Charles Denham II MD, William Adcox, Charles Denham III, Jaime Yrastorza, and Gregory Botz MD FCCM

This article is a narrative summary of the short film entitled *Masks: The SCIENCE of Success* posted on the Med Tac Global website providing access to free films and resources to families of the Essential Critical Infrastructure Workers of sixteen industry sectors and the general public.[1]

"It is critical that we all take the personal responsibility to slow the transmission of COVID-19 and embrace the universal use of face coverings." [2]
Dr. Robert Redfield, CDC Director

"There is no doubt that wearing masks protects you and gets you to be protected." [3]
Dr. Anthony Fauci, National Institute of Allergy and Infectious Diseases Director

"We need to support mask wearing…When I'm not in uniform I wear them…They were very effective, and I think they are a great investment for the American people." [4]
Admiral Brett Giroir, Assistant Secretary Health and Human Services

"It is not an inconvenience. It is not a suppression of your freedom." [5]
Dr. Jerome Adams
U.S. Surgeon General

"When you're outside and do not have the capability of maintaining distance, you should wear a mask at all times." [3]
Dr. Anthony Fauci, National institute of Allergy and Infectious Diseases Director

"This face covering actually is an instrument of freedom for Americans if we all use it." [5]
Dr. Jerome Adams
U.S. Surgeon General

"Wear facial coverings where social distancing is not possible." [5]
Dr. Alex Azar
Secretary Health and Human Services

"Please, please, please, wear a face covering when you go out in public" [5]
Dr. Jerome Adams
U.S. Surgeon General

"We have clear scientific evidence they work, and they are our best defense…this face mask is more guaranteed to protect me against COVID than when I take a COVID vaccine." [6]
Dr. Robert Redfield, CDC Director

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The following narrative is an annotated transcript of a video produced for a *Coronavirus Care Community of Practice* launched by a rapid response team convened to respond to the Coronavirus Crisis. The video was initially developed for families of workers from sixteen industry sectors that the Homeland Security Department has designated as Essential Critical Infrastructure Workforce. Through our research of more than 650 respondents representing families across the nation, we found that the general public was also in great need of well documented safety information. When the *Department of Homeland Security* added educators to the designation of essential workers, we expanded the scope of our training programs.

N95 Mask

Surgical Mask

Cloth Mask

I am Dr. Charles Denham, Chairman of TMIT Global and cofounder of the Med Tac Bystander Rescue Care Program, which is a program founded to teach the general public lifesaving skills that dramatically increase survival from the most common emergencies before professional first responders can arrive. I am speaking on behalf of the terrific rapid response team that was assembled after the coronavirus crisis hit our communities. When we found that there were no resources to help protect the families of critical essential infrastructure workers, this team got to work.

So, who are critical essential infrastructure workers? They are our professional caregivers, first responders, and those who keep the food, power, water, and information flowing in our country. They work in sixteen industry sectors identified by the federal government. They have to go to work no matter what. In August of 2020, educators at all levels were added to this group.[7]

It is our belief that we can't train essential infrastructure workers alone. We believe that the family unit is an Achilles heel in the war against the virus.

Family Transmission chains spread through the essential critical worker family is a major risk. They may catch the virus at work, but they are also at great risk in the home.

The CDC has confirmed our belief of family and living unit spread with real evidence. It reported on a prospective study that household spread occurs in more than 50% of family members with the infections developing within 5 days.[8]

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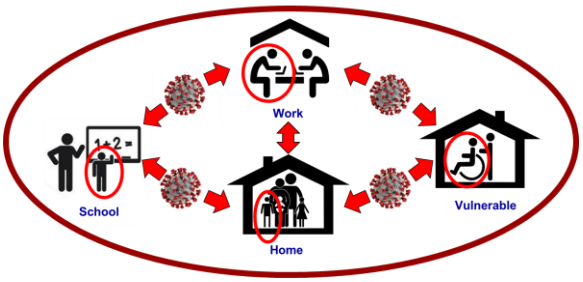
Family Transmission Chains



If you save the family, you can save the worker. Save the families across communities, you can help save the nation.

The CDC also formally confirmed the risk of aerosol spread of the virus from small droplets. This is where evaporation exceeds gravity of small droplets allowing viral particles to float in the air for hours.[9]

This is different than the large droplet spread where gravity exceeds evaporation and virus-laden droplets land near the infected patient.

Our frontline research through multiple webinars revealed that caregiver families, essential worker families, and families of the general public not only needed training but that they liked to be trained together.

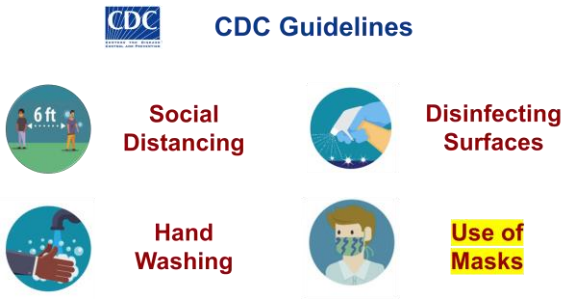
So we launched the Coronavirus Care Community of Practice. It is a learning community consisting of live webinars, training video production, and print publications that we will sustain through the crisis.

Our series of programs take a step-by-step approach to address the threats, vulnerabilities, risks, and solutions that families can take to keep their loved ones and housemates safe.[10 11 & 12] SEE: https://www.medtacglobal.org/coronavirus-response/

The Science of Masks

This topic addresses one of the most important things we can do to protect our families, those we love, our communities, and our country – ***wearing*** masks. We address the science behind how they work and how you can use them to protect you and your family. Infection risk is just basic math. The greater the number of virus particles you potentially breathe or absorb, the greater the risk for infection and the greater the risk for severe disease. It's a numbers game - in medicine we call this dose or viral load.

It is believed that individuals become infected by the virus entering the body through the wet mucous membranes that are the moist linings of our nose, eyes, mouth, and respiratory system. There are four pillars of safety the public must maintain. Masks have become increasingly recognized as critically important. However, they are no substitute for critical practices like social or physical distancing, which is most important, handwashing, avoiding touching our faces, and disinfecting high contact surfaces. Masks are but one of these four pillars, they all must work together.



