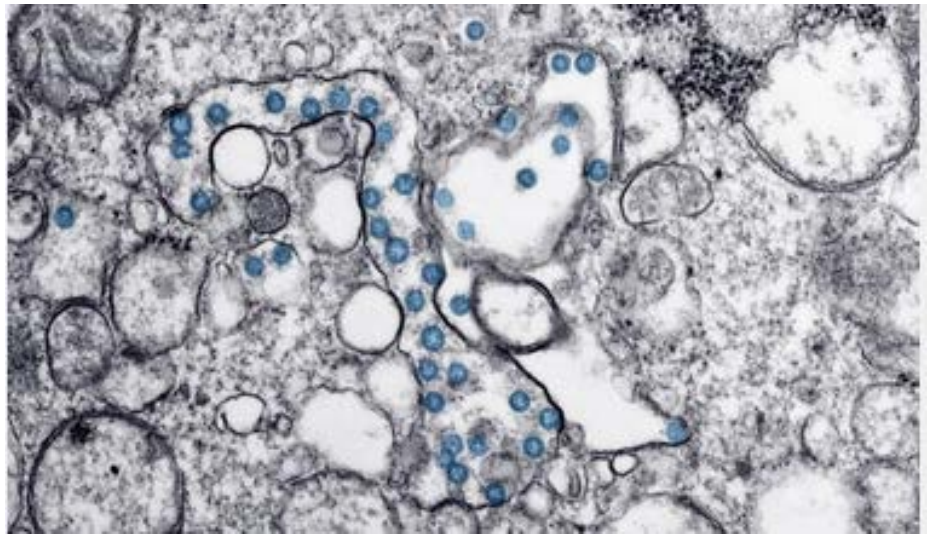
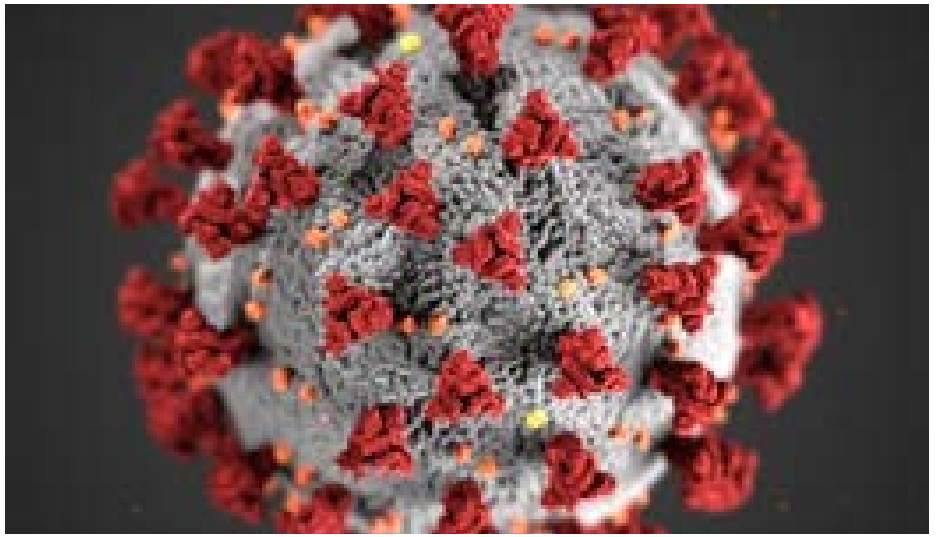
OVERVIEW

- Case presentation
- In-hospital cardiac arrest (IHCA) and COVID19
- Recommended modifications to protocol
  - PPE
  - Airway
  - Mechanical/automated CPR devices
  - Goals of care
  - Prone position
- Beth Israel Deaconess experience
- UC San Diego experience
- Summary

