



**COVID-19:**  
**A REVIEW OF THE RESEARCH**

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# HEALTHY ADVENTURES FOUNDATION'S BACKGROUND AND MISSION

- Non-profit, specializing in health and wellness programming and development for communities, organizations, groups, and individuals for seniors, adults, employees, and children
- We seek to improve quality of life, while seeking balance in healthy behaviors.
- We manage the employee wellness programs for school districts, non-profits, and for profit organizations.
- We offer community-based programming through the libraries, senior centers and programs, low-income housing units, and youth-focused centers.
- We also run the recreational youth wellness programs for Polinsky Childrens Center, high-risk after school programs and school-based and library based after-school programs.

# WENDY HILEMAN'S BACKGROUND

- CEO / CFO Healthy Adventures Foundation
- Education
  - Ph.D. Organizational Psychology
  - MPH Public Health
  - MSW Social Work
  - MS Organizational Psychology
  - BS Physical Education, Athletic Training
  - AS Intelligence Collections
- Part-time professor at Southwestern college
- Adjunct lecturer at USC
- US Air Force Veteran

# AGENDA

- COVID-19: the basics
- Current trends
- Virus mutations
- Risk factors
- Defenses to mitigate risk
- Complications of COVID-19
- Current and promising treatments
- Vaccinations

# COVID-19

The Basics



# WHAT WE KNOW ABOUT COVID-19

- Coronavirus disease 2019 (COVID-19), caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is a serious disease that has resulted in widespread global morbidity and mortality (Dan, et al 2020).
- COVID-19 seems to spread more easily than flu and causes more serious illnesses in some people. It can also take longer before people show symptoms and people can be contagious for longer (CDC, 2020).
- There appears to be some immune memory but not full immunity for those who have had COVID-19. Reinfection has occurred but we do not have enough information about how often, the load of the virus both times, or how long, if any immunity occurs (Dan, et al 2020).

## Reference:

CDC (May 2020). Symptoms of Corona Virus. Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>

Dan. JM, Mateus, J. Kato, Y, Hastie, KM, Faliti, CE, Ramirez, SI, Frazier, A, Yu, ED, Grifoni, A, Rawlings, SA, Peters, B, Krammer, F, Simon, V, Saphire, EO, Smith, DM, Weiskopf, D, Sette, A, Crotty, S (2020). Immunological memory to SARS-CoV-2 assessed for greater than six months after infection. Retrieved from: <https://www.biorxiv.org/content/10.1101/2020.11.15.383323v1.full.pdf>

# HUMAN CORONAVIRUS TYPES

- Coronaviruses are named for the crown-like spikes on their surface. There are four main sub-groupings of coronaviruses, known as alpha, beta, gamma, and delta.
- Human coronaviruses were first identified in the mid-1960s. The seven coronaviruses that can infect people are:
  - 229E (alpha coronavirus) - common
  - NL63 (alpha coronavirus) - common
  - OC43 (beta coronavirus) - common
  - HKU1 (beta coronavirus) - common
  - MERS-CoV (the beta coronavirus that causes Middle East Respiratory Syndrome, or MERS)
  - SARS-CoV (the beta coronavirus that causes severe acute respiratory syndrome, or SARS)
  - SARS-CoV-2 (the novel coronavirus that causes coronavirus disease 2019, or COVID-19)
- Sometimes coronaviruses that infect animals can evolve and make people sick and become a new human coronavirus. Three recent examples of this are 2019-nCoV, SARS-CoV, and MERS-CoV.

Reference:

National Center for Immunization and Respiratory Diseases (NCIRD), Division of Viral Diseases (February 15, 2020)

# IMMUNITY ...

- Common colds can be from a human corona virus. Immunity generally lasts about 6 months (NCIRD, 2020; Weintraub, 2020).
- 35 year study found that immunity for Corona Virus' is short-lived (Edridge, Kaczorowska, Hoste, *et al.* 2020). Re-infection rates range from 6 months – 8 years and 9 months. The most common reinfection is within 1 year.

## Reference:

National Center for Immunization and Respiratory Diseases (NCIRD), Division of Viral Diseases (February 15, 2020)

Karen Weintraub (November 10, 2020). There may be a COVID-19 vaccine by the end of the year, but 'normality' may not come until end of 2021. USA TODAY – Health. Retrieved from: <https://www.usatoday.com/story/news/health/2020/11/10/covid-19-vaccine-willingness-needed-to-end-pandemic/3516649001/>

Edridge, A.W.D., Kaczorowska, J., Hoste, A.C.R. *et al.* Seasonal coronavirus protective immunity is short-lasting. *Nat Med* **26**, 1691–1693 (2020). <https://doi.org/10.1038/s41591-020-1083-1>



# STAGES OF COVID

- Asymptomatic – more common in young people
  - No symptoms
  - Still contagious
- Mild
- Moderate
- Severe – more common in people 65+
  - Severe disease is exuberant inflammation in the respiratory tract of patients (*Merad & Martin, 2020*).

Reference:

Merad, M. & Martin, J.C. (2020). *National Review Immunology*, 20, 355.

# SLOWER RECOVERY PERIOD FROM COVID

- With COVID-19, 65% of the cases are back to usual health within 2-3 weeks (Tenforde, et al 2020).
- With the flu, it is 90% within 2 weeks (Petrie, Cheng, Malosh, et al, 2016).

## Reference:

Tenforde, MW, Kim, SS, Lindsell, CJ, Rose, DB, Shapiro, NI, Files, DC, Gibbs, KW, Erickson, HL, Steingrub, JS, Smithline, HA, Gong, MN, Aboodi, MS, Exline, MCM, Henning, DJ, Wilson, JG, Khan, A, Qadir, N, Brown, SM, Peltan, ID, Rice, TW, Hager, DN, Ginde, AA, Stubblefield, WB, Patel, MM, Self, WH, Feldstein, LR, IVY Network Investigators, CDC COVID-19 Response Team (July 31, 2020). Morbidity and Mortality Weekly Report - Symptom Duration and Risk Factors for Delayed Return to Usual Health Among Outpatients with COVID-19 in a Multistate Health Care Systems Network — United States, March–June 2020. US Department of Health and Human Services/Centers for Disease Control and Prevention, 69, 30.

