

- Distinct difference in COPD Exacerbation w/COVID
 - Vascular injury
 - Pneumonitis
 - Coagulopathy
 - Systemic inflammation
 - Cytokine storm
 - Multiorgan involvement
- 

COPD-Maintenance & Prevention in COVID-19 Pandemic

- If stable remain on ICS and OCS
- Ensure enough medication
- Remain on ACE inhibitors and Angiotensin Receptive Blockers
- Inhalers vs aerosols
- Vaccinations: Pneumococcal PPSV23, [Tdap](#) vaccine
- Prioritize for Covid Vaccination/Boosters
- General strategies, sheltering in place, hand washing, masking but [not lead to social isolation](#)
- Stay connected



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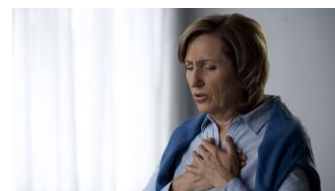
Symptoms: COPD Exacerbation vs. COVID-19

COPD Exacerbation: More [coughing](#) than usual, [↑SOB](#), fatigue, edema, trouble sleeping, changes in sputum

COPD & COVID-19 Overlap: [Cough and SOB](#)

COVID-19: [Fever, loss of smell or taste](#), headaches, lymphopenia, GI symptoms, profound fatigue, sore throat, congestion

Treat aggressively with systemic corticosteroids and other meds to reduce morbidity and mortality

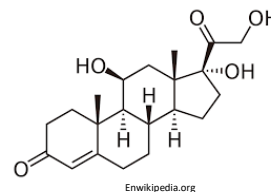


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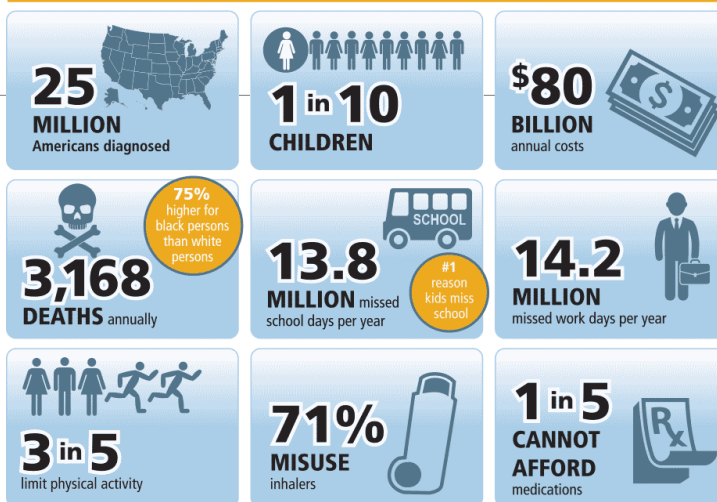
COPD w/COVID-19

Special Management Considerations

- Dexamethasone for up to 10 days reduced mortality in patients on Invasive Mechanical Ventilation (IMV) or oxygen alone
- Systemic Glucocorticoids reduce mortality in those **NOT** on IMV or vasopressors
- Aggressive EXTRA thromboprophylaxis 2 times daily
- Antibiotics with purulent sputum or (IMV)
- At risk for nutritional deficiency and skeletal muscle loss
 - Dietary support and early mobilization



Asthma



AllergyAsthmaNetwork.org



ASTHMA-Dx, Risk & Severity in COVID-19

Dx-

- Pulmonary Function Testing, History, Environment, Symptoms
- Spirometry if urgent or essential, Dx or assess lung function prior to surgery, RT-PCR test
- Home Peak Flow measurement, and validated questionnaires ie; Asthma Control Test



Risk & Severity

Asthmatics-decreased risk of contracting Covid-19

- Decreased ACE-2 expression may lower the risk of Covid 19 severity and mortality
- T helper-2 (Th2) immune response
- ICS use may reduce the risk of infection or developing symptoms

[Persons with Moderate to severe asthma are at increased risk of severe illness in COVID-19](#)