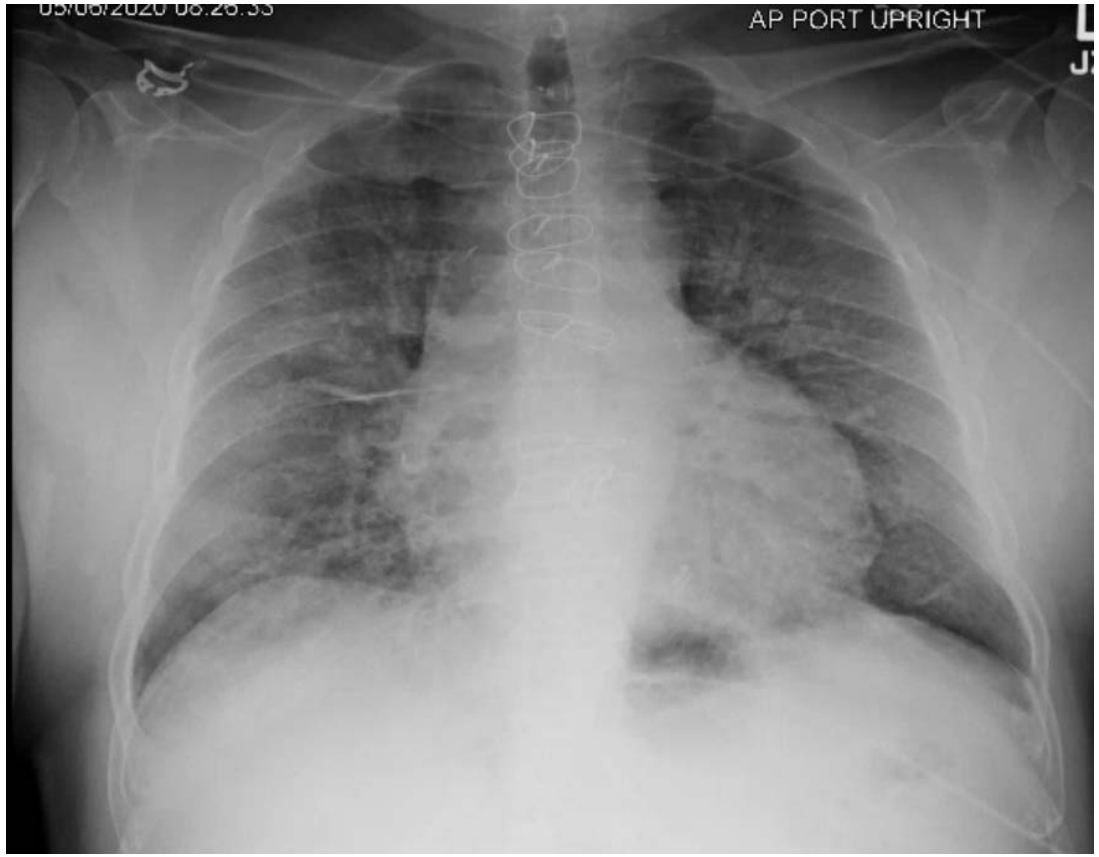




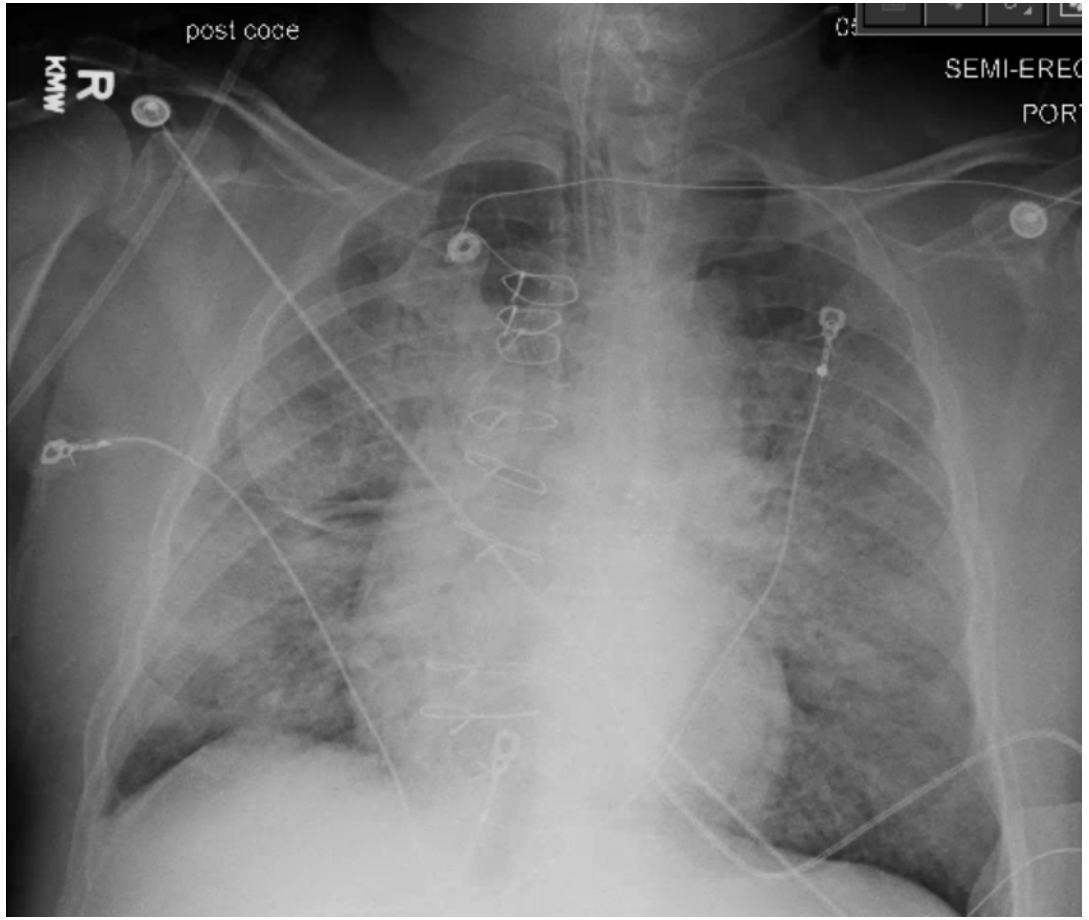
CDC.gov

90	78	84	87	94	97	94	92	89	92	84	82	72	56	SpO2
	Non-r...		Heate...	Heate...		Heate...								O2 Device
	15		55	55		55								O2 Flow Rate (.
			100	100		100								FiO2 (%)

- Near the beginning of the pandemic, a 61-year old man presented with a week of fevers, cough and shortness of breath and a positive COVID19 test.
- He rapidly required increasing amounts of oxygen and was intubated.
- He was managed with standard lung protective strategies and higher PEEP, sedation, paralytics and prone positioning with improved oxygenation.



95	95	25		63	62	68	94	96	98	SpO2
										O2 Device
60	60	60	60	60	60	60	100	100	100	FiO2 (%)



- On the night of hospital day 2, the patient was switched to a transport ventilator to be moved.
- Outside the room he acutely desaturated with sustained hypoxia.
- He became bradycardic and lost his pulse.

Code Blue

- He was pushed back into his original room, CPR was initiated and he received 1 mg of epinephrine. After 3 minutes of CPR, ROSC obtained.

- After a 31-day hospital stay he was discharged to a long-term acute care facility with a tracheostomy.

- He is now home, breathing on his own and improving.

BACKGROUND IN-HOSPITAL CA

IHCA [Data from 2008-2011 from the American Heart Association's Get With The Guidelines-Resuscitation (GWTG-R) registry]

- Incidence = 290,000 adults
- Mean Age = 66years
- Men account for 58% of CA
- Most often presenting rhythm = non-shockable (81%)
- Survival to hospital discharge has been increasing over last 2 decades (appx 20-25%)

Andersen, L. W., Holmberg, M. J., Berg, K. M., Donnino, M. W., & Granfeldt, A. (2019). In-Hospital Cardiac Arrest: A Review. *JAMA*, *321*(12), 1200–1210. https://doi.org/10.1001/jama.2019.1696

Table 1.