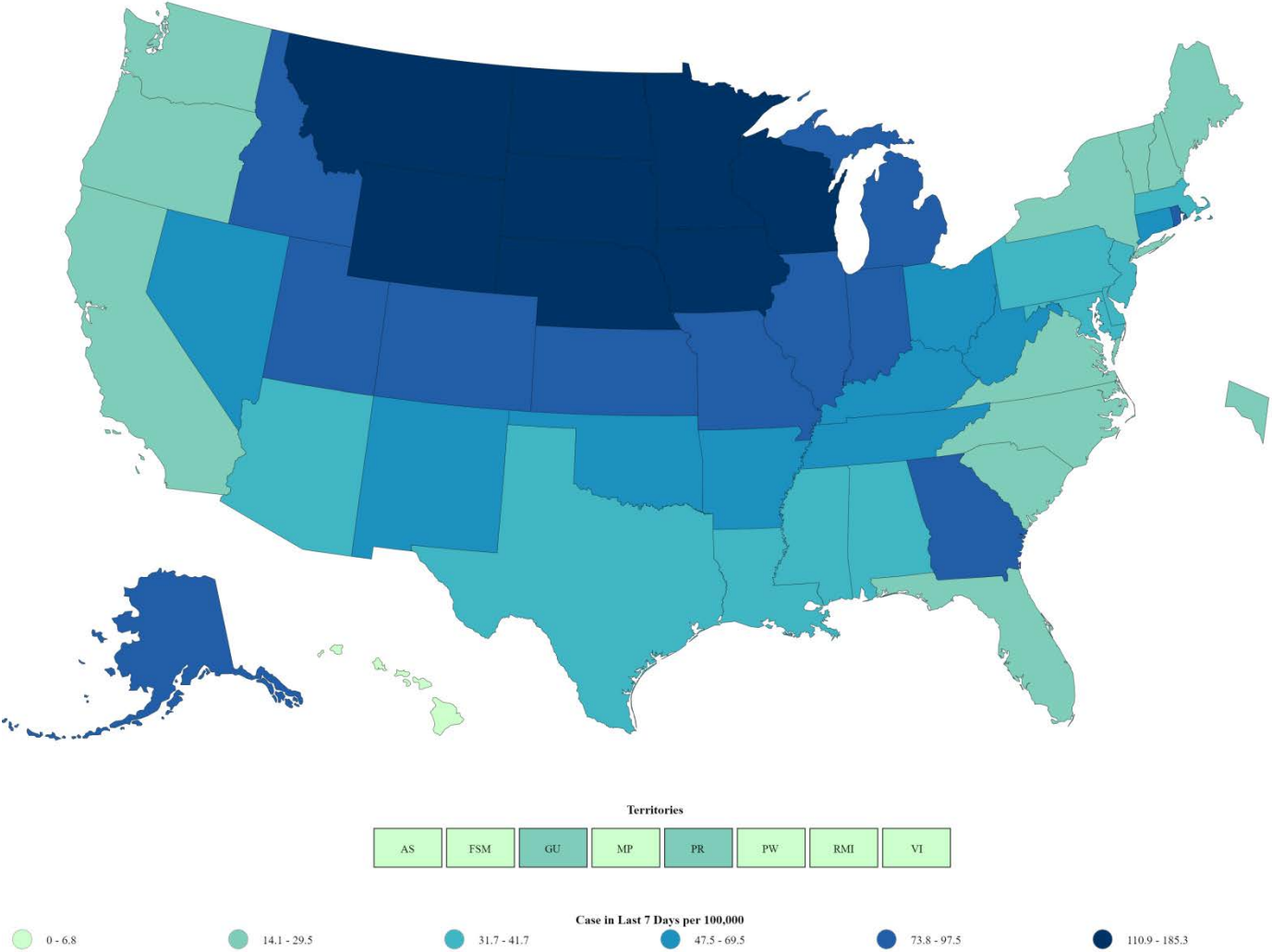
Petrie JG, Cheng C, Malosh RE, et al. (2016). Illness severity and work productivity loss among working adults with medically attended acute respiratory illnesses: US Influenza Vaccine Effectiveness Network 2012–2013. Clin Infect Disease, 62:448–55.