In our video by the same name as this brief article, we cover three types of masks that can be used. We cover the most important aspects of what each offer to both those who wear them and those who are in the

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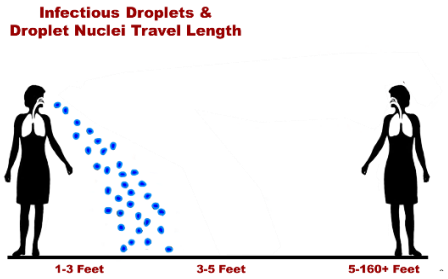
community. It turns out that all three types of masks benefit everyone.

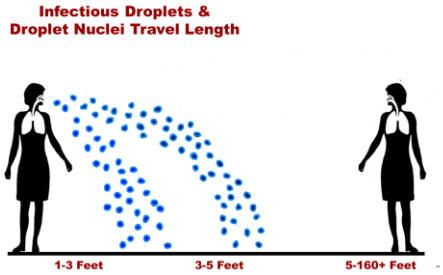
Some vocal champions of masks have stated that going without a mask is like drunk driving with a blindfold. You will never know who you hurt or who will hurt you, but the odds are against you. It has been said that you can no more defy the law of gravity than you can defy the laws of pandemics. If we infect a loved one and they die, we will never get over it.

Airborne Transmission: Droplets and Aerosols

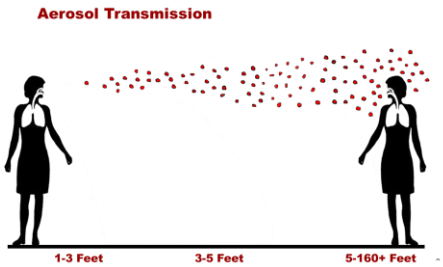
It helps to understand the size of the Coronavirus. They are smaller than a micron or one-millionth of a meter. The droplets that can carry the viruses are about 5 microns in size. A human hair might be 100 microns in diameter and a red blood cell might be seven microns. Our vision as humans is limited to about 40 microns. So, what infects us is just too small to see. We can become infected by breathing droplets expelled by infected patients. Those who breath, talk, sing, cough, or sneeze can expel virus particles that are encased in droplets--what the public might call globs of mucus, saliva and water. The bigger globs fall faster so they splash down quickly. Traditionally called droplets by scientists dating back to the 1930's, they were thought to fall rapidly onto anything nearby. Scientists thought they only drop within three to as far six feet from those infected.



After new technologies were developed to study breath plumes and droplet spread, we now understand they may land much farther from the source.



Smaller droplets or globs evaporate faster than they fall, therefore the viruses can linger in the air and drift farther afield. These are called aerosols. On July 6, 2020, an open letter to the World Health Organization (WHO) in the *Clinical Infectious Diseases Journal* entitled *It is Time to Address Airborne Transmission of COVID-19* [13] was published by 239 researchers regarding the risk for aerosol transmission through micro droplets smaller than 5 microns in size.



The WHO responded to the article with an announcement of a briefing paper that will be forthcoming addressing all routes of spread. When released, we will update our repository on our website and include their analysis in our training films as soon as it is available.[14]

Professor Kimberly Prather, one of the researchers appealing to the WHO, is the

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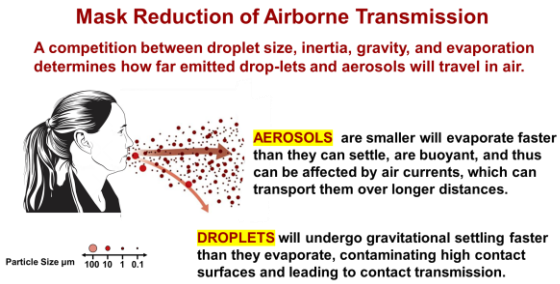
chair of Atmospheric Chemistry at the Scripps Institute of Oceanography. She published an excellent paper in *Science* on June 26.[15] We use it as a guide in our film to help us explain the two types of airborne transmission of the coronavirus. She describes airborne transmission as a competition between droplet size, inertia, gravity, and evaporation. These factors determine how far emitted droplets and aerosols will travel. She describes in detail how droplets will undergo gravitational settling faster than they evaporate, thus contaminating high contact surfaces and leading to potential contact transmission. When we are close to someone and we inhale these larger droplets, it can be very dangerous. Aerosols are smaller and defined as less than 5 microns in size. They will evaporate much faster than they settle and are very buoyant. Thus, they can be affected by air currents which can transport them over longer distances even much farther than 6 feet. They can be inhaled deeply into the lower respiratory track where COVID-19 can do the most damage.

Many studies have shown that aerosols can hang in the air for hours. The extent and impact of aerosol spread is being studied and the science of airborne spread will be evolving rapidly. However, all of the growing evidence supports it is likely occurring.



The physics of droplet spread, airflow, and the function of barriers are now being intensively studied by many scientists. One paper in the *Journal of Physics of Fluids* [16] describes the modeling of air flow through and around the edges of masks. The paper underscores the value of masks and importance of fit or the seal between the mask and the face.

The research regarding the effectiveness of masks will continue to expand and will leverage new technologies such as lasers, digital imaging devices, and predictive analytics. For instance, *Florida Atlantic University* [17] has undertaken a study simulating how far droplets might spread by replicating the physics of a cough. They compared the distance of droplet spread without a mask, with a bandana alone, and likely projection through a two-layer cloth mask. The press reported this study and showed bandanas fared least well.

Guidelines for Masks

The eventual CDC announcement of recommendations for masks[18] didn't surprise us because those of us in the field knew that the delay was due the lack of availability of masks and not a function of their effectiveness.

