

How Has the COVID Pandemic Changed the Future of Health Care?

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Objectives

- Early Response to Pandemic
- Lessons Learned
- Telemedicine
- Changes in the ICU
- Changes in Healthcare Overall



Early Response to the Pandemic

Early Response to the Pandemic

- **December 29, 2019:** a hospital in Wuhan, Hubei Province, China reported an outbreak of **severe unexplained viral pneumonia**
- **January 8, 2020:** pathogen identified as a novel coronavirus 2019 (2019-nCoV), and its gene sequence was submitted to WHO
- **January 30, 2020:** WHO declares the outbreak of the 2019-nCoV as a public health emergency of international concern
- **February 12, 2020:** 2019-nCoV was officially named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and WHO officially declares the disease caused by SARS-CoV-2 coronavirus disease of 2019 (COVID-19)
- **March 11, 2020:** Declared world pandemic by WHO

Early Response to the Pandemic

- The SARS-CoV-2 has close similarity to bat coronaviruses (96.2% similarity) and it has been postulated that bats are the primary source and the origin is still being investigated.
- Patients' initial clinical manifestations included **fever, nonproductive cough, dyspnea**, myalgia, fatigue, normal or decreased leukocyte counts, and radiographic evidence of pneumonia.
- Found initially to more likely to affect older men with comorbidities (HTN, DM, Cardiovascular disease, malignancy) and could result in ARDS
- The median durations from first symptoms to dyspnea, hospital admission, and ARDS were **5 days** (IQR, 1-10), **7 days** (IQR, 4-8), and **8 days** (IQR, 6-12), respectively

Zhou P, Yang X-L, Wang X-G, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature 2020;579:270-3.
Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. JAMA. 2020;323(11):1061-1069.
Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study, January 29, 2020. Lancet.

Early Response to the Pandemic

- S-Protein binds to angiotensin converting enzyme type 2 (**ACE2**)
 - Similar to SARS-CoV-1, the spike (S) protein enables SARS-CoV-2 to identify ACE2 receptors in the mucosal epithelium and invade.
- Although SARS-CoV-2, SARS-CoV-1 and MERS coronaviruses belong to the same large family of coronaviruses, their genetic characteristics are significantly different.
- Two different phylogenetic types of SARS-CoV-2 have been identified
 - L Type: 70% of strains (mainly found in Wuhan, China)
 - S Type: 30% of strains (mainly found outside of Wuhan, China)
- Transmission of SARS-CoV-2 is through **respiratory droplets** and **contact**. It has also been confirmed that live virus and virus nucleic acid can be detected in **human stool**
- SARS-CoV-2 can be **aerosolized** in certain conditions under a prolonged exposure in a **relatively closed environment**

Jin H, Hong C, Chen S, et al. Consensus for prevention and management of coronavirus disease 2019 (COVID-19) for neurologists. Stroke & Vascular Neurology 2020;0

Early Response to the Pandemic



“Stay at home order”

Early Response to the Pandemic



Early Response to the Pandemic

- “No emergency in a pandemic”
 - PPE prior to entering room
 - Place towel, sheet or pillow cover over patient’s face if not intubated
 - Hands only CPR, no bagging or ventilating
- “Need more ventilators”
- “Need more PPE”

Utilization of PPE

- Rapid learning curve to broader utilization of PPE
- New innovative PPE



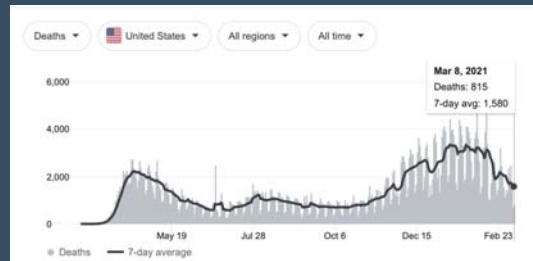
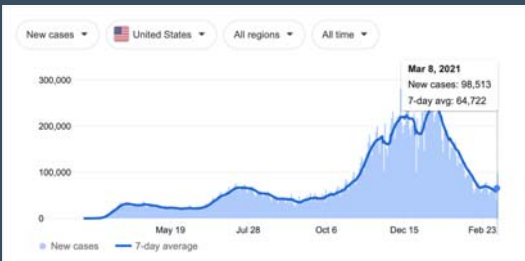
Early Response to the Pandemic

- Systemic corticosteroids were **not recommended** unless in severe sepsis or in COPD exacerbation for fear of worsening viral response
- Inappropriate administration of antibiotics avoided
- Hydroxychloroquine used commonly
- Lopinavir/ritonavir (protease inh) was widely used