Asthma Maintenance and Monitoring in COVID-19 Pandemic

Maintenance

- Continue therapy as usual including Biologics
- Continue ICS
- Little benefit of ICS in acute phases of virus if not already used
- Rescue pack of steroids at home
- Prednisone only for severe exacerbations

Monitoring

- Follow Asthma Action Plan
- Peak Flow Diaries
- Asthma Control Tests
- Avoid Triggers
- Review inhaler technique
- Telehealth found to significantly improve asthma control
- Most beneficial in severe disease vs. mild

Symptoms: ASTHMA vs. COVID-19

ASTHMA SYMPTOMS

- No fever
- **Audible Cough or wheeze**
- **Shortness of Breath**
- Chest Tightness and/or congestion
- You have to stop talking to catch breath
- Fatigue
- Not able to perform daily activities

SYMPTOMS COVID-19

- **Shortness of breath**
- **Coughing with or without wheeze**
- **Fever of over 100.4**
- **Loss of taste or smell**
- Headache
- Profound fatigue
- GI Symptoms
- Nasal congestion
- Sore throat

ALLERGIES Dx, Risk in COVID-19

DX:

Personal and Medical History

Physical Exam

Testing

- Skin Prick
- Blood tests
- Oral challenges
- Patch



RISK:

There is no evidence to suggest that people with allergies are at greater risk for COVID-19

Symptoms: ALLERGIES vs. COVID-19

SYMPTOMS: SEASONAL ALLERGIES

- Runny nose, usually with clear or pale-colored mucus
- Sneezing
- Coughing
- Red, watery eyes
- Itching around the nose, mouth, or eyes

Symptoms if left untreated

- Shortness of breath
- Nasal congestion, postnasal drip
- Headache
- Sore throat
- Decreased sense of smell
- Sinus, ear infections
- Puffiness or dark circles under the eyes
- Fatigue

SYMPTOMS: COVID 19

- Fever or chills
- Coughing
- Shortness of breath
- Fatigue
- Muscle, body aches, headache
- **NEW** loss of taste or smell
- Sore throat, congestion, runny nose
- Nausea or vomiting, diarrhea

ALLERGY Management & Prevention in COVID-19

- Continue prevention measures Intranasal same for AR, prevent sneezing
- GOLD guidelines-continue biologics
- Take allergy medication 2 weeks before symptoms occur
- General strategies, sheltering in place, hand washing, masking but **not lead to social isolation**
- Get the COVID-19 vaccine
- Pfizer/BioNTech and Moderna contain *polyethylene glycol (PEG) or polysorbate, may cause allergic reactions in some people*
 - Health professionals monitor patients for adverse symptoms for 30min
 - Facilities should be equipped to treat severe allergic reactions
 - Bring your own epinephrine auto-injector for extra protection

REMDESIVIR use in COVID-19

REMDESIVIR

Inhibits viral RNA dependent RNA polymerase which inhibits SARS CoV-2 in vitro

- **Use** for 5 days or until discharge for patients with supplemental O₂ with **NO** need for HFNC, NIV, IMV or ECMO
- **EARLIER** the administration the greater benefit
 - Decreased LOS reduced recovery time by 4 days most effective in those receiving supplemental oxygen
 - Reduced disease progression
 - Decrease use of respiratory assist devices and ECMO



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Monoclonal Antibodies

SARS CoV-2 enters the system through ACE-2 receptors in lungs and GI tract

Initially used on compassionate basis w/regulatory approval

In **Low** antibody titer or later in disease course or both:

- Lack of survival benefit
- Does not stop disease progression or help stabilize symptoms

In **High** antibody titer/early w/ mild & mild to mod disease

- Slowed progression and better survival
- Decreased progression to hospital and death with IV route

Recommend for outpatients @ high risk of severe Covid-19

Challenges:

- Limited availability and delays in administration
- New Variants will render these ineffective
- Developing Sub Q, IM or inhalation and improving access will impact outpatient care