In a congressional testimony, Dr. Anthony Fauci was challenged regarding the delay in recommending mask use. **Congressman David McKinley of West Virginia: "Do you now regret not advising people more forcefully to wear masks earlier?" Dr. Anthony Fauci: "Okay we are going to play that game. Let me explain to you what happened back then." Congressman: "That should be a yes or no." Dr. Fauci: "No there's more than a yes and no by the tone of your question. I don't regret that because let me explain**

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to you what happened. At that time, there was a paucity of equipment that our healthcare providers needed to put themselves daily in harm's way of taking care of people who are ill. We did not want to divert masks and PPE away from them to be used by the people." You can see from Dr. Fauci's testimony to Congress it was due to the lack of available masks for caregivers earlier in the crisis.[19]

The CDC guidelines regarding the use of masks by the public had good evidence. They are based on the risk of asymptomatic patients who may never get symptoms spreading the virus as well as pre-symptomatic individuals who are in the early stages of an infection and have just not yet experienced symptoms. Early in the pandemic it was believed that it was highly probable that pre-symptomatic patients were a major transmission source of infection, potentially representing 45% of the spread even before they have symptoms. The clearly symptomatic patients, who knew they had some form of illness, were thought to represent 40% of the transmission spread of the infections. Pauci-symptomatic patients are those who have such mild symptoms that they may not realize it and just push through their activities. It was thought that approximately 10% of the infections come from the environment such as from high contact surfaces and objects. Asymptomatic patients were thought to represent 5% of the transmission of infections in adults, and an even larger proportion of children, youth, and young adults. The asymptomatic and pauci-symptomatic patients were thought to possibly represent a large group. The numbers were merely estimates and led to confusion because the categories were not black and white.[20] As the pandemic evolved, it became much clearer that asymptomatic patients were an invisible and major driver of spread. Younger age correlated strongly with asymptomatic and mild infections and it became clear that children were hidden drivers.[21]

Approximately 50% of Transmission is from Asymptomatic Persons

Two recent articles published in the *New England Journal of Medicine* document cases of asymptomatic transmission. One study documented the outbreak of COVID-19 on the aircraft carrier *USS Theodore Roosevelt*. It revealed that almost 50 percent of COVID-19 positive patients onboard were asymptomatic. This group was linked to the transmission of the virus on the ship.[22] The other study was of Marine Corps recruits who had been tested and placed in supervised quarantine. The study revealed asymptomatic transmission of the virus and certain asymptomatic recruits had high viral loads reflecting a high probability of potential contagiousness.[23]

On December 4, 2020 the Centers for Disease Control released their Morbidity and Mortality Weekly Report (MMWR) entitled *Summary of Guidance for Public Health Strategies to Address High Levels of Community Transmission of SARS-CoV-2 and Related Deaths, December 2020*. Upon seeing the surge of community infections, hospitalizations, and deaths in the fourth quarter of the year, they made a series of critical recommendations. Their opening summary could not have been more clear. "With colder weather, more time spent indoors, the ongoing U.S. holiday season, and silent spread of disease, with approximately 50% of transmission from asymptomatic persons, the United States has entered a phase of high-level transmission where a multipronged approach to implementing all evidence-

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based public health strategies at both the individual and community levels is essential." Their statement supporting universal mask use was as follows: "Compelling evidence now supports the benefits of cloth face masks for both source control (to protect others) and, to a lesser extent, protection of the wearer. To preserve the supply of N95 respirators for health care workers and other medical first responders, CDC recommends non-valved, multilayer cloth masks or nonmedical disposable masks for community use."[24]

Despite the recent CDC guidelines, there has been confusion in recent weeks about a Danish study published in Annals of Internal Medicine. Some media outlets claimed that the study showed that masks were ineffective at preventing the spread of COVID-19. This conclusion, however, is misleading, and led many large media outlets to label the study as misinformation. We wish to clarify any misunderstanding regarding this study. The study reported that their data showed that wearing masks did not protect wearers more than 50%, a finding that anti-mask advocates misinterpreted as stating that masks provide no benefit. However, the study explicitly stated that their overall results were in fact, inconclusive, although they showed a slight, statistically insignificant benefit to mask wearers. The authors stated that the results "should not be used to conclude that a recommendation for everyone to wear masks in the community would not be effective." The study had many several self-described limitations, including, "Inconclusive results, missing data, variable [mask wearing] adherence, patient reported findings on home tests, no blinding, and no assessment of whether masks could decrease disease transmission from mask wearers to others."[25] The study was also conducted in an environment with low transmission rates, and uncommon mask use by the general public. Masks are most effective when used properly by large portions of the population. In summary, the study does not show that masks are ineffective.

In their review article on June 3, 2020 in the *Annals of Internal Medicine*, Oran and Topel submit that "asymptomatic persons seem to account for approximately 40% to 45% of SARS-CoV-2 infections, and they can transmit the virus to others for an extended period, perhaps longer than 14 days".[26]

A typical sneeze may unleash as many as 40,000 droplets. These may carry virus particles that can not only cause direct spread to others but may land on surfaces we come in contact with all the time. A now frequently cited *New England Journal of Medicine* article[27] addressed the persistence of viable virus on high contact surfaces. The study also stated that virus can be suspended in the air and represent an aerosol risk. We are now watching this topic closely. A report from the *University of Nebraska* biocontainment experts [28] commissioned by the CDC address shedding of the virus by patients and found the same potential. Medical studies are addressing the distance that droplets can travel when someone sneezes. The NIH, CDC, and leading universities may continue to influence the national guidelines for the use of masks and modifications of social distancing[29].