Early Response

- Tocilizumab used for cytokine storming
- Remdesivir (GS5734) was being trialed as a RNA polymerase inhibitor
- Vaccine manufacturing began by Moderna and Bio-N-Tech (Pfizer) in January 2020 once genomic sequence was sent to their labs

Early Response



- Early on it was less political, more medically and scientifically based response. “#inthisogether”
- After second wave (July), it seems there was a wave of complacency set in with restrictive measures leading to rapid rate increase in November/December/January

Lessons Learned

Science Matters



PPE

- COVID-19 was thought to have **droplet** and **contact** spread
- It was not known how long or how extensively COVID-19 is **aerosolized** – was under investigation
- Now known that COVID-19 probably was more aerosolized than previously thought (less contact spread) which lead to numerous “superspreader” events

Lessons Learned

- “Contaminated surfaces are the highest risk for COVID-19 transmission”
 - Was a common belief in the beginning of the pandemic
 - A number of surfaces were continuously cleaned / contact spread may have been over emphasized
 - the chance of transmission through inanimate surfaces is very small, and only in instances where an infected person coughs or sneezes on the surface, and someone else touches that surface soon after the cough or sneeze (within 1–2 h)

Lancet Infect Dis. 2020 Aug; 20(8): 892–893.

Lessons Learned

- Research studies are further confirming that people should have focused on wearing appropriate masks and physical distancing
- When sanitizing surfaces, most cleaners require you to wipe off only after 1-10 minutes of spraying

Lessons Learned

- Who gets severe COVID-19 infection?
 - More likely in:
 - Obese
 - Hypertensive
 - Pregnant
 - Those with pre-existing lung disease
 - Those with pre-existing severe end-organ medical conditions (stroke, heart attack, etc)

Lessons Learned

- Patients may be hypoxic and asymptomatic
 - A number of patients with COVID-19 remained asymptomatic with sats in the 70s– 80s.
“Happy Hypoxia”
 - Several of these patients rapidly deteriorated on ambulation

Lessons Learned

- “Any mask will decrease the spread of COVID-19”
 - In the initial outbreak phase of the disease, mask use was initially discouraged by the CDC
 - In the second phase, it was established that “any mask” would decrease the spread
 - “Mask hysteria” hit and people were wearing several different types of masks

Lessons Learned



Surgical Masks
Cloth Masks
N95, Respirators
Bandanas, Neck Gaiters
Masks with Filter Ports

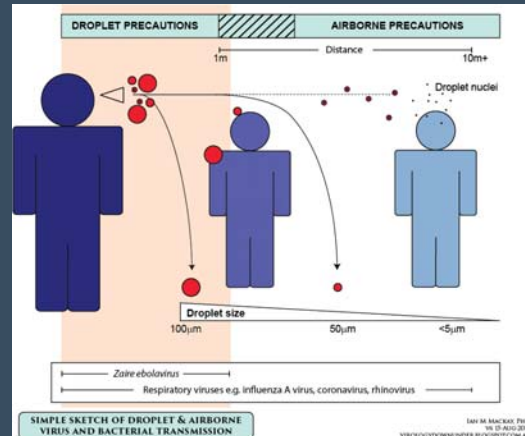


Personal Protective Equipment (PPE)

Droplets: larger particles released during speech, coughing, sneezing that someone standing nearby (< 6 ft) can directly inhale and get infected. These fall out of the air quite rapidly

Aerosol: smaller particles, linger in air longer, remain suspended for longer period of time, can travel farther (worse during CPR, intubation, bronch)

Contact: Both aerosols and droplets reach a surface and this is touched and brought to a mucous membrane



PPE

- **N95 Respirator Mask:** N95 designation means that when subjected to careful testing, the respirator blocks at least 95 percent of very small (0.3 micron) test particles. Must be fitted to your face. [protects from **aerosol** and **droplets**]
- **Surgical Mask:** A surgical mask is meant to help block large-particle droplets, splashes, sprays, or splatter that may contain germs (viruses and bacteria), keeping it from reaching your mouth and nose. Surgical masks may also help reduce exposure of your saliva and respiratory secretions to others. [protects mainly from **droplets**]



3M Disposable Welding Respirator technology

- The cake-resistant fiber media helps prevent buildup on the respirator, providing longer respirator life. (Does not apply to the 3M 8505)
- Welding web is flame resistant per modified ASTM D2859. (Not a substitute for a face shield)
- Advanced Electrostatic Media (AEM) technology enhances airflow through the material.
- The proprietary 3M™ Cool Flow™ Valve helps reduce heat buildup inside the respirator.