Comparison of Out-of-Hospital and In-Hospital Cardiac Arrest

	In-Hospital Cardiac arrest	Out-of-Hospital Cardiac Arrest
Incidence	290 000 per year in the United States	350 000 per year in the United States[a]
Patient characteristics	Mean age: 66 y Approximately 60% men	Median age: 65 y Approximately 60% men
Presenting rhythm	Often nonshockable (approximately 80%)	Often nonshockable (approximately 80%)
Cause	Primarily cardiac and respiratory	Primarily cardiac
Prevention	Potentially possible with recognition of deterioration and early intervention	Often impossible given the lack of pre-cardiac arrest monitoring
Timing of basic life support	Often instantaneously	Variable depending on bystander involvement
Timing of advanced life support drugs	Within 5 to 10 min	On average, approximately 20 min after the onset of cardiac arrest
Airway management	Approximately one-third of patients already intubated (eg, intensive care unit patients); often performed by physicians	Often performed by clinicians (eg, paramedics) with variable experience in advanced airway management
Drugs	Limited evidence; epinephrine and amiodarone recommended	Some evidence; epinephrine and amiodarone recommended
Post-cardiac arrest treatment	Limited evidence; supportive care and targeted temperature management recommended	Some evidence; supportive care and targeted temperature management recommended
Prognostication	Limited evidence; focuses on both neurological status and organ failure	Some evidence; focuses on neurological status
Survival to discharge	Approximately 25%	10% to 12%

[a]Assessed by emergency medical services but not necessarily treated.[2]

Andersen, L. W., Holmberg, M. J., Berg, K. M., Donnino, M. W., & Granfeldt, A. (2019). In-Hospital Cardiac Arrest: A Review. *JAMA*, *321*(12), 1200–1210. https://doi.org/10.1001/jama.2019.1696