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Glutocorticoids

Dexamethasone

- RECOVERY TRIAL study showed a **GREATER mortality benefit** in patients with **SEVERE** illness with supplemental O₂ and IMV
- When used as a Standard of care
 - **LESS** beneficial in patients with supplemental O₂
 - **NO Benefit** with patients on Room Air
 - Immunosuppressive agents increase viral replication in early illness



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Medication Nebulization

- Inhalers vs aerosols
- Viral filters
- Mesh nebulizers separate meds from patient interface including circuits
- Proper hygiene and barrier precaution



Presenter image

Hypoxia/Hypoxemia

Hypoxia- reduced O₂ at the tissue level

- Anaerobic metabolism with Lactate production

Hypoxemia- Drop in the arterial pressure of O₂ below 80mmHg

Five causes of Hypoxemia

- Alveolar hypoventilation,
- RT to LT shunt
- Diffusion-perfusion abnormality
- Diffusion impairment
- Ventilation Perfusion mismatch

These result in SOB



“Silent” or “Happy” Hypoxemia

- * Well tolerated
- * Early stages on infection
- * No sensation of dyspnea, SOB or increased Work of Breathing

Non Vent Adults with Hypoxemic Respiratory Failure (HRF)



- Begin with Nasal Cannula
- High Flow Nasal Cannula (HFNC) preferred over NIPPV
- HFNC > ventilator free days than conventional O₂ or NIPPV
- 90 day mortality lower in HFNC than conventional O₂ and NIPPV
- HFNC reduced the rate of intubation and ICU mortality
- **HFNC and NIPPV use may avoid 20-25% of intubations decreasing use of critical resources during the pandemic**

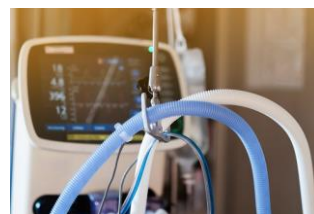
Awake Prone Positioning –Non Intubated

- **TRIAL** of awake prone positioning in **Persistent** Hypoxemia despite O₂ and **NO** indication for Invasive Mechanical Ventilation(IMV):
- Awake patients that can adjust position and tolerate prone
- Acceptable in pregnant patients:
 - Lateral decubitus or fully prone
- **Contraindications:** patients in respiratory distress or require intubation and IMV, hemodynamically unstable, abdominal surgery and unstable spine
- Recommendation **AGAINST** prone positioning as **RESCUE** measure for refractory hypoxemia to avoid intubation

Invasive Mechanical Ventilation (IMV)

Previously intubated early

- When O₂ needs exceeded 5-6 lpm
- Fear of spreading the virus
- Closed ventilatory system



Early intubation placed a heavy burden on critical care resources

- Ventilator shortages

2020 studies from Italy and New York recognized a higher mortality with the intubated mechanically ventilated patient

Impact of Prolonged Mechanical Ventilation

- Delirium
- Hemodynamic instability
 - Secondary to decreased sympathetic drive and positive pressure ventilation
- Increased risk of infection
- Immobilization with increase risk of thromboembolism
- Neuromuscular paralysis
- Post ICU syndrome (PICS) physical and neurocognitive dysfunction



Patient Self Inflicted Lung Injury (P-SILI)

Patient Self-Inflicted Lung Injury (P-SILI) in the non-intubated patient with Acute HRF

- High Min. Ventilation, High RR, High Respiratory Drive
- Worsens any pre existing lung injury w/ increased vascular permeability with local and global lung over distension
- Compares to Ventilator-Induced Lung Injury (VILI) caused by high pleural and trans pulmonary pressure swings

RESCUE Therapies in IMV, Severe Hypoxemia in COVID-19

Severe Hypoxemia despite optimal ventilation and other strategies

Use recruitment maneuvers , lung protective strategies

- Reduce mortality and improved oxygenation 24 hrs after the maneuver and decreased need for rescue therapy