Lessons Learned

- What type of mask should we wear? How about the general public?
 - As mounting evidence comes out, it seems the coronavirus is spread by droplet and aerosol more than other ways. The answer is likely an N95 or full respirator mask would be the most protective to prevent both COVID-19 transmission and acquisition. *limited supply
 - Surgical masks and cloth masks reduce some transmission, however are far less effective than N95/Respirator and provide much less protection from acquisition
 - Bandanas, neck gaiters are better than nothing, but only reduce transmission by about 50% or less
 - Respirators with valves are not recommended – can cause aerosolization

Ongoing Response to COVID-19 in the
ICU Today

Ongoing Response to COVID-19 in ICU Today



Medications

- Hydroxychloroquine **not** routinely recommended
- Ritonavir/Lopinavir **not** routinely recommended

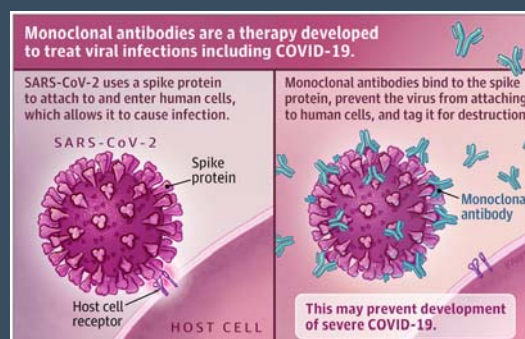
Medications

- Currently the only two medications fully utilized for treatment of COVID-19 in the ICU are **Remdesivir** and **Dexamethasone**
- **Casirivimab** and **imdevimab** were released in November 2020 as monoclonal antibodies to help fight COVID 19 and at high risk to develop severe COVID (“Regeneron” cocktail)

Monoclonal Antibodies

Bamlanivimab and casirivimab/imdevimab

“looked at benefits of bamlanivimab (LY-CoV555 - Lilly) and casirivimab/imdevimab (REGN-CoV2 - Regeneron) at multiple dose regimens (1,2). Though reduction in viral load was shown, there was no clinically meaningful effect. The statement that “early data suggest greater benefit in high-risk patients” is therefore **not supported** by available evidence”

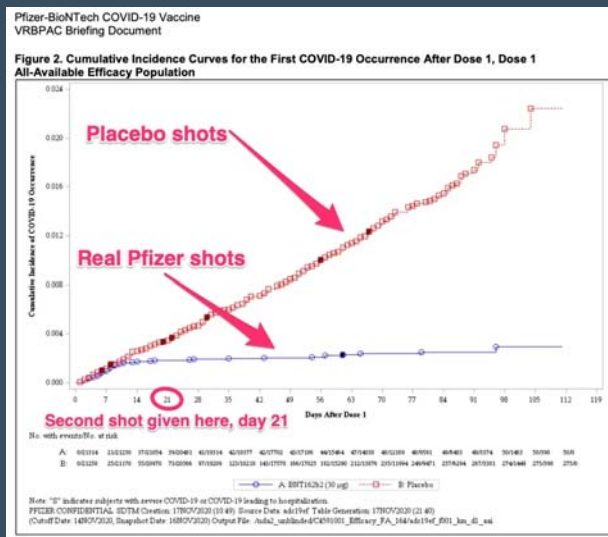


JAMA. 2021;325(10):1015

Vaccine Trials

- Trials of mRNA type vaccines have exemplary initial reports:
 - Moderna up to 94% effective
 - Pfizer up to 95% effective
- Both released under Emergency Use Authorization in December 2020
- J&J just got EUA for their vaccine

Vaccine Trials



The Future of Healthcare

Changes Since COVID

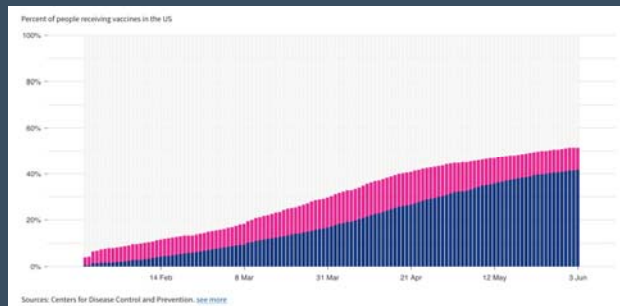
- > 596,000 COVID related deaths in US
- 33.3 Million Cases in the US alone



- Jobs lost in excess of 114 million (2020)