# CURRENT TRENDS

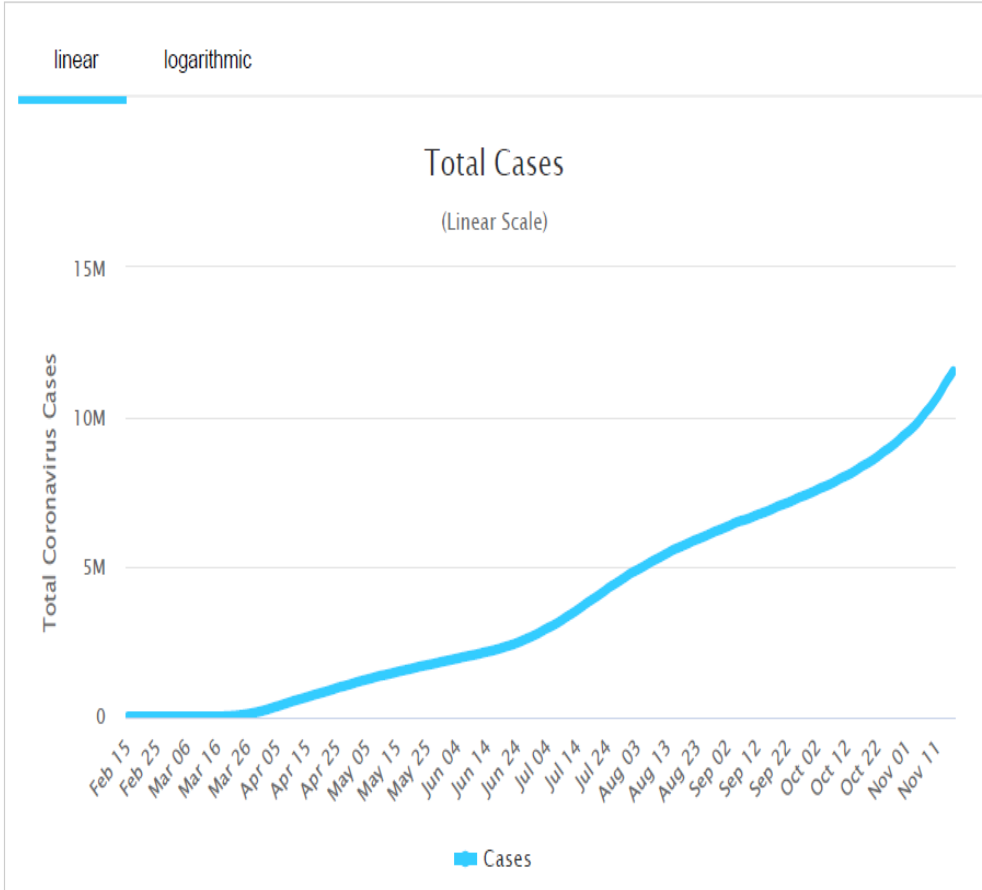
COVID-19 virus trends



# REVIEW CURRENT TRENDS – AS OF NOVEMBER 18, 2020



Total Coronavirus Cases in the United States

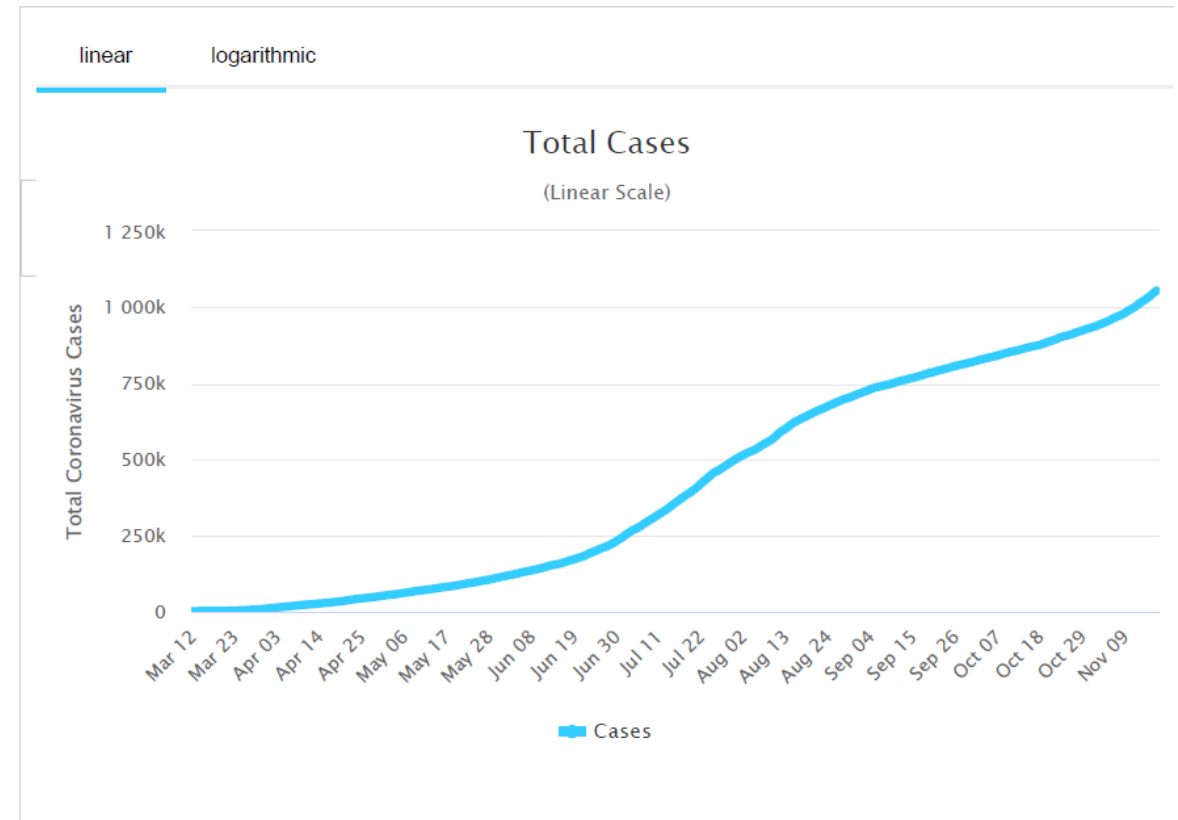


CDC COVID Tracker (November 18, 2020). Retrieved from: [https://covid.cdc.gov/covid-data-tracker/#cases\\_casesper100klast7days](https://covid.cdc.gov/covid-data-tracker/#cases_casesper100klast7days)  
 Worldmeter COVID Cases (November 9, 2020). Retrieved from: <https://www.worldometers.info/coronavirus/country/us/>

# REVIEW CURRENT TRENDS IN CALIFORNIA –AS OF NOVEMBER 18, 2020

- California has 21.9 COVID-19 cases for every 100,000 people.
- Compared with North Dakota, which has 185.3 cases for every 100,000 people.
- California ranks 49<sup>th</sup> out of 61 states and territories.

Total Coronavirus Cases in California



CDC COVID Tracker (November 18, 2020). Retrieved from: [https://covid.cdc.gov/covid-data-tracker/#cases\\_casesper100klast7days](https://covid.cdc.gov/covid-data-tracker/#cases_casesper100klast7days)  
Worldmeter COVID Cases (November 9, 2020). Retrieved from: <https://www.worldometers.info/coronavirus/usa/california/>

# REVIEW CORONA VIRUS MUTATIONS

What that means with regards to risk



# NOT THE SAME VIRUS TODAY ...

- SARS-CoV-2 is not the same as it was when it came out of China. Today, the infection has a higher viral load, but they do not get sicker. They are much more contagious though (Hou, et al, 2020).
- This evolution and mutation is a normal part of virus development. This also makes it more challenging for vaccinations and therapeutic modalities.
- Viruses in an epidemic or pandemic evolve many times as the virus is determining how to survive in its hosts. Survival is the goal, not death.

## Reference:

Y. J. Hou et al. (2020). SARS-CoV-2 D614G variant exhibits efficient replication ex vivo and transmission in vivo. *Science* 10.1126/science.abe8499.

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K. A. Tsetsarkin, S. C. Weaver, Sequential adaptive mutations enhance efficient vector switching by Chikungunya virus and its epidemic emergence. *PLOS Pathog.* 7, e1002412 (2011). doi:10.1371/journal.ppat.1002412 Medline

The Chinese SARS Molecular Epidemiology Consortium, Molecular evolution of the SARS coronavirus during the course of the SARS epidemic in China. *Science* 303, 1666–1669 (2004). doi:10.1126/science.1092002 Medline

J. ter Meulen, E. N. van den Brink, L. L. M. Poon, W. E. Marissen, C. S. W. Leung, F. Cox, C. Y. Cheung, A. Q. Bakker, J. A. Bogaards, E. van Deventer, W. Preiser, H. W. Doerr, V. T. Chow, J. de Kruif, J. S. M. Peiris, J. Goudsmit, Human monoclonal antibody combination against SARS coronavirus: Synergy and coverage of escape mutants. *PLOS Med.* 3, e237 (2006). doi:10.1371/journal.pmed.0030237 Medline

B. Rockx, T. Sheahan, E. Donaldson, J. Harkema, A. Sims, M. Heise, R. Pickles, M. Cameron, D. Kelvin, R. Baric, Synthetic reconstruction of zoonotic and early human severe acute respiratory syndrome coronavirus isolates that produce fatal disease in aged mice. *J. Virol.* 81, 7410–7423 (2007). doi:10.1128/JVI.00505-07 Medline

M. Letko, K. Miazgowiec, R. McMinn, S. N. Seifert, I. Sola, L. Enjuanes, A. Carmody, N. van Doremalen, V. Munster, Adaptive evolution of MERS-CoV to species variation in DPP4. *Cell Rep.* 24, 1730–1737 (2018). doi:10.1016/j.celrep.2018.07.045 Medline

C. E. Edwards, B. L. Yount, R. L. Graham, S. R. Leist, Y. J. Hou, K. H. Dinno III, A. C. Sims, J. Swanstrom, K. Gully, T. D. Scobey, M. R. Cooley, C. G. Currie, S. Randell, R. S. Baric, Swine acute diarrhea syndrome coronavirus replication in primary human cells reveals potential susceptibility to infection. *Proc. Natl. Acad. Sci. U.S.A.* 117, 26915–26925 (2020). doi:10.1073/pnas.2001046117 Medline

# MINK VARIATION IN DENMARK

- The mink variation (cluster 5) in Denmark is a variation that allows for transmission from human to mink, mink to mink, and mink to human. The mink get sick from it and can die from the variation.
- So far, mink are the only animal to transmit to humans like this.
- Twelve people have been infected with this variation.
- The worry is that this variation, which is on the spike protein, may be less affected by the vaccinations in progress. The vaccinations are targeting the spike protein.
- However, the World Health Organization and independent experts said there was no evidence so far that the cluster 5 variant would diminish the value of vaccines currently in development.

## Reference:

James Gorman (Nov. 13, 2020). Mink and the Coronavirus: What We Know. The New York Times. Retrieved from: <https://www.nytimes.com/article/mink-coronavirus-mutation.html>



# RISK FACTORS

Who is most and least at risk



# HIGHEST RISK FACTORS FOR DEATH FROM COVID-19

- Aging population, with the great risk group is 85 years+
  - 80% of the deaths are 65 and older
- Underlying medical conditions
- Male

## References:

CDC (September 2020). Aging. Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html>

Bastard, P, Rosen, LB, et al. (2020). Autoantibodies against type I IFNs in patients with life-threatening COVID-19. *Science*, 370, 423. Retrieved from: <http://science.sciencemag.org/>.

# THE TRIFECTA RISK FACTORS +

- Three risk factors for life-threatening coronavirus disease 2019 (COVID-19) pneumonia have been identified— being male, being elderly, or having other medical conditions—but these risk factors cannot explain why critical disease remains relatively rare in any given epidemiological group (Bastard, Rosen, et al, 2020).
- Genetic risks:
  - Inborn errors of type I IFN immunity accounts for life-threatening COVID-19 pneumonia in at least 2.6% of women and 12.5% of men. This impairs innate and intrinsic antiviral immunity, especially in men (Bastard, Rosen, et al, 2020).
  - At least 3.5% of patients with life threatening COVID-19 pneumonia had known or new genetic defects. Type I IFN administration may be of therapeutic benefit in selected patients, at least early in the course of SARS-CoV-2 infection

Reference:

Bastard, P, Rosen, LB, et al. (2020). Autoantibodies against type I IFNs in patients with life-threatening COVID-19. *Science*, 370, 423. Retrieved from: <http://science.sciencemag.org/>.

Zhang et al. (2020). Inborn errors of type I IFN immunity in patients with life-threatening COVID-19 *Science* 370, 422. Retrieved from: <http://science.sciencemag.org/>.