IF decompensation occurs-DC

- Traditional PEEP strategies decrease mortality
- **AGAINST** incremental PEEP staircase



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Neuromuscular Blockade in COVID-19 IMV Adults w/Moderate to Severe ARDS

Neuromuscular Blocking Agents (NMBA)

Intermittent boluses PRN or continuous

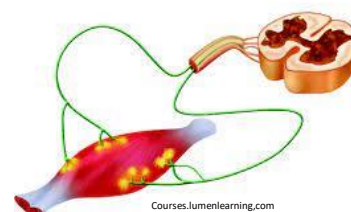
Continuous NMBA infusion 48 hours

- In patient ventilator desynchrony
- Ongoing deep sedation prone Ventilations
- Persistent high plateau pressures

Monitoring and controlling pain and anxiety

Succinylcholine can lead to hyperkalemia, malignant hypothermia, myalgia, increased gastric intraocular and cranial pressure, cardiac dysrhythmias, (bradycardia) and allergic reactions

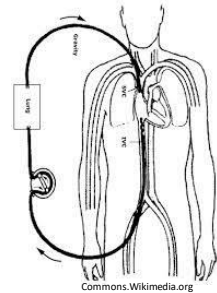
Neurons from the spinal cord excite skeletal muscle



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Extracorporeal Membrane Oxygenation (ECMO)

- Resource intense, nuanced and specialized
- Patient selection, maintenance and liberation
- Indications, Contraindications, Principles remain the same
- **Veno-Venous** most common for Respiratory Failure with better outcomes
- High Thrombus threat in COVID-19 - PTT values of **1.5-2.5** times normal



VENO-VENOUS

Extracorporeal Life Support Organization

- 40% 90 day mortality rate in 1000 carefully selected patients

Impact on Chronic Lung Disease Patients in COVID-19

ASTHMA in normal times

- Anxiety & Depression
- Mood disorders greater in PWA leads to poor control medication adherence and health outcomes
- Lack of Social support

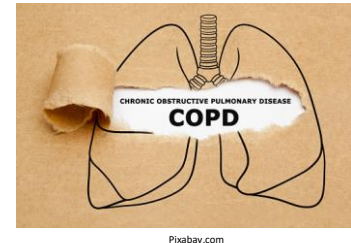


COPD In normal times:

- PTSD, anxiety
- Fear, depression suicidal ideation
- 40% depressive symptoms
- 36% anxiety symptoms

IMPACT on COPD Patients in COVID-19

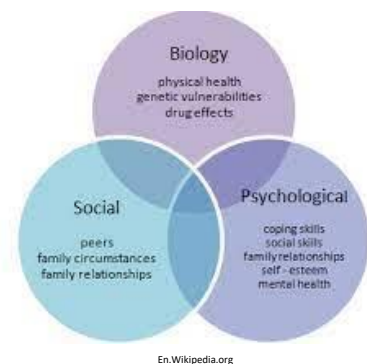
- Pandemic may exacerbate worry and symptoms
 - Financial stressors bad news, unemployment demoralizing and discouraging
 - Social isolation lockdowns feeling trapped hopeless and suicidal ideation
 - Bereavement over the loss of loved ones
 - Adopt excessive drinking, substance misuse, smoking
- **Important to use Psychological screening tools
- **Depression Anxiety Stress Scale



BioPsychoSocial IMPACT in Older Adults

“The boundaries between health and disease, between well and sick are far from clear and never will be clear for they are diffused by cultural, social and psychological considerations

-George Engel, 1977



Biological IMPACT

- Multi organ dysfunction in active and post infection
- NEW** physical disability and health deterioration in COVID-19 survivors

Respiratory Manifestation

- ARDS

Neurological

- New disorder
- Or underlying condition



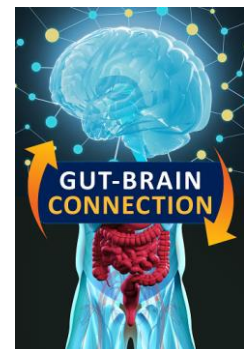
****Cytokine Storm and systemic inflammation responsible****