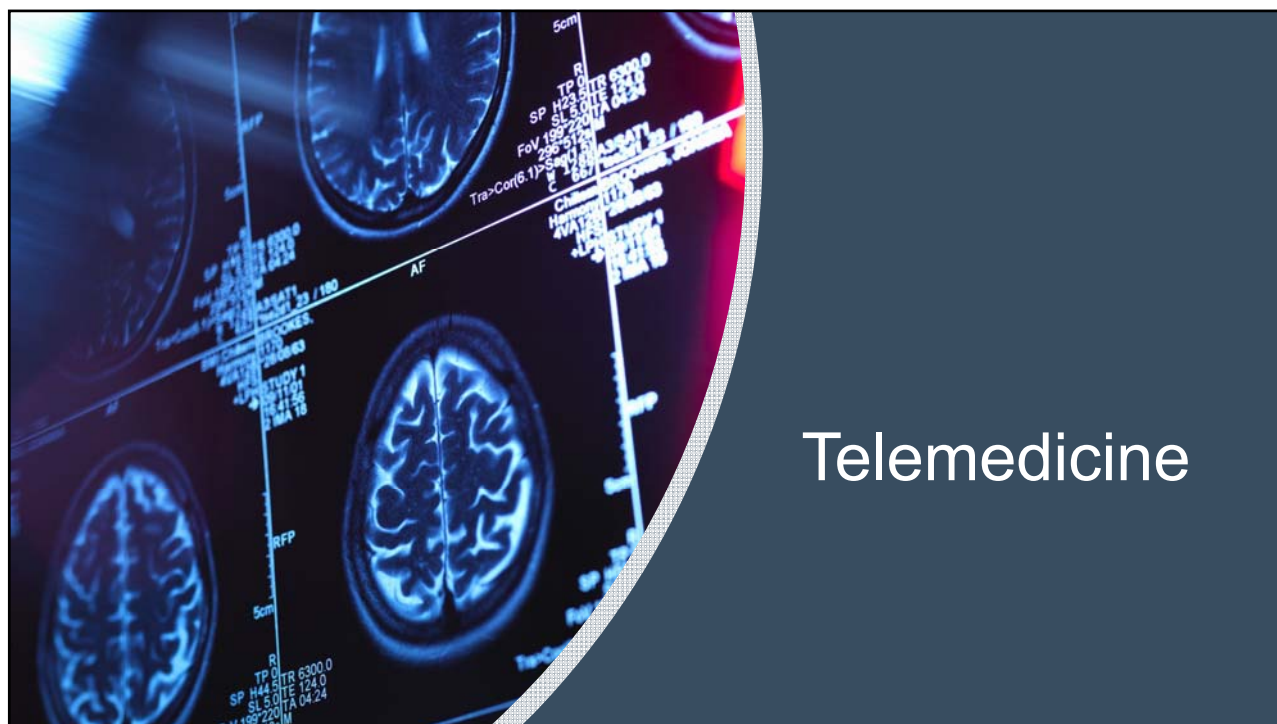
Changes since COVID

- About a 42% of the country is fully vaccinated and a little more than 1/2 of the country has at least one shot



“COVID Long Haulers”

- For those with chronic COVID-19 symptoms (“Long Haulers”)
 - Have symptoms lasting into 3 months, even without severe disease
 - “Brain Fog”
 - Heart Disease, chronic hypercoaguability
 - Recovery Clinics
 - Biobanking samples of blood, tissue, CSF



Telemedicine

Telemedicine

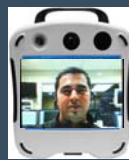
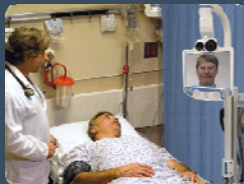
- The utilization of telemedicine and virtual visits skyrocketed during the pandemic
- Pre-COVID roughly 2% of ambulatory visits were virtual
- In May 2020: 65 – 75% of visits were virtual
- Currently: Virtual visits make up about 20% of all visits, number is dropping slowly

Reasons for Telemedicine

- Improves access to healthcare for patients
- Convenient for patients
- Infection control
- Specialty care consultation which can reduce hospital transfer of patients
- Potential for cost reduction in healthcare

Spectrum of Telemedicine

- Outpatient services on a patient's smartphone, tablet, or computer
- Acute/ED subspecialty consults






Telemedicine Applications

Synchronous	Asynchronous			
				
Outpatient, Inpatient, Acute Virtual Visits	Remote Patient Monitoring	Clinical Apps	Remote Imaging Upload	Online 2 nd Opinions