# BIGGEST RISK FACTORS = AGING

- As we age, it is common for chronic inflammation to be present, known as inflammaging (Akbar & Gilroy, 2020).
- Excessive inflammation can inhibit immunity (Akbar & Gilroy, 2020) and can inhibit antigen-specific immunity (De Maeyer, et al, 2020).
- Older individuals who are infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), often have excessive inflammation, which increases mortality.
- Reducing inflammation may be a therapeutic strategy for enhancing immunity in older people.
- Healthy individuals (60 years +) tend to have chronic low-grade sterile inflammation (not pathogen-driven), detectable by high baseline serum concentrations of C reactive protein (CRP) and cytokines. This is a predictor of frailty and early mortality (Franceschi, Garagnani, Vitale, Capri & Salvioli, 2017).
- Inflammaging is linked to the accumulation of misfolded proteins, compromised gut barrier function, and obesity (Franceschi, Garagnani, Vitale, Capri & Salvioli, 2017).

## References:

Franceschi, C., Garagnani, P., Vitale, G., Capri, M. & Salvioli, S. (2017). Trends Endocrinology Metabolism, 28, 199.

De Maeyer, R. P. H. et al (2020). Natural Immunology, 21, 615.

Arne N. Akbar and Derek W. Gilroy (17 JULY 2020). Aging immunity may exacerbate COVID-19: Increased general inflammation in aging inhibits immunity and affects responses to infections. Science, 369, 6501. Retrieved from <http://science.sciencemag.org>.

# TREATMENT FOR OLDER PEOPLE WITH SEVERE COVID-19

- This may be of particular relevance for older patients with COVID-19 who have severe inflammation in the respiratory tract during disease progression that may hinder antiviral immunity.

# PRE-EXISTING MEDICAL CONDITIONS

- Older age and presence of multiple chronic medical conditions have previously been associated with illness severity among adults hospitalized with COVID-19 (Zhou, et al 2020; Jordan, Adab & Cheng, 2020)
- Adults of any age with certain underlying medical conditions are at increased risk for severe illness from the virus that causes COVID-19 (CDC, 2020).

Reference:

CDC (November 2020).

Zhou F, Yu T, Du R, et al. (2020). Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet*, 395:1054–62. [https://doi.org/10.1016/S0140-6736\(20\)30566-3](https://doi.org/10.1016/S0140-6736(20)30566-3)

Jordan RE, Adab P, Cheng KK. (2020). Covid-19: risk factors for severe disease and death. *BMJ* 2020;368:m1198. <https://doi.org/10.1136/bmj.m1198>

# HEALTH DISPARITIES AND UNDERLYING MEDICAL CONDITIONS

- There is evidence that some racial and ethnic minority groups are being disproportionately affected by COVID-19.
- Studies have found race/ethnicity to be a risk factor for severe COVID-19 illness (Price-Haygood, Burton, & Fort, 2020).
- This follows health disparities that we see for other preventable disease.
- Those highest at risk are:
  - African American
  - Native American/Alaskan Native
  - Latinx/Hispanic
  - Asian Pacific Islander/American Samoa

## References:

Stokes EK, Zambrano LD, Anderson KN, et al. Coronavirus Disease 2019 Case Surveillance — United States, January 22–May 30, 2020. *MMWR Morb Mortal Wkly Rep* 2020;69:759–765. DOI: <http://dx.doi.org/10.15585/mmwr.mm6924e2>external icon.

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Gold JA, Wong KK, Szablewski CM, et al. Characteristics and Clinical Outcomes of Adult Patients Hospitalized with COVID-19 — Georgia, March 2020. *MMWR Morb Mortal Wkly Rep* 2020;69:545–550. DOI: <http://dx.doi.org/10.15585/mmwr.mm6918e1>external icon.

Price-Haygood EG, Burton J, Fort D, Seoane L. Hospitalization and Mortality among Black Patients and White Patients with Covid-19. *N Engl J Med* 2020. DOI: <https://doi.org/10.1056/nejmsa2011686>external icon.

Millet GA, Jones AT, Benkeser D, et al. Assessing Differential Impacts of COVID-19 on Black Communities. *Ann Epidemiol*. 2020;47:37-44. DOI: <https://doi.org/10.1016/j.annepidem.2020.05.003>external icon.

# MEDICAL CONDITIONS THAT MAY INCREASE RISK

Increased Risk	May have increased risk
Cancer	Asthma (moderate-to-severe)
Chronic kidney disease	Cerebrovascular disease (affects blood vessels and blood supply to the brain)
COPD (chronic obstructive pulmonary disease)	Cystic fibrosis
Heart conditions, such as heart failure, coronary artery disease, or cardiomyopathies	Hypertension or high blood pressure
Immunocompromised state (weakened immune system) from solid organ transplant	Immunocompromised state (weakened immune system) from blood or bone marrow transplant, immune deficiencies, HIV, use of corticosteroids, or use of other immune weakening medicines
Obesity (body mass index [BMI] of 30 kg/m <sup>2</sup> or higher but < 40 kg/m <sup>2</sup> )	Neurologic conditions, such as dementia
Severe Obesity (BMI ≥ 40 kg/m <sup>2</sup> )	Liver disease
Pregnancy	Overweight (BMI > 25 kg/m <sup>2</sup> , but < 30 kg/m <sup>2</sup> )
Sickle cell disease	Pulmonary fibrosis (having damaged or scarred lung tissues)
Smoking	Thalassemia (a type of blood disorder)
Type 2 diabetes mellitus	Type 1 diabetes mellitus



# HEALTH DISPARITIES

- Discrimination can impede access and equity, as well as leading to toxic stress. This may put some people from racial and ethnic minority groups at increased risk for COVID-19.

## Reference:

Price-Haygood EG, Burton J, Fort D, Seoane L. Hospitalization and Mortality among Black Patients and White Patients with Covid-19. N Engl J Med 2020. DOI: <https://doi.org/10.1056/nejmsa2011686>external icon.

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Simons RL, Lei MK, Beach SRH, et al. Discrimination, segregation, and chronic inflammation: Testing the weathering explanation for the poor health of Black Americans. Dev Psychol. 2018;54(10):1993-2006. DOI: <https://doi.org/10.1037/dev0000511>external icon.

Cordes J, Castro MC. Spatial Analysis of COVID-19 Clusters and Contextual Factors in New York City. Spat Spatiotemporal Epidemiol. 2020;34:100355. DOI: <https://dx.doi.org/10.1016%2Fj.sste.2020.100355>external icon.

# HEALTH DISPARITIES

- People from marginalized groups have higher uninsured rates, poorer healthcare access for a variety of reasons, and a distrust of government and healthcare systems.

## Reference:

Berchick, Edward R., Jessica C. Barnett, and Rachel D. Upton Current Population Reports, P60-267(RV), Health Insurance Coverage in the United States: 2018, U.S. Government Printing Office, Washington, DC, 2019.

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# HEALTH DISPARITIES

- People from some racial and ethnic minority groups are disproportionately represented in essential work settings such as healthcare facilities, farms, factories, grocery stores, and public transportation.
- Lower high school completion rates and barriers to college entrance may lead to limited job options, often lower paid jobs that are work with the public during the pandemic (higher exposure).

## Reference:

U.S. Bureau of Labor Statistics. Labor force characteristics by race and ethnicity, 2018 [online]. 2019 [cited 2020 Jun 24]. Available from URL: <https://www.bls.gov/opub/reports/race-and-ethnicity/2018/home.htm>


Economic Policy Institute. Black workers face two of the most lethal preexisting conditions for coronavirus—racism and economic inequality [online]. 2020 [cited 2020 Jun 28]. Available from URL: <https://www.epi.org/publication/black-workers-covid/>

The Annie E. Casey Foundation. Unequal Opportunities in Education [online]. 2006 [cited 2020 Jun 24]. Available from: <https://www.aecf.org/m/resourcedoc/aecf-racemattersEDUCATION-2006.pdf> 

# HEALTH DISPARITIES

- Housing: Some people from racial and ethnic minority groups live in crowded conditions that make it more challenging to follow prevention strategies. In some cultures, it is common for family members of many generations to live in one household. In addition, growing and disproportionate unemployment rates for some racial and ethnic minority groups during the COVID-19 pandemic may lead to greater risk of eviction and homelessness or sharing of housing (The Annie E. Casey Foundation, 2006).