A study published by the NIH and picked up by the press on May 13, 2020 reported that speech droplets generated by asymptomatic carriers of the coronavirus are increasingly considered a mode of disease transmission. The study found that loud speech can generate thousands of oral fluid droplets per

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second and that they can last in stagnant air for 8 to 14 minutes. The conclusion of the authors of the study was that these observations confirm a substantial probability that normal speaking causes airborne transmission in confined environments.[30]

On November 10, 2020, in its posted article entitled *Scientific Brief: Community Use of Cloth Masks to Control the Spread of SARS-CoV-2,* the CDC released recommendations for mask use to not only reduce spread by those who are infected, but protection of the non-infected wearer. "CDC recommends community use of masks, specifically non-valved, multi-layer cloth masks, to prevent transmission of SARS-CoV-2. Masks are primarily intended to reduce the emission of virus-laden droplets ("source control"), which is especially relevant for asymptomatic or pre-symptomatic infected wearers who feel well and may be unaware of their infectiousness to others, and who are estimated to account for more than 50% of transmissions. Masks also help reduce inhalation of these droplets by the wearer ("filtration for personal protection"). The community benefit of masking for SARS-CoV-2 control is due to the combination of these effects; individual prevention benefit increases with increasing numbers of people using masks consistently and correctly." The article continued: "A retrospective case-control study from Thailand documented that among more than 1,000 persons interviewed as part of contact tracing investigations, those who reported having always worn a mask during high-risk exposures experienced a greater than 70% reduced risk of acquiring infection compared with persons who did not wear masks under these circumstances."[31] The CDC conclusions were "Experimental and epidemiological data support community masking to reduce the spread of SARS-CoV-2. The prevention benefit of masking is derived from the combination of source control and personal protection for the mask wearer. The relationship between source control and personal protection is likely complementary and possibly synergistic, such that individual benefit increases with increasing community mask use."[32]

A Review of Masks

Dr. Atul Gawande, one of our leading patient safety champions, provides a great review of the science of masks and social distancing in his first in a series of New Yorker magazine articles entitled: *Amid the Coronavirus Crisis, A Regimen for Reentry* [33] on May 13, 2020. He cites a study in *Nature* [34] reporting that surgical masks block 99% of respiratory droplets expelled by people with coronaviruses or influenza viruses. The construction of the surgical masks is described as melt-blown polypropylene fiber fabric that looks like cotton candy under a microscope. Electrostatic charge is applied to the fabric which is one of the functions that captures the viruses. Dr. Gawande cites a study in *Disaster Medicine and Public Health Preparedness* [35] comparing surgical masks to cloth masks that showed that the surgical masks were three times better than cloth masks at blocking outward transmission of respiratory viruses. He further states that the benefit to the wearer may be limited. However laboratory research found they reduce inhalation of respiratory droplets by three quarters for the surgical masks and about half as much for the two layer cloth masks. [36] Lastly, Dr. Gawande references an extensive review of the research from an international consortium of scientists.[37] He suggests that if at least 60% of the population wear masks that were just 60%

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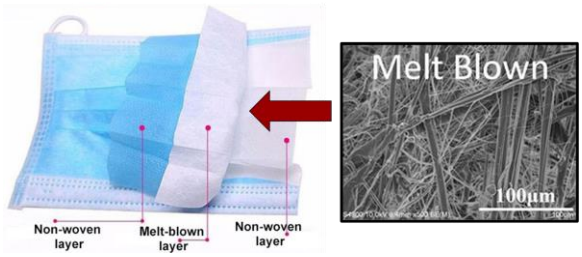
effective in blocking viral transmission which a well-fitting two-layer cotton mask can do, the epidemic could be stopped. The takeaway is that masks work to reduce transmission to the uninfected from both patients with known infections and those who are asymptomatic or pre-symptomatic. He proposes an expression regarding the basic logic: "I protect you…you protect me". We highly recommend everyone follow his series in the *New Yorker*.

An even more recent article published in the journal *Physics of Fluids* on December 22nd quantified the number of exhaled viral droplets that can pass through the various kinds of masks. In line with previous findings, the scientists reported that all masks drastically reduce the number of infectious droplets exhaled by the wearer: surgical masks block up to 99.94% of exhaled droplets, and cloth masks block up to 98.3% of droplets. Despite these excellent numbers, the journal also reported that because of the sheer volume of viral particles expelled when an infected person sneezes or coughs, it may be possible to exceed the infection threshold and deliver dangerous viral doses even while wearing a mask.[38] The numbers reported in this study were also generated in ideal conditions, which means they are likely overly optimistic. We point out two salient take-aways: firstly, though masks are a very effective tool, they are not an absolute solution and cannot substitute for social distancing. Secondly, it is important that everyone wears a mask; if an infected mask wearer is indeed able to deliver a dangerous viral dose, the mask of an uninfected wearer will minimize this risk because it reduces the number of inhaled droplets and therefore the number of viral particles delivered.

Surgical Mask Composition: Melt Blown Fibers



How Masks and HEPA Filters Work

We are often asked about how masks and HEPA filters (High Efficiency Particle Air filters) work. The science will help make sense of what we are hearing about masks in the press and the risk related to airflow on airlines. Masks work by a combination of filtration and electrostatic attraction that catch viruses. An electrostatic charge is put on N95 and surgical masks in the factories; this helps them catch germs by attraction. The plus is that this really works. The minus is that we have to be careful about how we might clean them for reuse in case the cleaning process removes the electrostatic charge.

N95 masks catch droplets and viruses with very refined filtration materials. They're specified to catch 95% of 0.3-micron particles--that's how they get their name. N95 masks are typically used in hospitals when caregivers are performing medical procedures with clear aerosol risk. They must be fit tested using a method defined by the manufacturers to make sure there is no leakage around the seal of the mask and the face. Due to the resistance they generate, especially without a fit test verification process, a surgical mask may offer more protection for the general public because more airflow may pass through the mask.

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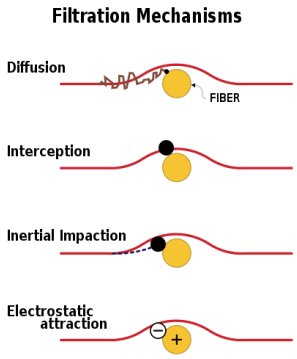
An N95 mask with a valve such as an industrial grade mask that lets airflow out will not afford protection to the public. Surgical masks catch droplets and viruses by both electrostatic attraction and filtration through the processes of physical interception and inertial impaction. These are just technical terms for how they physically catch the particles.



Cloth masks only catch droplets and viruses by filtration. That's why they're more breathable and less effective. HEPA filters, which are in airliners and in certain buildings, work by three processes: inertial impaction, interception, and diffusion; but not by electrostatic attraction. We merely cover the highlights of these processes in our film and provide more detail in our certification courses.