Express Care Online

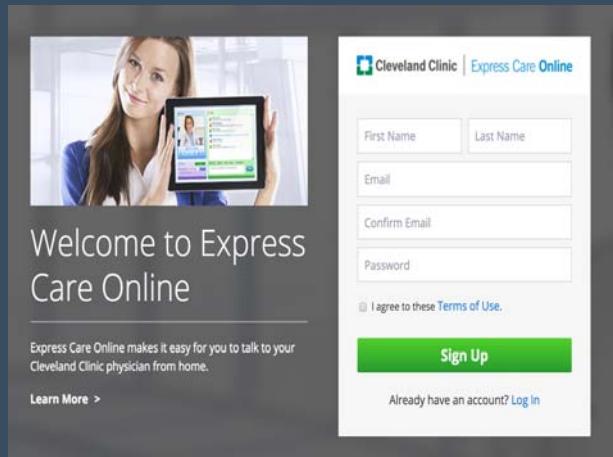
- American Well Online Care Group (OCG) “skype-like” visits across 50 states
- Cleveland Clinic joined OCG in 2015 to launch Express Care Online

Access Anytime Anywhere
Nationally leading care for every day? Why not? See how easy we've made it for you.

		
Click in. Use your laptop, tablet or smart phone to instantly connect yourself with Cleveland Clinic adult and pediatric care. Express Care Online (not available) Requires an appointment online. MyConsult (online specialist second opinion). MyChart	Walk in. No appointment is needed for these services. Our expert caregivers are standing by, ready to help you. Express Care Clinic Urgent Care Emergency Departments Multispecialty Shared Services	Call in. Call today for an appointment today. Standing appointments at area locations. 888.223.CARE Pediatrics 216.444.KIDS

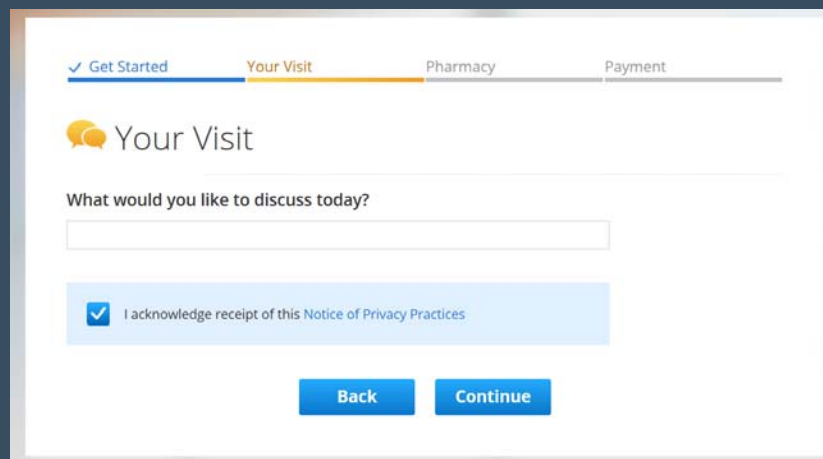
Express Care Online

- 24/7, 365 days on demand access
- Pre-schedule video visits
- Can be anywhere to connect



The screenshot shows the Cleveland Clinic Express Care Online sign-up page. On the left, there is a photo of a woman holding a tablet displaying a video chat interface. Below the photo, the text reads: "Welcome to Express Care Online". Underneath, it says: "Express Care Online makes it easy for you to talk to your Cleveland Clinic physician from home." and "Learn More >". On the right, there is a registration form with the following fields: "First Name", "Last Name", "Email", "Confirm Email", and "Password". Below the form, there is a checkbox for "I agree to these Terms of Use." and a green "Sign Up" button. At the bottom right, there is a link: "Already have an account? Log In".

Intake Sheet



The screenshot shows the Cleveland Clinic Express Care Online intake sheet. At the top, there is a progress bar with four steps: "Get Started" (checked), "Your Visit" (highlighted), "Pharmacy", and "Payment". Below the progress bar, there is a section titled "Your Visit" with a speech bubble icon. The text asks: "What would you like to discuss today?" and there is a text input field. Below the input field, there is a checkbox with a checkmark and the text: "I acknowledge receipt of this Notice of Privacy Practices". At the bottom, there are two buttons: "Back" and "Continue".

Intake Sheet

✓ Get Started **Your Visit** Pharmacy Payment

Medical History (optional)

CONDITIONS Have you ever been diagnosed with any of the following conditions?

<input type="checkbox"/> Alcoholism/Cirrhosis	<input type="checkbox"/> Gout
<input type="checkbox"/> Allergies	<input type="checkbox"/> Headaches
<input type="checkbox"/> Anxiety	<input type="checkbox"/> Hearing Loss
<input type="checkbox"/> Arthritis	<input type="checkbox"/> Heart Disease
<input type="checkbox"/> Asthma	<input type="checkbox"/> Heartburn, Reflux
<input type="checkbox"/> Atrial Fibrillation	<input type="checkbox"/> High Blood Pressure/Hypertension
<input type="checkbox"/> Attention Deficit Disorder	<input type="checkbox"/> High Cholesterol
<input type="checkbox"/> Back Pain	<input type="checkbox"/> Immune Deficiency
<input type="checkbox"/> Bipolar Disorder	<input type="checkbox"/> Incontinence
<input type="checkbox"/> Blood Clots	<input type="checkbox"/> Inflammatory Bowel Disease (Crohn's Disease/Ulcerative Colitis)
<input type="checkbox"/> Breast Disease	<input type="checkbox"/> Irritable Bowel Syndrome
<input type="checkbox"/> Cancer	<input type="checkbox"/> Kidney Stones
<input type="checkbox"/> Chronic Fatigue Syndrome	<input type="checkbox"/> Macular Degeneration

Intake Sheet

ALLERGIES Are you allergic to any of the following medications?