Reference:

The Annie E. Casey Foundation. Unequal Opportunities in Education (2006). Available from: <https://www.aecf.org/m/resourcedoc/aecf-racemattersEDUCATION-2006.pdf>

# HEALTH DISPARITIES

- These factors and others are associated with more COVID-19 cases, hospitalizations, and deaths in areas where racial and ethnic minority groups live, learn, work, play, and worship (Price-Haygood, Burton, Fort, & Seoane. 2020; Berchick, Barnett, & Rachel, 2019; Wadhera, Wadhera, Gaba, Figueroa, Joynt Maddox, Yeh, & Shen, 2020; Kim & Bostwick, 2020).
- They have also contributed to higher rates of some medical conditions that increase one's risk of severe illness from COVID-19. In addition, community strategies to slow the spread of COVID-19 may cause unintentional harm, such as lost wages, reduced access to services, and increased stress, for some racial and ethnic minority groups (Webb Hooper, Nápoles, & Pérez-Stable, 2020).

## Reference:

Price-Haygood EG, Burton J, Fort D, Seoane L. (2020). Hospitalization and Mortality among Black Patients and White Patients with Covid-19. *New England Journal of Medicine*. DOI: <https://doi.org/10.1056/nejmsa2011686>external icon.

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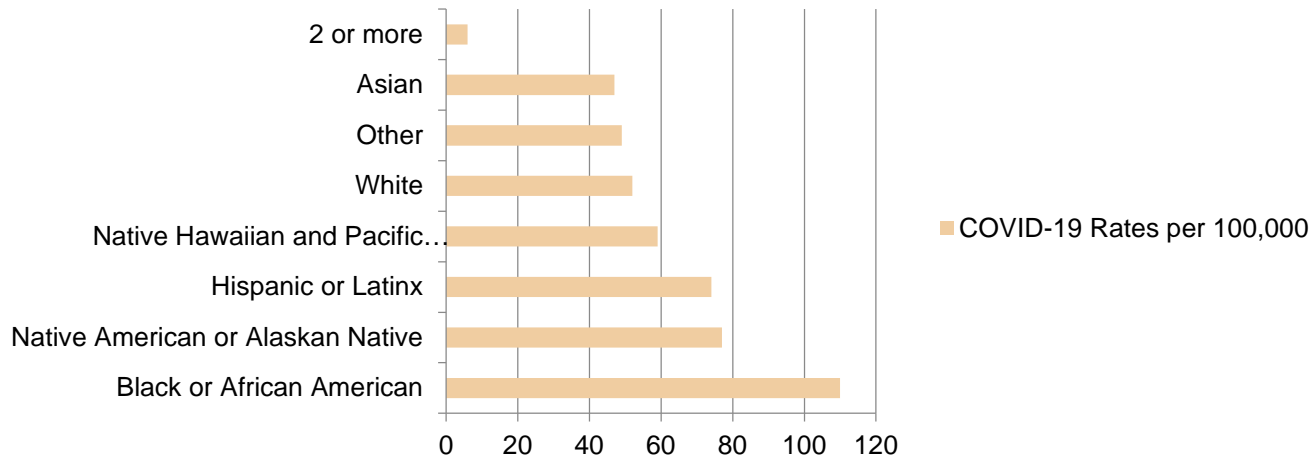
Kim SJ, Bostwick W. (2020). Social Vulnerability and Racial Inequality in COVID-19 Deaths in Chicago. *Health Educ Behav*. 47(4):509-513. DOI: <https://doi.org/10.1177/1090198120929677>external icon.

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# HEALTH DISPARITIES WITH STARK CONSEQUENCES

- Nationwide, Black people are dying at 2.1 times the rate of white people.

**COVID-19 Rates per 100,000**



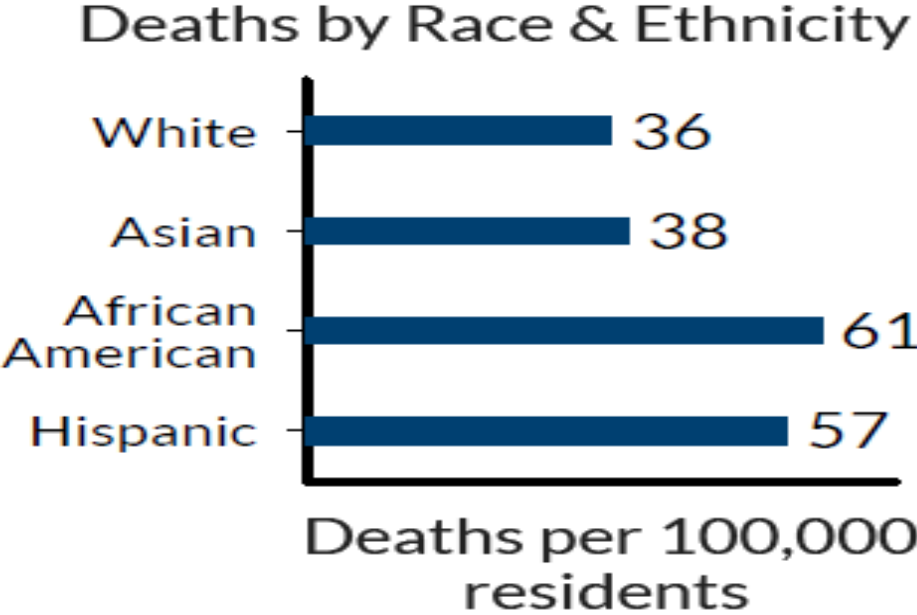
- We've lost at least 45,511 Black lives to COVID-19 to date. Black people account for 20% of COVID-19 deaths where race is known (blacks represents 13.4% of the population in the US – Census data from 2019).

Reference:

The COVID Tracking Project (ND). The COVID Racial Data Tracker: COVID-19 is affecting Black, Indigenous, Latinx, and other people of color the most. The Atlantic. Retrieved from: <https://covidtracking.com/race>

# CALIFORNIA DISPARITIES IN COVID-19 MORTALITY

## Disparities in COVID-19 Mortality



COVID-19 Health Equity Interactive Dashboard (November 17, 2020).  
Emory University. Retrieved from: <https://covid19.emory.edu/>

# HEALTH DISPARITIES

## CORONA VIRUS DISEASE 2019 (COVID-19)

Rate ratios compared to White, Non-Hispanic Persons	American Indian or Alaska Native, Non-Hispanic persons	Asian, Non-Hispanic persons	Black or African American, Non-Hispanic persons	Hispanic or Latino persons
Cases <sup>1</sup>	2.8x higher	1.1x higher	2.6x higher	2.8x higher
Hospitalization <sup>2</sup>	5.3x higher	1.3x higher	4.7x higher	4.6x higher
Death <sup>3</sup>	1.4x higher	No Increase	2.1x higher	1.1x higher

Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

CDC (Aug. 18, 2020). CASES, DATA & SURVEILLANCE. COVID-19 Hospitalization and Death by Race/Ethnicity. Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html>



# EXPLAIN DEFENSES TO MITIGATE RISK

Best defenses



# RISK LOWERING FACTORS

- Keep chronic levels of inflammation low
- Under 65+ years
- Lifestyle strategies, which normally enhance immunity (nutrition, exercise, stress reduction, weight management)
- Keep vaccinations current to lessen chances of co-morbidity
- ABO Blood Group O is associated with a decreased risk for contracting SARS-CoV-2 infection (Barnkob, et al 2020).