Molecular Mechanism IMPACT

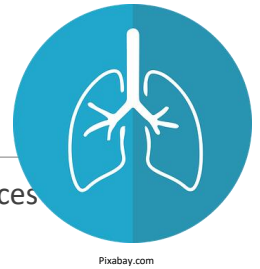
Virus infected myeloid and lymphoid cells cause neuroinflammation that linger beyond acute infection leading to neuropsychiatric disorders

Pharmacotherapy

- Immunomodulating corticosteroids
 - Disturbed sleep and cognition
- Gut-Brain Access
 - Alter the microbiome of the gut and brain resulting in psychiatric symptoms



LONG COVID-Post COVID



Symptoms: **Fatigue**, anxiety, myalgia, low mood and sleep disturbances

Risk: No relationship between the severity of the illness and risk of developing Long COVID

Findings: Absence of classic respiratory symptoms

- Biopsychosocial effects contribute to long lasting physical and mental symptoms
 - Patients with no previous disability are deficient in physical performance
- **Prioritization of rehab and psych support and NOT diagnostics and respiratory services**

Mental Health Impacts on Patient, Family and Healthcare Workers in COVID-19

Admission to the ICU is traumatic for the patient and family

Family involvement in normal circumstances is encouraged and has a positive effect

Families unable to be physically and emotionally there for their loved one

Patients will to live is diminished

WHO speculates this isolation will increase loneliness, harmful alcohol use and drug use, self harm and suicidal behavior

Healthcare workers continuously worked in stressful, fearful, resource depleted environments, along with the constant threat of exposure to the virus

Lack of mental health professionals, counselors and programs present an ongoing challenge

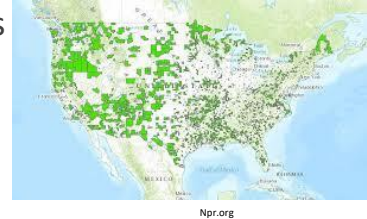
Socio-Economic IMPACT

Income/Job insecurity as a result of decreased global trade

Decreased financial security and reduced earnings

Some forced to retire early:

- Unsafe in workplace
- Unable to telework
- Ageism



BEFORE pandemic older adults suffered from food insecurity
income based and accessibility barriers

Pandemic created market shortages

Food deserts in rural areas

LONG COVID-Post COVID

UC Davis Post COVID 19 Clinic - Dr. Christian Sandrock

Common symptoms Sleep Disturbances, **Fatigue**, Lethargy

Treatment focused on better living and high quality of life

- Sleep through stress reduction, Meditation and Yoga

Adjust expectations:

- Difficult to progress a few steps forward and then steps back
- Faltering recoveries, Waxing and waning symptoms
- Requires patience
- NIH announced grants as part of it's Post Acute Sequelae of SARS-CoV-2 Infection (PASC)



LONG COVID-Post COVID



A retrospective cohort study reviewed 273,618 Covid -19 survivors

Symptoms: breathlessness, **fatigue**, chest throat pain , headache, abdominal symptoms myalgia, cognitive and anxiety depression

Findings: 1 in 3 had 1 or more features of Long COVID Between 3-6 months after diagnosis

2 in 5 patient recorded Long COVID symptoms in 3-6 month period but none in 1-3 month

Risk: Higher in patients with severe illness, females and young people
White and Non White equally affected

Chronic Fatigue in Post COVID-19

- A very large number of viruses can trigger ME/CFS
- Chronic Fatigue Syndrome or ME/CFS
- 17 – 24 million people worldwide
- United States est. 2.5 million
- All ages and races
- More common in women than men
- The Institute of Medicine reports that patients with ME/CFS are more functionally impaired than people with rheumatoid arthritis, diabetes, and hypertension
- Democratic Rep. Jamie Raskin of Maryland is co-sponsoring a bill, [HR 7057](#), the "Understanding Covid-19 Subsets and ME/CFS Act."