Goals

1. Identify cause of IHCA (Hs &Ts)
   - Could improve outcomes
   - Has post-CA implications if ROSC achieved
2. Prevention = first link in Chain of Survival for IHCA
   - Identify “at-risk” patients
   - Create appropriate interventional responses (i.e. rapid response teams)

Andersen, L. W., Holmberg, M. J., Berg, K. M., Donnino, M. W., & Granfeldt, A. (2019). In-Hospital Cardiac Arrest: A Review. *JAMA*, *321*(12), 1200–1210. https://doi.org/10.1001/jama.2019.1696

MANAGEMENT

- **Chest compressions, ventilation, and early defibrillation**, when applicable – cornerstone of CA treatment
- **Quality** of chest compressions and of CPR in general associated with better outcomes
- Data supporting the efficacy of medications during in-hospital cardiac arrest are sparse.
  - For in-hospital events:
    - Early administration of epinephrine in patients with a nonshockable rhythm is associated with better outcomes.
    - Early epinephrine for patients with shockable rhythms is associated with worse outcomes.
- Airway management is key but early intubation may or may not be helpful.
  - Emerging evidence in both out-of-hospital and in-hospital cardiac arrest suggests that alternative approaches may be equally or even more effective.

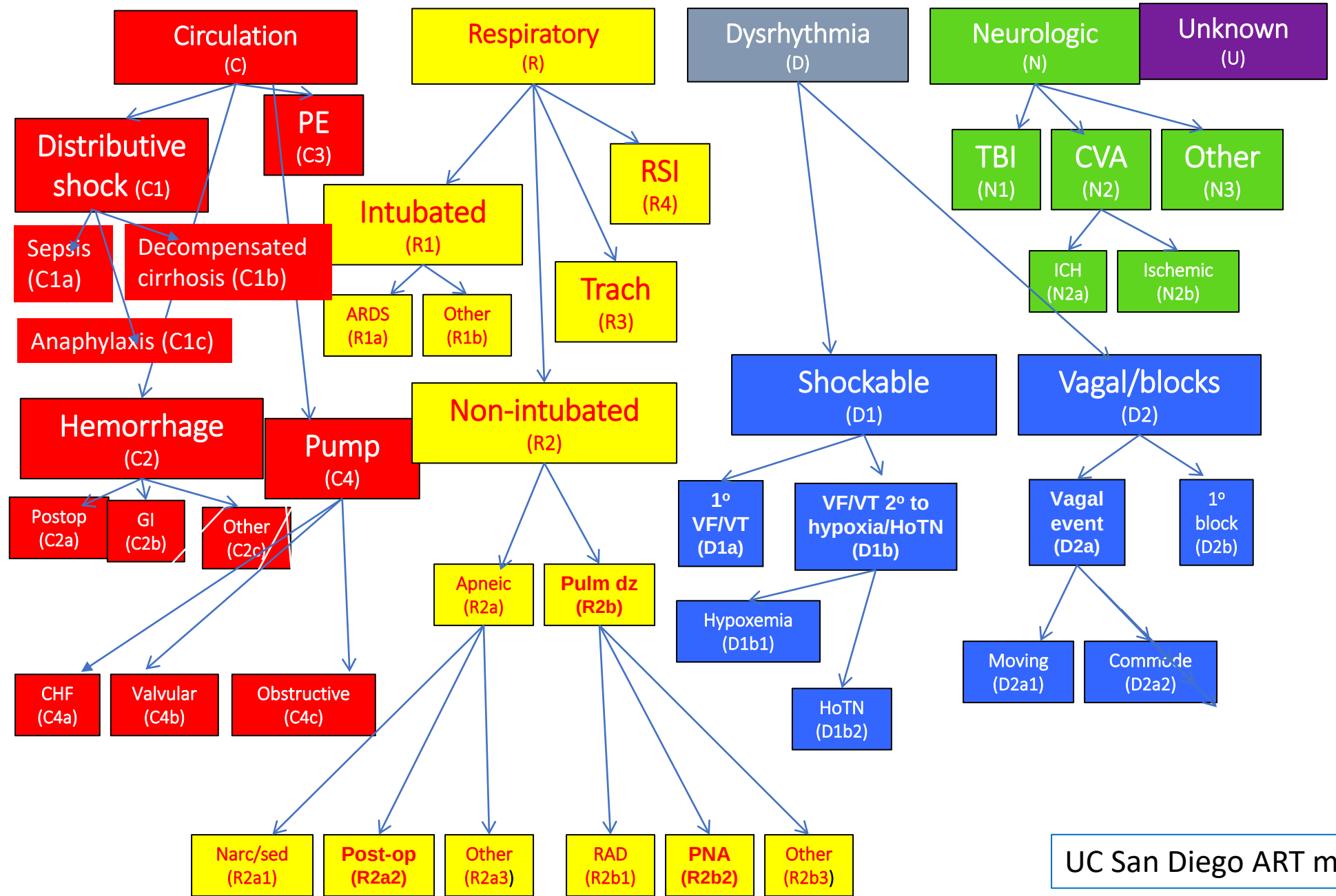
Andersen, L. W., Holmberg, M. J., Berg, K. M., Donnino, M. W., & Granfeldt, A. (2019). In-Hospital Cardiac Arrest: A Review. *JAMA*, *321*(12), 1200–1210. https://doi.org/10.1001/jama.2019.1696