If you must care for a family member at home, remember to follow the directions of their caregiver. At first thought, it might seem like we would all want N95 masks. However, the public has no way to be adequately fit tested, there are not enough to go around, and our professional caregivers need them.

If you were to care for someone at home who is sick, remember that you want to reduce the dose or the number of virus particles you might absorb. Your best defenses are distance, speed, and barriers. Keep your distance from the patient, minimize the time in the same room or nearby, and properly use barriers--a mask is a barrier. A good quality surgical mask will offer real protection. Many of our caregivers use them to take care of patients who are positive for coronavirus in our hospitals. As you will see they provide more protection than cloth masks. Make sure the infected patient wears one also.

Summary Review for Certificate Candidates

The following summary review is for those of you who are seeking to do well on our certification courses. The same information applies to our medical, nursing, pharmacy, and college students, our professional first responders including law enforcement and lifeguards, our faith-based medical and security volunteers, our educators and schools at all levels, scout groups, teams and membership organizations and family seeking certificates to reduce insurance costs. The information we review will definitely end up on your quizzes and tests in our *CareUniversity* learning management platform.

In our film, we use the graphics adapted from Dr. Prather's excellent article to review the scientific evidence for surgical and cloth masks. We do so because these are the masks that are most likely in use by our families on a daily basis. We address maximum exposure and the risk of droplets that are greater than 5 microns in size. Historically, we believed such droplets fall only 3 to 6 feet away from the person infected. However, recent studies have shown that these large droplets may be propelled much further. Aerosols are less than 5 microns in size, and they float in the air. They can float much farther than 6 feet or 2 m. Aerosols may represent a large

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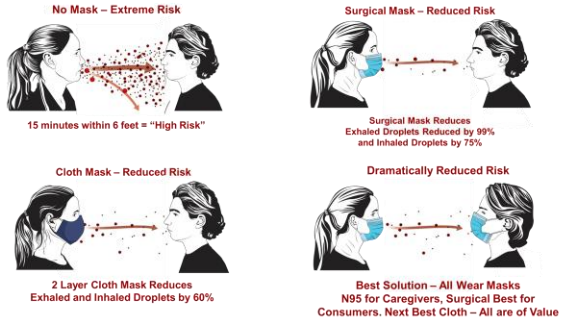
proportion of the spread from pre-symptomatic, and to a lesser degree, asymptomatic patients. When we talk about emitting virus particles in the air, we talk about viral shedding. Silent shedders are highly contagious before symptoms develop and their contagiousness peaks at the time of first symptoms. Speaking and breathing generate significant aerosols which put the public at risk. Social or physical distancing is based on studies of large respiratory droplets done in the 1930s prior to higher technology measuring capabilities. That's why we know that the 6 feet distance physical distance recommendation is probably a minimum. As we look back, airborne transmission was determined to have played a major role in the SARS outbreak in 2003. The SARS infection was transmitted greater than 6 feet from the index, or the first, patient infected according to the case studies.

As for minimizing exposure and risk, the N95 masks, surgical masks, and two-layer cloth masks all have value to both the wearer and the public. Yes, both the wearer and the public. The public health information here has been confusing and has evolved over time. There is much misinformation on the internet, however all of the leading scientists are in agreement that masks have value.

Every single country that has done well has implemented masks. In every country where the virus is out of control, masks have not been used across the population. Although it took time, the US coronavirus task force leadership acknowledged the value to both the wearer and the public of masks when there was a tremendous surge in multiple Southern states. It became very clear we needed them.

Dr. Debrorah L. Birx, the lead epidemiologist on the task force, made the following statement at a press conference in Texas: *"We know now that there is scientific evidence that masks both keep you from infecting others but may also partially protect you from getting infected."* [39]

In the words of Dr. Anthony Fauci at a congressional briefing: *"There is no doubt no doubt that wearing masks protects you and gets you to be protected"*. [40]



In our film summary review, we recap the evidence. Surgical masks block 99% of respiratory droplets expelled by people with coronavirus or influenza viruses. Surgical masks also reduce inhalation or breathing in of droplet size particles by 75%. Two-layer cloth masks reduce inhalation by half as much as the surgical masks and surgical masks are three times better than cloth masks at reducing expelled transmission of respiratory viruses.

It's interesting to know that if at least 60% of the population wear masks that are just 60% effective in blocking viral transmission-which a well-fitting two-layer cloth mask is, the epidemic could be stopped. A two-layer cloth mask reduces inhalation of the virus by half as much a surgical mask. Mask wearers were half as likely to get infected during the SARS outbreak.

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We have covered a lot of numbers and references in our film and this summary. We have done so to help our medical nursing and scientific colleagues know where the evidence originated. However, all the numbers start to swim together in our heads, and we need to reduce the evidence to action.

In closing, let's see if we can summarize what we can use that can properly inform our actions. The goal is to reduce the dose of virus we might breathe or absorb from others and the dose we might deliver to others. The dose is literally the number of viable viral particles to which anyone is exposed.

The most extreme risk to any of us is to be within 6 feet of an infected person for more than 15 minutes which was the first definition of a "close contact" by the Centers for Disease Control (CDC). On October 21 2020, the CDC modified their recommendations for a "close contact" requiring quarantine to be someone who was within 6 feet of an infected person for a ***cumulative*** total of 15 minutes or more over a 24-hour period, having provided direct care to someone infected and ill with COVID-19, someone who had direct physical contact such as having hugged or kissed the person, having shared eating or drinking utensils, or having had direct contact with respiratory droplets.[41] The longer you're close to somebody, breathing the same air, and touching the same surfaces, the more you are exposed. If you are in this high-risk group of having been within 6 feet of someone who has been infected, you may get a call from a contact tracer to notify you. This means you must quarantine or get a COVID-19 test to assure you are free of infection. Follow the CDC guidelines as to when you can discontinue quarantine, or isolation if you become infected.