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Healthcare Workers and Post COVID

A study of persistent post COVID symptoms in HCW

- Covid-19 greater lethality in Males
- Females more to suffer from long term COVID
- After 4 months of the peak wave 45% had symptoms persisting and 32% indicated difficulty coping
- 39% Moderate to severe fatigue

Universal symptoms

- Mild to moderate SOB
- Anxiety
- Sleep disturbances

ONLY 16% consulted GP only 2% taking sick leave after initial recovery

Even with acknowledgement of severity and struggle to cope



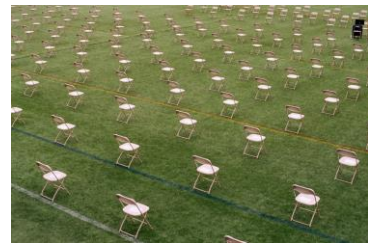
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HAND WASHING/ SANATIZING



MASKING

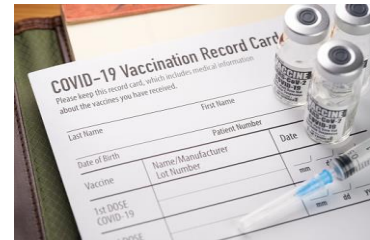


SOCIAL DISTANCING





VACCINES/BOOSTERS





[Long COVID SOS](#)

[Patient-Led Research Collaborative](#)

[HR 7057](#)

www.nih.gov

www.hopkinsmedicine.org

www.cdc.org

www.fda.gov

www.allergyasthmanetwork.org

REFERENCES

- Agusti, A., Torres, F., & Faner, R. (2021). Early treatment with inhaled budesonide to prevent clinical deterioration in patients with COVID-19. *The Lancet. Respiratory medicine*, 9(7), 682–683. [https://doi.org/10.1016/S2213-2600\(21\)00171-5](https://doi.org/10.1016/S2213-2600(21)00171-5)
- Anderson, M., & Perrin, A. (2017). Technology use among seniors. Washington, DC: Pew Research Center for Internet & Technology.
- Beltramo, G., Cottenet, J., Mariet, A. S., Georges, M., Piroth, L., Tubert-Bitter, P., ... & Quantin, C. (2021). Chronic respiratory diseases are predictors of severe outcome in COVID-19 hospitalised patients: a nationwide study. *European Respiratory Journal*.
- Berardelli, I., Sarubbi, S., Rogante, E., Cifrodelli, M., Erbuto, D., Innamorati, M., ... & Pompili, M. (2021). The impact of the COVID-19 pandemic on suicide ideation and suicide attempts in a sample of psychiatric inpatients. *Psychiatry research*, 303, 114072.
- Berg-Weger, M., & Morley, J. E. (2020). Loneliness and social isolation in older adults during the Covid-19 pandemic: Implications for gerontological social work.
- Blazoski, C., Baram, M., & Hirose, H. (2021). Outcomes of extracorporeal membrane oxygenation in acute respiratory distress syndrome due to COVID-19: The lessons learned from the first wave of COVID-19. *Journal of cardiac surgery*, 36(7), 2219-2224.
- Cacioppo, J. T., & Cacioppo, S. (2014). Social relationships and health: The toxic effects of perceived social isolation. *Social and personality psychology compass*, 8(2), 58-72.
- Carmichael, H., Coquet, J., Sun, R., Sang, S., Groat, D., Asch, S. M., Bledsoe, J., Peltan, I. D., Jacobs, J. R., & Hernandez-Boussard, T. (2021). Learning from past respiratory failure patients to triage COVID-19 patient ventilator needs: A multi-institutional study. *Journal of biomedical informatics*, 119, 103802. <https://doi.org/10.1016/j.jbi.2021.103802>
- Cukrowicz, K. C., Cheavens, J. S., Van Orden, K. A., Ragain, R. M., & Cook, R. L. (2011). Perceived burdensomeness and suicide ideation in older adults. *Psychology and aging*, 26(2), 331.