<input type="checkbox"/> Cephalosporins (Omnicef, Keflex, Ceftin)	<input type="checkbox"/> Penicillins (Amoxicillin, Ampicillin)
<input type="checkbox"/> Dilantin (Phenytoin)	<input type="checkbox"/> Sulfa (Bactrim, Septra)
<input type="checkbox"/> Hydrocodone, Codeine	<input type="checkbox"/> Tegretol (Carbamazepine)
<input type="checkbox"/> Insulins	<input type="checkbox"/> Tetracyclines (Minocycline, Doxycycline)
<input type="checkbox"/> Non-steroidal anti-inflammatories (Ibuprofen, Naproxen)	

MEDICATIONS Are you currently taking any medications?

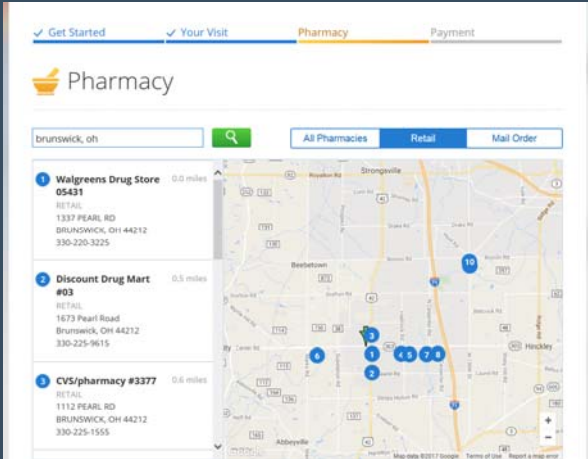
Enter Medication Name

VITALS Do you know your current vitals?

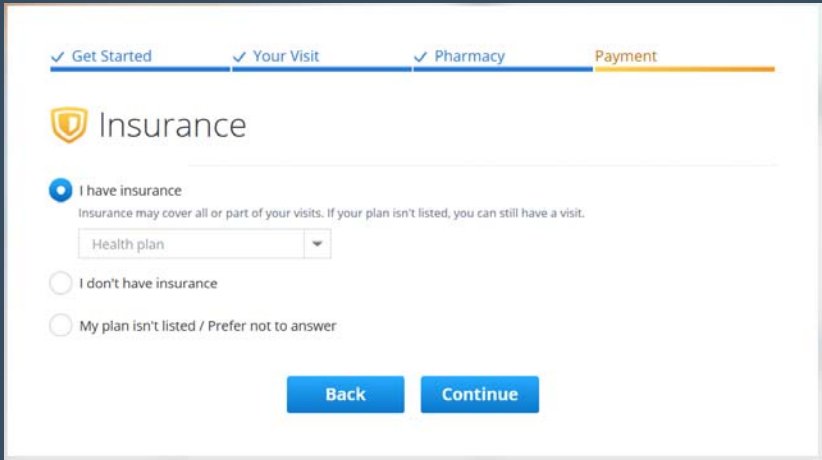
Blood Pressure	Temperature	Weight
Systolic <input type="text"/> mmHg	<input type="text"/> °F	<input type="text"/> lbs
Diastolic <input type="text"/> mmHg		

SHARE A FILE Would you like to share a photo, lab result, or other information with your provider?

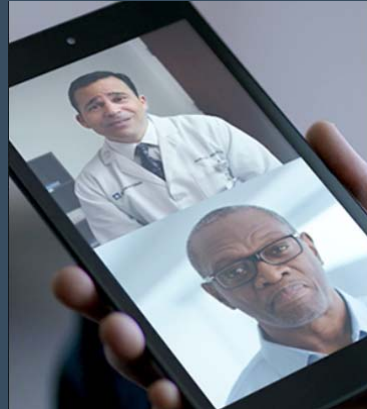
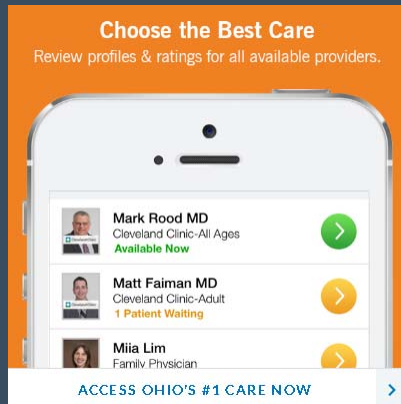
Select a Pharmacy