## Reference:

Mike Bogetofte Barnkob, Anton Pottegård, Henrik Støvring, Thure Mors Haunstrup, Keld Homburg, Rune Larsen, Morten Bagge Hansen, Kjell Titlestad, Bitten Aagaard, Bjarne Kuno Møller, Torben Barington (2020). Reduced prevalence of SARS-CoV-2 infection in ABO blood group O. *Blood Adv* (2020) 4 (20): 4990–4993. <https://doi.org/10.1182/bloodadvances.2020002657>

# DEFENSES TO MITIGATE RISK

- Follow CDC, State, Regional, and Local Public Health recommendations
  - Masks – helps to protect others and “can also reduce wearers' exposure to infectious droplets through filtration, including filtration of fine droplets and particles less than 10 microns," CDC November 11, 2020.
  - Social distancing
  - Avoiding large gatherings
  - Limit exposure possibilities

# COMPLICATIONS OF COVID-19

Potential complications



# SYMPTOMS OF CORONAVIRUS: SHORT-TERM

- People with COVID-19 have had a wide range of symptoms reported – ranging from mild symptoms to severe illness. Symptoms may appear **2-14 days after exposure to the virus**. People with these symptoms may have COVID-19:
  - 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

Reference:

CDC (May 2020). Watch for Symptoms. Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>

# POTENTIAL COMPLICATION OF COVID-19

- Baseline inflammation may initiate an inflammatory cascade that amplifies the excessive inflammation that occurs in response to pathogens.

## References:

Franceschi, C., Garagnani, P., Vitale, G., Capri, M. & Salvioli, S. (2017). Trends Endocrinolpgy Metabolism, 28, 199.

De Maeyer, R. P. H. et al (2020). Natural Immunology, 21, 615.

Arne N. Akbar and Derek W. Gilroy (17 JULY 2020). Aging immunity may exacerbate COVID-19: Increased general inflammation in aging inhibits immunity and affects responses to infections. Science, 369, 6501. Retrieved from <http://science.sciencemag.org>.

# LONG-TERM COMPLICATIONS

- The most common signs and symptoms that linger over time include:
  - Fatigue
  - Shortness of breath
  - Cough
  - Joint pain
  - Chest pain
  - Muscle pain or headache
  - Fast or pounding heartbeat
  - Loss of smell or taste
  - Memory, concentration or sleep problems
  - Rash or hair loss

Reference:

Mayo Clinic Staff (November 17, 2020). COVID-19 (coronavirus): Long-term effects. Mayo Clinic. Retrieved from: <https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/coronavirus-long-term-effects/art-20490351>

# LONG-TERM COMPLICATIONS

- More serious long term complications can be:
  - Organ damage
    - Heart damage
    - Lung damage to the tiny air sacs (alveoli) and scar tissue that can lead to long-term breathing problems.
    - Brain damage: strokes, seizures and Guillain-Barre. COVID-19 may also increase the risk of developing Parkinson's disease and Alzheimer's disease.
    - Long-lasting problems with the liver and kidneys.
  - Blood clots and blood vessel problems
- Problems with mood and fatigue
- Many long-term COVID-19 effects still unknown

Reference:

Mayo Clinic Staff (November 17, 2020). COVID-19 (coronavirus): Long-term effects. Mayo Clinic. Retrieved from: <https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/coronavirus-long-term-effects/art-20490351>



# CURRENT AND PROMISING TREATMENTS

What is working



# CURRENT TREATMENTS

- ICU care has gotten better, as we have learned more about COVID-19 – what works and what doesn't. Mortality rates in ICUs are declining Dr. Craig Cooper Smith, director of the Emory Critical Care Center (Harris, 2020).
- Steroids, such as dexamethasone routinely, helped control the inflammation in the most severe cases of SARS-CoV-2 (Stauffer, Alpern, & Walker, 2020). Glucocorticoids may modulate inflammation-mediated lung injury and thereby reduce progression to respiratory failure and death (The RECOVERY Collaborative Group, 2020)
- Putting people on their stomachs to assist with breathing; prone positioning - helps increase the amount of oxygen getting to the lungs (Cohen, 2020).
- Ventilators, in extreme cases.

## Reference:

Harris, R (September 20, 2020). Advances In ICU Care Are Saving More Patients Who Have COVID-19. NPR. THE CORONAVIRUS CRISIS. Retrieved from: <https://www.npr.org/sections/health-shots/2020/09/20/914374901/advances-in-icu-care-are-saving-more-patients-who-have-covid-19>

Stauffer WM, Alpern JD, Walker PF (2020). COVID-19 and Dexamethasone: A Potential Strategy to Avoid Steroid-Related *Strongyloides* Hyperinfection. *JAMA*;324(7):623–624. doi:10.1001/jama.2020.13170

The RECOVERY Collaborative Group (July 17, 2020). Dexamethasone in Hospitalized Patients with Covid-19 — Preliminary Report. *New England Journal of Medicine*. DOI: 10.1056/NEJMoa2021436

Elizabeth Cohen (April 14, 2020). 'Such a simple thing to do': Why positioning Covid-19 patients on their stomachs can save lives. CNN. Retrieved from: <https://www.cnn.com/2020/04/14/health/coronavirus-prone-positioning/index.html>

# PROMISING TREATMENT

- For those with inborn errors of type I IFN immunity, particularly in men, prevention and treatment may include convalescent plasma treatments.

Reference:

Bastard, P, Rosen, LB, et al. (2020). Autoantibodies against type I IFNs in patients with life-threatening COVID-19. *Science*, 370, 423. Retrieved from: <http://science.sciencemag.org/>.

# INCREASING THE EFFECTIVENESS OF VACCINES FOR PEOPLE WITH ELEVATED INFLAMMATION

- Increased inflammation is detrimental for the efficacy of many vaccines, such as against influenza virus (5).
- The negative impact of inflammation on immunity during aging can be reversed in part by treatment with the mTOR (mammalian target of rapamycin) inhibitor rapamycin, which enhances influenza-specific antibody responses after influenza vaccination in treated individuals (6).
- Short-term administration of an oral p38 mitogen-activated protein kinase (MAPK) significantly increased the immune response to varicella zoster virus (VZV, which causes chicken pox in children and shingles in adults) (7).
- Reducing inflammaging with a short-term course of mTOR or p38 MAPK inhibitors and possibly other anti-inflammatory agents (e.g., steroidal drugs such as dexamethasone) may be a strategy for immune enhancement in older people.

## Reference:

Arne N. Akbar and Derek W. Gilroy (17 JULY 2020). Aging immunity may exacerbate COVID-19: Increased general inflammation in aging inhibits immunity and affects responses to infections. *Science*, 369, 6501. Retrieved from <http://science.sciencemag.org>.

# VACCINATIONS

Current state



# DIFFERENT VACCINE DEVELOPMENT STRATEGY

- mRNA
- Pure protein
- T-cell development

Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

# MRNA VACCINE DEVELOPMENT

- In 2015, Bill & Melinda Gates Foundation invested \$53 million in the German company, CureVac, which specializes in the development of these mRNA vaccines.
- mRNA vaccines are new technology. Before now, a successful mRNA vaccine has never been created before, but studies show they can elicit immunity against flu, Zika, rabies and coronavirus
- Vaccines using mRNA, or messenger ribonucleic acid, are the focus against the coronavirus pandemic.
- mRNA is a molecule that carries codes from DNA which encodes proteins of a virus and inserts them into a cell to trigger an immune response and create antibodies (Cohan, 2020). This imitates infection and triggers acquired immunity (Hubaud, 2015).
- RNA-based vaccines appear to perform better than DNA-based vaccines. They are safer, as injection of RNA presents no risk of disrupting the cell's natural DNA sequence (Hubaud, 2015).
- mRNA vaccines are non-infectious, can be produced quickly at large scale, and tend to be less expensive
- RNA can thus be produced *in vitro*, i.e. outside the cells, using a DNA template containing the sequence of a specific antigen. This also avoids common vaccination allergies (Hubaud, 2015).