When it comes to masks, at least wear a two-layer cloth mask. This likely reduces droplets you exhale and droplets you inhale, both by 60%. Although of great value, masks cannot replace social or physical distance. If you wear a surgical mask it will reduce droplets you exhale by 99% and droplets you inhale by 75%. The highest protection is with an N95 mask. However, as we have discussed, they need to be fit tested to deliver optimal performance. Professional caregivers have been given the priority for them. Many of our caregivers who are taking care of COVID-19 patients use good quality surgical masks in the hospital.

Dr. Scott Gottlieb, former FDA Commissioner wrote an op-ed article in the Wall Street Journal on November 22, 2020 entitled *Some Masks Will Protect You Better Than Others.* He affirmed that supply chains have relaxed somewhat allowing consumers to obtain medical procedure masks. He submits that a surgical mask offers more protection that a cloth mask. "A real medical-procedure mask will be cleared by the Food and Drug Administration and designated as offering one of three levels of protection. Generally, a level 2 or level 3 medical mask is best."[42]

If you need to care for a loved one at home, we agree that surgical masks are much better than cloth masks. As our patient safety hero Dr. Gawande has said, "I protect you, you protect me" is a great message. It is clear, however, that no matter what kind of mask you wear, if you use it properly, you'll have some protection. That in turn will help protect your family and those you love.

Charles Denham II MD, William Adcox, Charles Denham III, Jaime Yrastorza, and Gregory Botz MD FCCM

Messages to Key Constituencies

The following messages are not in the currently posted video. They are messages from each of the co-authors to their constituencies and members of our community of practice.

The message from our youth leaders to their friends and families is:

We all want to get back to a normal life and the fastest way to there is to wear masks and maintain our social distance. Think of the use of masks as an opportunity to help save lives in your community. You will influence those around you by your example. If we all pitch in on this issue, we can end the epidemic. The studies clearly show how masks work…so now you need to put them to work.

Charles R. Denham III

The message from our college and graduate student leaders to their families and friends:

One of the prevailing attitudes among my age cohort is that, because the risk of serious infection is comparatively low, masks and other social distancing techniques are an unnecessary inconvenience. Unfortunately, data shows that people of my age group are spreading the virus at alarming rates. Both as members of the community and as the future leaders of the nation, students and other young adults have an obligation to wear masks. This duty stems not only from concern for our individual health, but also from the personal responsibility we all must take in the health of the community. I would encourage all students and young adults to be leaders by encouraging their peers to social distance and wear a mask. Adopting the mindset that we are communally responsible for the well-being of others is critical in the fight against the virus.

Jaime T. Yrastorza

The message from our law enforcement leaders to their colleagues and their families is:

Police officers and their departments understand the real risk that COVID-19 presents to frontline essential personnel and their families. They understand how easy it is to become infected. Because of their professional role, police officers have little choice regarding contact with persons who might be infected. Many factors increase their risk for exposure and infection. This includes pandemic fatigue, increases in homelessness, increases in domestic violence, and growing mental health issues. And often this exposure involves persons who may not consistently follow the recommended public health measures like wearing masks, maintaining physical distance and following good hygiene practices. The appropriate wearing of masks is one of the most important actions officers and community members can do to protect themselves and others from exposure and potential infection. This combined with the other important prevention strategies are the cornerstones of pandemic safety. In law enforcement, we stress time, distance and shielding. As much as is practical, minimize time and exposure near someone who is unmasked. Maintain appropriate distance, at least six feet from the person(s) with whom you have made contact. And shield yourself with a mask and other means such as googles or face shields, gloves, etc. It is always better to be safe than sorry. And most importantly

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in these very stressful times, be considerate of each other.

William H. Adcox

The message from our higher education and clinical leaders to their colleagues, patients, and their families is:

Our Essential Critical Infrastructure Workforce, including healthcare providers and educators, stand at the frontline of the COVID-19 Pandemic. We endeavor to do our jobs safely and effectively, while maintaining the safety of our loved ones at home and in our communities. Following the well-tested public health measures – wearing masks, keeping distance, washing hands, and cleaning contact surfaces – is the mainstay for our safety as we work to understand and mitigate the risks of this deadly virus. Please remain vigilant! Continue to act as caregivers to your patients and their families, as well as your families. Be a role model for best practices based on data-driven evidence as the knowledge and understanding evolves. Spread the word about good educational materials, including this project, to collectively raise awareness in your communities.

Gregory H. Botz, MD, FCCM

The message to the public regarding our *Coronavirus Care Community of Practice* members is:

Please join our learning community. We have used the same *5 C Innovation Framework* for more than thirty years in patient safety with hospitals when we established original The Leapfrog Group survey and rating system, with technology companies such as Google, and leading innovators around the world. We continuously convene our current and new members, connect them through a common cause, celebrate what they bring to our joint work, co-create new solutions, and hopefully change care in their communities. We employ an "all teach – all learn" methodology and a "what can we do by Tuesday" mindset from the Institute for Healthcare Improvement. Join us to make the impossible the inevitable.

Charles R. Denham II MD

Final Reminders

We end our film with three quick final reminders. First is regarding the fit of the mask. If air is escaping around the edges of the mask, you are defeating its purpose. The better the seal, the better the protection. Second, don't touch the mask when it's on. When you remove it, do so by the straps and then wash your hands immediately. You can become contaminated by the very device that is meant to protect you. Third, do not be fooled by counterfeit masks that are flooding the market. Make sure if you're buying an N95 mask or surgical mask that they are approved for medical use. Purchase them from a trusted source.

A note on N95 masks versus KN95 masks: The N95 mask is the standard used in the United States while the KN95 mask refers to the standard in China. They both require filtration of 95% of small particles. On paper they appear the same, however in tests, many Chinese KN95 masks fail to meet the filtration standard.[43]

If you use cloth masks, make sure they are two layers thick and that they can work as a filter. Dr. Jerome Adams, the US Surgeon General, has produced a video to

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demonstrate a quick process to create one from folded fabric. Cloth masks should be made of closely woven fabric. If you hold them up to the sun and can see through them, they are not adequate.