Payment



Connect



Webside Manner

- Dress professionally
 - Avoid wearing patterns
- Look into your camera lens in order to appear that you are making eye contact
- Use a private office space
- Let the patient log off first



Concerns Regarding Telemedicine

- Lack of Physical Exam/Diagnosis Limitations
- Treatment Limitations
 - Remember telehealth is a **tool!**
 - Need to use the right tool for the patient (**can't deliver a baby virtually**)
- Reimbursement

Tele-ICU Rounding / Use during Pandemic

- A number of both patients as well as healthcare workers were getting sick from COVID-19
- Our traditional ICU rounding team is made up of trainees (residents, fellows, visiting students, etc.) and we need to review imaging and go from patient to patient
- Issues with Narrow halls, small rooms

Tele-ICU Rounding / Use during Pandemic



Tele-ICU Rounding / Use during Pandemic

- Some team members could still round at the bedside



Tele-ICU Rounding / Use during Pandemic

- We would collaborate:
 - Residents, APPs
 - Fellows
 - Staff Attending
 - Pharmacy
 - Case Management/Social Work
 - Nursing
 - Students

Tele-ICU Rounding / Use during Pandemic

- We utilized a combination of tablets and computers to set up meetings where multi-disciplinary teams could meet



ICU Rounding

- As numbers have continued to drop, rounding teams have come back to the bedside
- Family members are also back at the bedside
- Teaching students resuming

Meetings

- Most have gone virtual
- New platforms have developed allowing healthcare delivery teams to collaborate across several centers
- Meetings which once were all in person have now converted



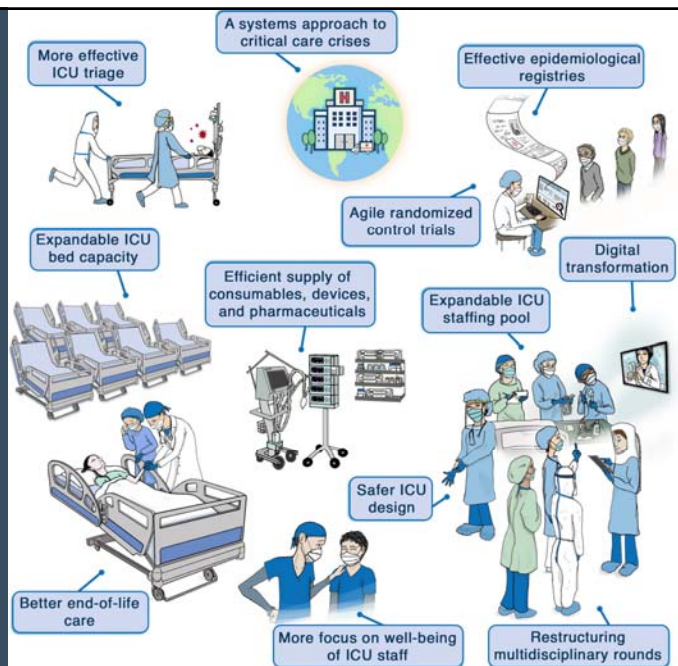
Critical Care

Changes to Critical Care

- Highlighted elements of emergency preparedness:
 - Strategic reserves of PPE
 - Strategic reserves of ICU Devices
 - Strategic reserves of consumables and pharmaceuticals
 - New staffing models that allow for surges of demand

Changes to Critical Care

- As a reflection of what we have learned, it is important to recognize what worked and what did not.
 - Looking at Restructuring rounds
 - Focus on well-being of ICU staff
 - Better End of Life Care



Changes to Critical Care

- Focus on system-wide delivery model
 - Relaxing and tightening ICU admission/discharge criteria to spread disease burden optimally across hospital systems
 - Decreasing elective surgeries as needed while minimizing negative effects
 - Creation of “Command Centers” for system-wide triaging and patient flow

Changes to Critical Care

- The need for ICU beds and ventilators was noted even from the earliest points in the pandemic
 - Various makeshift approaches to expand ICU capacity were utilized
 - Several logistical challenges
- ICU strain was linked to a higher proportion of COVID deaths

Changes to Critical Care

- Creation of “silent ICU” units
 - Emergency Rooms
 - PACU
 - Regular wards with enhanced capability as needed
 - These units could be converted back to their original function
- Key requirement is flexibility