Reference:

Alexi Cohan (May 23, 2020). mRNA vaccines: What they are and how they work. Retrieved from: <https://www.msn.com/en-us/health/medical/mrna-vaccines-what-they-are-and-how-they-work/ar-BB14uSTc>

Alexis Hubaud (May 5, 2015). RNA vaccines: a novel technology to prevent and treat disease. Retrieved from: <http://sitn.hms.harvard.edu/flash/2015/rna-vaccines-a-novel-technology-to-prevent-and-treat-disease/>

# VACCINATION STATUS UPDATES: PFIZER INC AND BIONTECH SE

- Pfizer Inc. and BioNTech SE announced their mRNA-based vaccine candidate, BNT162b2, against SARS-CoV-2 has demonstrated evidence of efficacy against COVID-19 in participants without prior evidence of SARS-CoV-2 infection, based on the first interim efficacy analysis conducted on November 8, 2020 by an external, independent Data Monitoring Committee (DMC) from the Phase 3 clinical study (Press Release, November 9, 2020).
  - *Vaccine candidate was found to be more than 90% effective (N=94), within 7 days after receiving the second dose (28 days from first dose), in preventing COVID-19 in participants without evidence of prior SARS-CoV-2 infection in the first interim efficacy analysis (updated to 95% on 11/18/20).*
    - *Efficacy is likely to vary as the study continues.*
  - *Phase 3 of the study started July 27 and enrolled 43,538 participants, with 38,955 receiving the second dose. Globally, 42% having diverse backgrounds, 30% in the US. and no serious safety concerns have been observed; Safety and additional efficacy data continue to be collected*
  - *Submission for Emergency Use Authorization (EUA) to the U.S. Food and Drug Administration (FDA) planned for today (11/20/20)*
  - *Clinical trial to continue through to final analysis at 164 confirmed cases in order to collect further data and characterize the vaccine candidate's performance against other study endpoints*
    - *Will be evaluating endpoints at 7 days and 14 days after second dose.*

Reference:

Press Release November 9, 2020. Pfizer and BioNTech Announce Vaccine Candidate Against COVID-19 Achieved Success in First Interim Analysis from Phase 3 Study. Retrieved from: <https://www.businesswire.com/news/home/20201109005539/en/>.



# VACCINATION STATUS UPDATES: MODERNA

- First interim analysis included 95 participants with confirmed cases of COVID-19 (Moderna Press Release, 2020).
- Phase 3 study met statistical criteria with a vaccine efficacy of 94.5% ( $p < 0.0001$ ) (Moderna Press Release, 2020).
- Moderna intends to submit for an Emergency Use Authorization (EUA) with U.S. FDA in the coming weeks and expects the EUA to be based on the final analysis of 151 cases and a median follow-up of more than 2 months (Moderna Press Release, 2020).
- Advantages over Pfizer
  - Easier to store, transport, and prepare than Pfizer (Gander, 2020).
  - Moderna vaccine is that it does not require dilution or special handling at health care facilities, said Julie Kalabalik-Hoganson, chair of pharmacy practice and associate professor at Fairleigh Dickinson University School of Pharmacy and Health Sciences. "This means administering the [Moderna] vaccine in pharmacies and physician offices will be fairly easy."
- Fun fact: Dolly Parton donated \$1M that went toward Vanderbilt University Medical Center's efforts to combat Covid-19, which included Moderna's vaccine trial and clinical research

## Reference:

Berkeley Lovelace Jr. & Noah Higgins-Dunn (NOV 16 2020). Moderna says preliminary trial data shows its coronavirus vaccine is more than 94% effective, shares soar. CNBC - HEALTH AND SCIENCE. Retrieved from: <https://www.cnbc.com/2020/11/16/moderna-says-its-coronavirus-vaccine-is-more-than-94percent-effective.html>

Moderna Press Release (November 16, 2020). Moderna's COVID-19 Vaccine Candidate Meets its Primary Efficacy Endpoint in the First Interim Analysis of the Phase 3 COVE Study. Retrieved from: <https://investors.modernatx.com/news-releases/news-release-details/modernas-covid-19-vaccine-candidate-meets-its-primary-efficacy>

Kashmira Gander (November 17, 2020). Why Moderna's COVID Vaccine Has a 'Huge Advantage' Over Pfizer's. Newsweek. Retrieved from: <https://www.msn.com/en-us/health/medical/why-moderna-s-covid-vaccine-has-a-huge-advantage-over-pfizer-s/ar-BB1b68jP?ocid=msedgdhp>

# VACCINATION STATUS UPDATES: ASTRAZENECA

- The ChAdOx1 nCov-2019 coronavirus vaccine, developed by teams at the University of Oxford, along with AstraZeneca, has been shown to trigger a robust immune response in healthy adults aged 56-69 and those over 70 years of age. The data, published November 19, 2020 in The Lancet, suggest that one of the groups most vulnerable to serious illness, and death from COVID-19, could build immunity.
- Reporting on data from a Phase II trial of the ChAdOx1 nCov-2019 vaccine, the authors write that volunteers in the trial demonstrate similar neutralizing antibody titres, and T cell responses across all three age groups (18-55, 56-79, and 70+).
- During the Phase 2 trial the vaccine has been evaluated in 560 healthy adult volunteers aged between 18-55 years, 56-69 years and aged 70 or over. Volunteers received 2 doses of the vaccine ChAdOx1 nCoV-19, or a placebo MenACWY vaccine. No serious adverse health events related to ChAdOx1 nCoV-19 were seen in these volunteers. These data are consistent with the Phase I data reported for healthy adults aged 18-55 early this year.
- The Phase III trials of the ChAdOx1 nCov-2019 vaccine are ongoing, with early efficacy readings possible in the coming weeks.
- This group has been working on SARS Corona Virus research for the past 3 years.

## Reference:

University of Oxford (November 2020). Oxford coronavirus vaccine produces strong immune response in older adults. Our Research Coronavirus Vaccine. Retrieved from: <https://www.research.ox.ac.uk/Article/2020-11-19-oxford-coronavirus-vaccine-produces-strong-immune-response-in-older-adults>

# VACCINE DEVELOPMENT UPDATES

- We don't know how long the efficacy is
- 8 vaccines in efficacy trials
- 50 vaccines in initial testing
- Likely many will see similar efficacy with other vaccines
- 80,000 people have been vaccinated
- Extremely safe from preliminary data, however, these are very early results
- More data will be out in the next 3-6 months
- Efficacy, traditionally, lesser with the elderly
- Many vaccines will be available in 2021

Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

# VACCINATION STATUS UPDATES

- Some likely to be somewhat available by the end of 2020 but not in full distribution mode until 2021 (Weintraub, 2020).
- Dr. Fauce announced this week that he expected them to be in full distribution by Spring 2021.

Reference:

Karen Weintraub (November 10, 2020). There may be a COVID-19 vaccine by the end of the year, but 'normality' may not come until end of 2021. USA TODAY – Health. Retrieved from: <https://www.usatoday.com/story/news/health/2020/11/10/covid-19-vaccine-willingness-needed-to-end-pandemic/3516649001/>

# VACCINATION ACCEPTANCE AND HESITANCY

- Childhood vaccination viewpoints
  - 90% acceptance rates of vaccinations
  - 5% rejection rates of vaccinations
  - 5% mixed
- HPV
  - 55-60% acceptance rates of vaccinations (in EU)
- COVID vaccinations
  - 55% acceptance rates of vaccinations

Reference: Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

# APPROACH TO VACCINATIONS

- Vaccines do not end disease, vaccinations do.
- Who should get it?
  - Those that give the vaccine
  - Healthcare workers
  - Aging (over 60 years)
  - Current co-morbidity
  - Risk factors (hypertension, overweight)
  - General population, particularly the young
- Protect those highest at risk
- Protect marginalized groups that are at risk for more serious consequences of COVID-19
- Need 70-80% vaccination rates to create “herd immunity”.
  - During the 2018-2019 flu season, 49.2% of people ages six months and older got a flu vaccine, according to the Centers for Disease Control and Prevention (CDC). This was the highest level since the 2009-2010 flu season.

Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

# HERD IMMUNITY

- Need 70% vaccination rates to create “herd immunity”.
  - During the 2018-2019 flu season, 49.2% of people ages six months and older got a flu vaccine, according to the Centers for Disease Control and Prevention (CDC). This was the highest level since the 2009-2010 flu season.
- Not likely that we will achieve this.

## Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

US Facts (September 27, 2020). How many Americans get flu shots? The federal government has the goal of vaccinating 70% of the population against the flu. The latest data shows that less than half of Americans get vaccinations. Retrieved from: <https://usafacts.org/articles/how-many-americans-get-flu-shots-vaccine-cdc/>

# SUPREME COURT DECISION PRECEDENT

- Jacobs vs. Massachusetts
  - 1905
  - \$5 fine for not getting fine
  - Supreme Court determined that public health took priority over individual liberties. However, they would not force vaccinations, they could fine those
  - Mandates don't work well in US and EU.

Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.



# THE UPWARD CLIMB TOWARDS VACCINATING THE PUBLIC

- According to a new study from the COVID Collaborative, the majority of Americans understand that a vaccine is critical to stopping the spread of COVID-19.
- Yet only 25 percent of Americans surveyed are planning to get the COVID-19 vaccine as soon as it's offered; about 3 in 5 Americans say they'll take a "wait and see" approach instead.

## Reference:

Julia W. Wu and Michelle A. Williams (November 12, 2020). An effective COVID-19 vaccine is on the horizon. We need to support vaccine advocacy. Public health experts can reduce fear and build public support. Boston Globe. Retrieved from: <https://www.bostonglobe.com/2020/11/12/opinion/an-effective-covid-19-vaccine-is-horizon-we-need-support-vaccine-advocacy/>

# FIVE WAYS TO REDUCE FEAR AND BUILD PUBLIC SUPPORT

- We need the right messenger.
  - Physicians to spread the word personally and top scientists and physicians to spread the word publicly (Wu & Williams, 2020).
- We need the right message; a specific outreach strategy to connect with each constituency, identify their specific fears, and alleviate them (Harvard, 2020).
  - Black Americans, along with women, Republicans, and younger Americans, all report greater hesitancy to get vaccinated because they believe that political pressure will lead to premature approval of a vaccine (Wu & Williams, 2020).
- We need to emphasize what's at stake. What is it we have to lose if we don't? Shift to framing the COVID-19 vaccination as every American's responsibility to their loved ones is a powerful motivator (Wu & Williams, 2020).
- Get the initial limited vaccine supply to those at highest risk first, with a multi-phase distribution plan backed by strong state-level leadership (Wu & Williams, 2020).
- Vaccines need to be affordable and accessible. Eliminate all barriers (Harvard, 2020)

## Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

Julia W. Wu and Michelle A. Williams (November 12, 2020). An effective COVID-19 vaccine is on the horizon. We need to support vaccine advocacy. Public health experts can reduce fear and build public support. Boston Globe. Retrieved from: <https://www.bostonglobe.com/2020/11/12/opinion/an-effective-covid-19-vaccine-is-horizon-we-need-support-vaccine-advocacy/>

# ADVOCACY WORK NEEDED FOR COVID VACCINES

- We need the right messenger.
  - Correct information into the hands of physicians.
- We need the right message.
- Peer discussions to promote vaccination use.
  - We use Promotora Models here similarly.
- EU uses negative reinforcement. Don't vaccinate? No subsidized child care.
- Need engagement instead of imposing.
- Need to understand each group's fear and concerns – need a lot more research in this area
  - Need to develop trust.
  - Lower fears.
  - Identify the best messengers.
  - For example, African Americans have a lot of knowledge about vaccines(of all marginalized groups) but the least amount of trust in vaccinations.

Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

Julia W. Wu and Michelle A. Williams (November 12, 2020). An effective COVID-19 vaccine is on the horizon. We need to support vaccine advocacy. Public health experts can reduce fear and build public support. Boston Globe. Retrieved from: <https://www.bostonglobe.com/2020/11/12/opinion/an-effective-covid-19-vaccine-is-horizon-we-need-support-vaccine-advocacy/>

# OBSTACLE TO VACCINATION

- Not enough money has been allocated for distribution. US spends less money on distribution than the EU.
- Individual worries on “fast track”, safety, anti-vaxxers
- mRNAs have transport issues due to the need for them to be frozen
  - Need big settings for distribution campaigns
  - Pfizer's needs to be stored at an "ultra-cold" -70 C, and Moderna's at -20 C. This is because, unlike the flu vaccine that can be kept for up to a year in a fridge, they contain genetic material called mRNA that degrades at room temperature.

## Reference:

Harvard Chan Events Webinar (November 17, 2020). Vaccine Hesitancy: The Greatest Challenge to COVID-19? Jaap Goudsmit, Wayne Koff, Julia Wu, and Barry Bloom.

Kashmira Gander (November 17, 2020). Why Moderna's COVID Vaccine Has a 'Huge Advantage' Over Pfizer's. Newsweek. Retrieved from: <https://www.msn.com/en-us/health/medical/why-moderna-s-covid-vaccine-has-a-huge-advantage-over-pfizer-s/ar-BB1b68jP?ocid=msedgdhp>

# VACCINATIONS ARE ONLY ONE TOOL TO TACKLE THIS PANDEMIC

- Testing
- Contact tracing
- Mass vaccinations
- Continued use of social distancing, masks
- Wash your hands
- Avoiding crowds
- Disease management
- Self-care: exercise, proper nutrition, stress management, weight management
- Mental health care, due to social isolation, loneliness, stress/anxiety, COVID fatigue
- Follow CDC, State, Regional, and Local public health recommendations

# TAKEAWAY MESSAGE

- COVID viruses are not new but it is new strains that can cause epidemics and pandemics
- Trending is significantly higher throughout most of the US but particularly in the middle of the country right now
- Mutations are a normal part of virus development, but it can impact vaccination strategies
- Significant health disparities with COVID-19
- There are things we can do to lower risk.
- Treatment of COVID-19 has improved as we have learned. It will continue to get better with time.
- Need a clear and consistent direction, along with messaging, for a vaccination plan and implementation.
- Will need to continue with public health strategies for infectious disease prevention, long-term.

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Arne N. Akbar and Derek W. Gilroy (17 JULY 2020). Aging immunity may exacerbate COVID-19: Increased general inflammation in aging inhibits immunity and affects responses to infections. *Science*, 369, 6501. Retrieved from <http://science.sciencemag.org>.

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Berchick, Edward R., Jessica C. Barnett, and Rachel D. (2019). Upton Current Population Reports, P60-267(RV), *Health Insurance Coverage in the United States: 2018*, U.S. Government Printing Office, Washington, DC.

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CDC (September 2020). Aging. Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html>

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CDC (Aug. 18, 2020). CASES, DATA & SURVEILLANCE. COVID-19 Hospitalization and Death by Race/Ethnicity. Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html>

CDC COVID Tracker (November 18, 2020). Retrieved from: [https://covid.cdc.gov/covid-data-tracker/#cases\\_casesper100klast7days](https://covid.cdc.gov/covid-data-tracker/#cases_casesper100klast7days)


CDC (November 2, 2020). People with Certain Medical Conditions. Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html>.

CDC (May 2020). Symptoms of Corona Virus. Retrieved from: <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>

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# THANK YOU



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