REFERENCES

- Edelson, D. P., Sasson, C., Chan, P. S., Atkins, D. L., Aziz, K., Becker, L. B., ... & Topjian, A. A. (2020). Interim guidance for basic and advanced life support in adults, children, and neonates with suspected or confirmed COVID-19: from the emergency cardiovascular care committee and get with the guidelines-resuscitation adult and pediatric task forces of the American Heart Association. *Circulation*, 141(25), e933-e943.
- Fang, F. C., Benson, C. A., Del Rio, C., Edwards, K. M., Fowler, V. G., Fredricks, D. N., Limaye, A. P., Murray, B. E., Naggie, S., Pappas, P. G., Patel, R., Paterson, D. L., Pegues, D. A., Petri, W. A., & Schooley, R. T. (2021). COVID-19-Lessons Learned and Questions Remaining. *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America*, 72(12), 2225–2240. <https://doi.org/10.1093/cid/ciaa1654> patterns in new clothing?. *Histopathology*, 77(2), 169.
- Fawzy A, Wu TD, Wang K, et al. Racial and Ethnic Discrepancy in Pulse Oximetry and Delayed Identification of Treatment Eligibility Among Patients With COVID-19. *JAMA Intern Med*. 2022;182(7):730–738. doi:10.1001/jamainternmed.2022.1906
- Gaber, T. A. K., Ashish, A., & Unsworth, A. (2021). Persistent post-covid symptoms in healthcare workers. *Occupational Medicine*, 71(3), 144-146.
- Grevelding, P., Hrdlicka, H. C., Holland, S., Cullen, L., Meyer, A., Connors, C., ... & Greco, A. (2021). Patient Outcomes and Lessons Learned from Treating Patients with Severe COVID-19 at a Long-Term Acute Care Hospital. *medRxiv*.
- Halpin, S., O'Connor, R., & Sivan, M. (2021). Long COVID and chronic COVID syndromes. *Journal of medical virology*.
- Halpin, D. M., Criner, G. J., Papi, A., Singh, D., Anzueto, A., Martinez, F. J., ... & Vogelmeier, C. F. (2021). Global initiative for the diagnosis, management, and prevention of chronic obstructive lung disease. The 2020 GOLD science committee report on COVID-19 and chronic obstructive pulmonary disease. *American journal of respiratory and critical care medicine*, 203(1), 24-36.
- Hansen, E. S. H., Moeller, A. L., Backer, V., Andersen, M. P., Kober, L., Kragholm, K., & Torp-Pedersen, C. (2021). Severe outcomes of COVID-19 among patients with COPD and asthma. *ERJ Open R*
- Haybar, H., Kazemnia, K., & Rahim, F. (2020). Underlying chronic disease and COVID-19 infection: a state-of-the-art review. *Jundishapur Journal of Chronic Disease Care*, 9(2).