Changes to Critical Care

- Safer ICU Designs
 - Single rooms vs Shared rooms – single offer lower likelihood of cross-contamination, but are not available everywhere
 - Closed off rooms may increase patient risk due to reduced visibility
 - Cohorting Units

Changes to Critical Care

- Safer ICU Design
 - Movement of patient equipment (ventilators, or just ventilator control boards) and pumps outside of the room
 - Artificial Intelligence algorithms used to manage some vasopressors and other drips

Changes to Critical Care

- Staffing
 - ICU nurse shortage
 - Intensivist shortage

Area	Strategy	Drawbacks
ICU staff	Increase the number of patients per staff Cancel vacations Increase the working hours Redeploy trained ICU staff (retired/working in other areas)	These solutions may be used as a short-term solution, but they are likely to increase the risk of complications and burnout
Hospital staff	Use of non-ICU staff to reinforce ICU staff with training provided* Re-distribution of tasks: e.g. interventional radiologists to manage line insertions, anesthesiologists to provide airway management Scale down non-essential activities such as elective surgeries and redeploy staff to ICU	Unintended consequences including patient harm can result from delays in routine care [28, 30, 76, 77]
Non-hospital staff	Deployment of HCWs from other hospitals in the city or other cities	Not feasible in all settings
Other approaches	Transfer patients from less-resourced to better-resourced hospitals	

Consider "uptraining" a pool of non-ICU staff (physicians and nurses) who can assist during surges with a tiered approach (consider staffing from anesthesiology, emergency medicine, general medicine, and hospital medicine)

Changes to Critical Care

- Well-being of Critical Care Staff
 - Transient acknowledgement of healthcare workers by public has been a positive aspect
 - 10% of COVID cases in the peak were among healthcare workers
 - Burnout was already prevalent, and this increased during pandemic with anxiety, depression and severe burnout near half of the intensivists population

Changes to Critical Care

- Well-Being of the Critical Care Staff
 - Moral Distress
 - Discrimination by the lay public against healthcare workers
 - Continual change PPE requirements and compliance with infection control practices

Changes to Critical Care

- Communication with Families
 - During pandemic, no families in rooms, patients dying alone
 - New video conferencing available
 - Now, family can be at bedside, and video conferencing also available



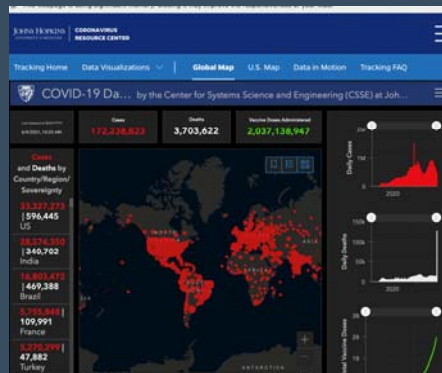
Overall Care

Changes to Overall Care

- Digital Transformation:
 - Wireless Monitoring
 - Remote monitoring technologies
- Deep learning models have been created:
 - COVNet – created to extract visual features from chest CTs
 - Can we use this to assist with future medical decisions and design treatments?

Changes to Overall Care

- Rapid creation of epidemiological registries



Health Insurance

- Resurgent push to nationalized or “universal” health care
- Employers are looking more towards health reimbursement arrangements (?more flexibility, ?less help)

Racial Disparity

- High proportion of African American and other minority populations with high death rate.
- Increased studies on the equity and justice in healthcare as a result of COVID 19



<https://huntsvillebusinessjournal.com/news/2020/04/14/hudsonalpha-company-local-business-working-to-address-health-care-disparities-in-america/>

Pharmaceuticals

- Pharmaceutical companies were previously only seen as the “greedy bad”
- Is this a chance for them to change this image
 - Vaccine created at remarkable speed and delivered to millions
 - Therapeutic studies on new medications created within record time
- Chance for US to make medications in America again

Key Takeaways

- Pandemic provided a number of learning experiences throughout healthcare
- We must continue to learn from advances and mistakes
- Telemedicine may offer a new durable solution to some of our access and healthcare needs

Key Takeaways

- A number of healthcare practices are returning to normal in 2021
- Some of the new advancements (virtual meetings, burnout prevention) may continue to stay on
- Flexibility is vital to preventing future catastrophes

Key Takeaways

- As the pandemic settles, we must continue to highlight elements of emergency preparedness
- Deep learning and artificial intelligence may provide new insight into future medical decision making and treatments
- Health and payor structure changes may be coming

Key Takeaways

- Racial disparities remain an issue in US based healthcare. COVID-19 gave us a glimpse of this social issue and research is ongoing into improvements on this front



Every life deserves world class care.