When you consider using cloth barriers, keep in mind that Duke researchers found that neck fleece gators or bandanas offer very little protection.[44]

You may have the right masks, but it is critical that they are worn properly. A mask should completely cover the nose and mouth and should be tight around the ears or head to ensure a snug fit. Some of the most common mistakes are wearing them without a good fit and failing to cover both the nose and the mouth.

In our certification courses, we show how professional caregivers remove masks they will have to reuse after they've cared for someone with known COVID-19. We show how to store them for reuse and how to make them last.

We are watching leading organizations including the World Health Organization, National Institutes of Health, specialty organizations and the Centers for Disease Control for updates in their guidelines and will be updating our films and resources accordingly.

An expression we are using is: "Wear a mask - save a life". The life you save may be your own. For the professional caregivers, scientists, and anyone who wishes to review the evidence based medical and scientific articles that we cite in our films, we post them on our website. We hope they will be shared with families, friends and colleagues.

The message of Rick Warren, the bestselling author of *The Purpose Driven Life: What on Earth Am I Here For?*, is "I just want to say for your benefit and for the benefit of all your family and for everybody else around you please…please…please wear a mask right. It's not a political statement. It is a statement of unselfishness. It's a statement of love. It's a statement of responsibility and a statement of good stewardship. It's a statement of loving your neighbor as yourself."[45, 46]

Our prayers are with you as you proceed through this crisis. We want to express a special thank you to our critical infrastructure workers as well - may God bless you for all you are doing for us. We know you are putting your entire families at risk.

In closing, as we say to our Med Tac Bystander Rescue Care Teams - we have to fight the good fight, finish the race, and keep the faith.[47] Everyone IS a patient, and everyone CAN BE a caregiver.

For those who wish to watch our video by the same name as this article, please use the following QR code which will take you to our basic video modules. Click on Masks: The SCIENCE of Success.

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Chief William H. Adcox is a national leader in threat solutions development and threat safety science. It was his advisory input to the team that allowed them to expand their focus to the top eight causes of death of otherwise healthy people which is now the target of the Med Tac program. Without his mentorship, there would be no Med Tac program as it exists today. His continuous support of the Med Tac team is substantial, and he is a key contributor on national education programs and R&D with healthcare safety leaders. The Med Tac Law Enforcement program has been pioneered by Chief Adcox at the MD Anderson Cancer Center. The Pete Conrad Global Patient Safety Award recognizes these individual contributions to the Med Tac Program and his leadership service to the team. With 37 years in municipal and campus policing, he serves as the Chief of Police and CSO at The University of Texas MD Anderson Cancer Center and The University of Texas Health Science Center. He has hundreds of team members keeping more than 20,000 caregivers, educators, and students safe. Chief Adcox holds an MBA degree from UTEP and is a graduate of the PERF's Senior Management Institute for Police and the Wharton School ASIS Program for Security Executives. He is the recipient of the IACLEA's 2013 Award for Administrative Excellence and was named by Security Magazine as one of the "Most Influential People in Security 2013." The agency received the IHSS Foundation's prestigious 2015 Lindberg Bell Distinguished Program Award. Nationally, Chief Adcox received the Campus Safety 2015 Director of the Year Award in Healthcare; and locally he received the Texas Police Chiefs Association's 2015 Leadership Award. He is a founder and health security lead for the Global Emerging Threats Community of Practice launched with major Medical Centers. Chief Adcox is the law enforcement and security lead for the Coronavirus Care Community of Practice for critical infrastructure worker families and families in the general public launched by the Med Tac Global Bystander Rescue program to deal with the Coronavirus crisis. Chief Adcox serves as uncompensated consultant for the Med Tac Bystander Rescue Care Program at TMIT Global and these relationships have been disclosed to MD Anderson's Conflict of Interest Office.

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Gregory H. Botz, MD, FCCM, is a Professor of Anesthesiology and Critical Care at The University of Texas MD Anderson Cancer Center. He is also an Adjunct Clinical Professor of Anesthesiology at Stanford University School of Medicine. He inspired initial focus of the team on active shooter events, and it was his continuous inspiration that led to the development of Med Tac. It was also his inspiration and idea to develop the CARE Huddle Checklist. He is the lead clinical content expert for the Med Tac program. He is a recipient of The Pete Conrad Patient Safety Award, recognizing these individual contributions to the Med Tac Program and his leadership service to the team. He received his medical degree from The George Washington University School of Medicine in Washington, DC. He completed an internship in internal medicine at Huntington Memorial Hospital, and then completed an anesthesiology residency followed by critical care medicine and medical simulation fellowships at Stanford University in California. He previously served on the faculty at Duke University School of Medicine. Dr. Botz is a 2004 graduate of the Intermountain Healthcare Advanced Training Program in Health Care Delivery Improvement. He has served as the University of Texas Chancellor's Health Fellow in Quality of Care and Patient Safety. Dr. Botz was previously medical director of the ICU, Transfer Center, Acute Care Training Center, Simulation Center, Code Blue Team Operations and the Medical Emergency Rapid Intervention Team at MD Anderson Cancer Center. As a clinician-educator, Dr. Botz serves as a national consultant for the Society of Critical Care Medicine Fundamentals training programs. He was a senior editor for the American Board of Anesthesiology Joint Council on Anesthesiology Examinations, program director for the UTHSC-Houston Anesthesiology Critical Care Medicine Fellowship, Regional

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Faculty for the American Heart Association Emergency Cardiovascular Care training programs and a member of The University of Texas System Health Care Components ICU Quality Improvement Collaborative. He has participated in SCCM education programs in collaboration with the Japanese Society of Intensive Care Medicine, the Saudi Critical Care Society, the Indian Society of Critical Care Medicine, and the Association of Intensive Medicine in Brazil (AMIB). He is a founder and health security lead for the Global Emerging Threats Community of Practice launched with major Medical Centers. Dr. Botz is the clinical lead for the Coronavirus Care Community of Practice launched by the Med Tac Global Bystander Rescue program for critical infrastructure workers and families, as well as the general public, to deal with the Coronavirus Pandemic. Dr. Gregory Botz serves Med Tac as an uncompensated consultant and this relationship has been disclosed to MD Anderson's Conflict of Interest Office.