REFERENCES

- Hsu, H., Greenwald, P. W., Laghezza, M. R., Steel, P., Trepp, R., & Sharma, R. (2021). Clinical informatics during the COVID-19 pandemic: Lessons learned and implications for emergency department and inpatient operations. *Journal of the American Medical Informatics Association*, 28(4), 879-889. *research*, 7(1).
- Huang, L., Yao, Q., Gu, X., Wang, Q., Ren, L., Wang, Y., ... & Cao, B. (2021). 1-year outcomes in hospital survivors with COVID-19: a longitudinal cohort study. *The Lancet*, 398(10302), 747-758.
- Laher, N., Bocchinfuso, S., Chidiac, M., Doherty, C., Persson, A., & Warren, E. (2021). The Biopsychosocial Impact of COVID-19 on Older Adults. *Gerontology and Geriatric Medicine*, 7, 23337214211034274.
- Logue, J. K., Franko, N. M., McCulloch, D. J., McDonald, D., Magedson, A., Wolf, C. R., & Chu, H. Y. (2021). Sequelae in adults at 6 months after COVID-19 infection. *JAMA network open*, 4(2), e210830-e210830.
- Lombardi, F., Calabrese, A., Iovene, B., Pierandrei, C., Lerede, M., Varone, F., ... & Sgalla, G. (2021). Residual Respiratory Impairment After COVID-19 Pneumonia.
- Nicholson, A. G., Osborn, M., Devaraj, A., & Wells, A. U. (2020). COVID-19 related lung pathology: old patterns in new clothing?. *Histopathology*, 77(2), 169.
- Nidadavolu, L. S., & Walston, J. D. (2021). Underlying vulnerabilities to the cytokine storm and adverse COVID-19 outcomes in the aging immune system. *The Journals of Gerontology: Series A*, 76(3), e13-e18.
- Rao, A., & Kelemen, A. (2021). Lessons Learned from Caring for Patients with COVID-19 at the End of Life. *Journal of palliative medicine*, 24(3), 468-471.
- Rutkowski, S. (2021). Management Challenges in Chronic Obstructive Pulmonary Disease in the COVID-19 Pandemic: Telehealth and Virtual Reality. *Journal of Clinical Medicine*, 10(6), 1261.
- Sykes, D. L., Holdsworth, L., Jawad, N., Gunasekera, P., Morice, A. H., & Crooks, M. G. (2021). Post-COVID-19 symptom burden: what is long-COVID and how should we manage it?. *Lung*, 199(2), 113-119.
- Skene, I. P., & Pfeffer, P. E. (2021). Improved asthma control during the COVID-19 pandemic: are there lessons to be learnt?.

REFERENCES

Stavropoulou, E., Kantartzis, K., Tsigalou, C., Konstantinidis, T., Voidarou, C., Konstantinidis, T., & Bezirtzoglou, E. (2021). Unraveling the interconnection patterns across lung microbiome, respiratory diseases, and COVID-19. *Frontiers in cellular and infection microbiology*, 10, 892.

Taquet, M., Dercon, Q., Luciano, S., Geddes, J. R., Husain, M., & Harrison, P. J. (2021). Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. *PLoS medicine*, 18(9), e1003773.

Troyer, E. A., Kohn, J. N., & Hong, S. (2020). Are we facing a crashing wave of neuropsychiatric sequelae of COVID-19? Neuropsychiatric symptoms and potential immunologic mechanisms. *Brain, behavior, and immunity*, 87, 34-39.

Van Tilburg, T. G., Steinmetz, S., Stolte, E., van der Roest, H., & de Vries, D. H. (2021). Loneliness and mental health during the COVID-19 pandemic: A study among Dutch older adults. *The Journals of Gerontology: Series B*, 76(7), e249-e255.

Whiteson, J. H., Escalón, M. X., Maltser, S., & Verduzco-Gutierrez, M. (2021). Demonstrating the vital role of physiatry throughout the health care continuum: Lessons learned from the impacts of the COVID-19 pandemic on inpatient rehabilitation. *Pm & R*, 13(6), 554.

Yao, Y., Wang, H., & Liu, Z. (2020). Expression of ACE2 in airways: Implication for COVID-19 risk and disease management in patients with chronic inflammatory respiratory diseases. *Clinical & Experimental Allergy*, 50(12), 1313-1324.

Ding, O. J., & Kennedy, G. J. (2021). Understanding vulnerability to late-life suicide. *Current psychiatry reports*, 23(9), 1-9.

Saghafi, F., West, S., Lopez, V., & Cleary, M. (2022). Mental health impacts of family members isolated from patients in the ICU during the coronavirus disease (COVID-19) pandemic. *Issues in Mental Health Nursing*, 43(1), 87-90.

Briggs, R., Ward, M., & Kenny, R. A. (2021). The 'Wish to Die' in later life: prevalence, longitudinal course and mortality. Data from TILDA. *Age and ageing*, 50(4), 1321-1328.



nancy.nathenson@gmail.com