Charles (Charlie) R. Denham III
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Scouts Program
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Charlie Denham is a high school student who lives in Southern California. As a Cub Scout he aspired to undertake an Eagle Scout Project before becoming a boy scout. Undeterred, he undertook development Med Tac for scouts as an independent service project. He and his father developed the program and tested the CARE Huddle Checklist with his own Cub Scout den, his flag football team, and then his school with a wonderful teacher who was an Eagle Scout and Cub Scout leader. Together starting in 2015 they verified that the knowledge about high impact care hazards and that bystander lifeline behaviors can be learned by children as young as third graders through multiple Med Tac after school and summer school programs. Charlie is a 2018 Pete Conrad Global Patient Safety Award winner for co-founding Med Tac and his role in pioneering the program for schools, churches, and scout groups after presenting the program at an innovation summit at the NASA Kennedy Space Center. Charlie is commonly seen in the Med Tac training videos and as a speaker in Med Tac national broadcasts designed to reach his age group. He has learned the value of Bystander Care through the experiences he has had during Junior Lifeguard training and his participation in competitive climbing, fencing, flag football, surfing, and on Scout adventures. He is participating on the multi-generational Med Tac team to develop its Survive & Thrive programs to deal with the coronavirus crisis and co-leads our scout education initiatives. He is a co-author of many of our Med Tac related articles and is developing a KIDLEADERS program for school children. He co-developed the Holiday Lifeguard Program to deal with the Coronavirus Crisis and family infection transmission chains during the Q4 surge of 2020. An avid waterman, he was certified as one of the youngest PADI Rescue Divers in the nation. An aspiring competitive surfer, he is a Junior Med Tac Instructor and helps lead the Med Tac Divers and Lifeguard-Surf Programs in California and Hawaii. His Med Tac Rescue Station Eagle Scout project placed rescue stations with Automated External Defibrillators and trauma care supplies at a California beach. It was the first of a number of such placements and spawned the development of the Med Tac Eagle Squadron of Eagle Scout candidates who are placing rescue stations at Southern California beaches to reduce resuscitation times to "3 Minutes from Drop to Shock". As a co-founder of Med Tac, he has had the opportunity as a junior instructor to teach at Stanford University, in his own school, and scouting community.

Jaime Yrastorza
Pre-med Student
Assistant Producer
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Jaime Yrastorza recently graduated from the University of California, San Diego with a major in molecular biology and a minor in chemistry. He researched the gene-environment interaction in cancer cell metastasis while at UCSD and is currently applying to medical schools. He is an assistant producer with the Coronavirus Care Community of Practice and is a co-author of multiple Med Tac Survive & Thrive Guides including Masks: The SCIENCE of Success. He is helping produce Med Tac Continuing Education programs which deliver certification hours of professional caregivers to fulfill their licensure requirements. He is involved in the Med Tac Family Rescue Education R&D

programs with multiple leading medical centers. Jaime is a frequent national speaker on Med Tac broadcasts for college students and young adults. He was a speaker with the Med Tac Team at a Campus Safety Summit hosted by Campus Safety Magazine. He and has been certified both by the AHA Heartsaver CPR/AED program and by the American College of Surgeon's STOP THE BLEED® program. He is an Eagle Scout from Troop 22 in Lincoln, Nebraska.

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Chairman, TMIT Global
Austin, TX

Dr. Denham initially funded Med Tac and leads its development. He has served hundreds of innovation teams during his 35 year career. While in practice as a radiation oncologist, he taught biomedical engineering and product development at the University of Texas at Austin. Together with Dr. Gregory Botz and Chief William Adcox of MD Anderson Cancer Center, he is developing and testing the Med Tac innovations. He is a 2018 Pete Conrad Global Patient Safety Award winner for co-founding Med Tac and his role in pioneering the program for schools, churches, and scout groups. Dr. Denham is a co-founder of the Global Emerging Threats Community of Practice launched with major Medical Centers. When the COVID-19 crisis hit his family decided to fund a Coronavirus Crisis Community of Practice to help Essential Critical Infrastructure Workforce families. Monthly live 90 minute webinars, videos, print articles, and curated resources are now provided at https://www.medtacglobal.org/coronavirus-response/. Dr. Denham has taught innovation adoption, technology transfer, and commercialization in both academia and industry. He has been an adjunct Professor of Health Services Engineering at the *Mayo Clinic College of Medicine* and had teaching appointments as an Instructor at the *Harvard School of Public Health* and as a Lecturer with the faculty of *Harvard Medical School*. He was a *Harvard Advanced Leadership Initiative* Fellow in 2009 and a senior Fellow in 2010 and 2011. His work there led to the production of two global documentaries on the *Discovery Channel*. He has served as Editor-in-Chief of the global *Journal of Patient Safety and* has more than 100 works including peer-reviewed papers and multimedia productions. He has been ranked in the top 50 Most Influential Physician Executives by *Modern Healthcare* in multiple years, and he has served as a regular columnist for *The Wall Street Journal* program The Experts: Journal Reports. Dr. Denham is an advisor to and collaborator with a number of *Stanford University* programs. He founded what became HCC Global Corporation, a for-profit innovation incubator, and TMIT Global, a non-profit 501c3 medical research organization, in the early '80s. The organizations work collaboratively on common innovation programs. He developed *CareUniversity*, the content engine and learning delivery system for consumers and caregivers serving Med Tac. His current R&D is in Threat Safety Science targeting reduction in preventable harm to families, caregivers, and institutions. His focus in communities is bystander rescue care through Med Tac. Med Tac is leading a multi-institutional study of families of essential critical infrastructure workers and the public to identify how to break family COVID-19 infection transmission chains. His focus in healthcare institutions is caregiver and patient harm from errors, fraud, and conflict of interest. Dr. Denham is a scout leader, certified PADI Rescue Diver, and BSA certified Lifeguard.