CHARACTERISTICS RELATED TO OUTCOMES

- Two of the factors most strongly associated with outcomes are presenting **rhythm and duration of CA.**
- Increased age → **decreased survival** following cardiac arrest in most studies.
- Presence of preexisting medical and surgical conditions → **worse outcomes** following in-hospital cardiac arrest.
- Relationship between race and outcomes → **Black and Hispanic patients** to have **lower rates of neurological recovery and survival** following in-hospital cardiac arrest compared with white patients.
    - Data from the GWTG-R registry have shown that racial disparities in outcomes have narrowed over time, with a reported absolute survival difference between black and white patients of 4.5% in 2000 and 1.8% in 2014.
- **Little evidence** exists **for any one tool for prognostication** after IHCA.

Andersen, L. W., Holmberg, M. J., Berg, K. M., Donnino, M. W., & Granfeldt, A. (2019). In-Hospital Cardiac Arrest: A Review. *JAMA*, *321*(12), 1200–1210. https://doi.org/10.1001/jama.2019.1696

Cardiopulmonary Arrest Etiologies



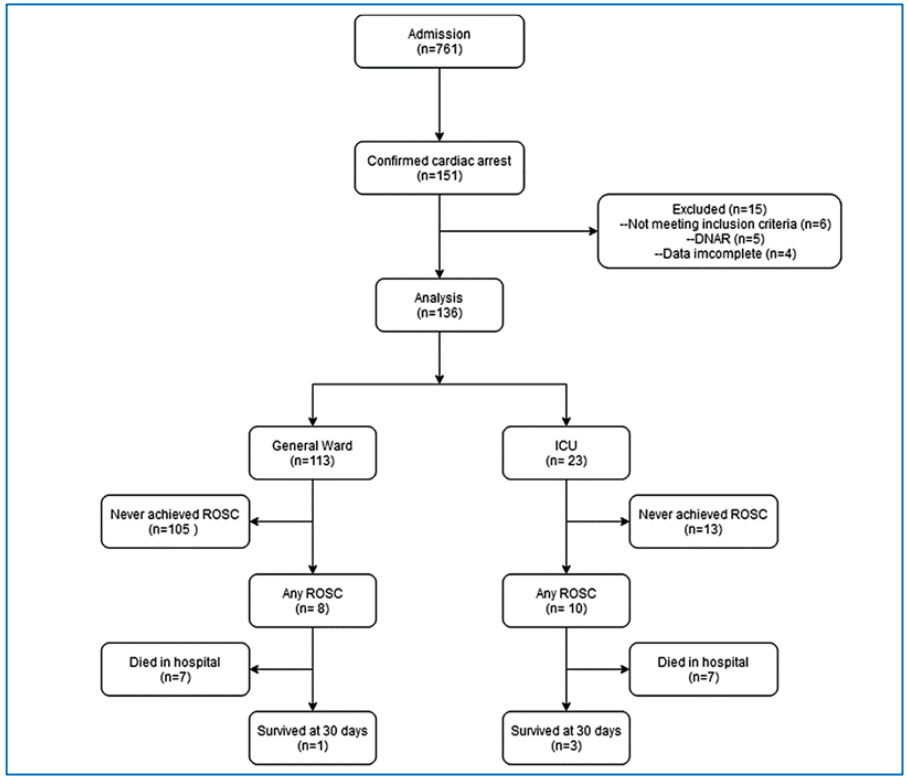
UC San Diego ART matrix of arrest

Has COVID19 changed CPR?

RESUSCITATION
OFFICIAL JOURNAL OF THE EUROPEAN RESUSCITATION COUNCIL

EUROPEAN RESUSCITATION COUNCIL

In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China



136 patients with COVID19 were resuscitated with only **18 (13.2%)** achieving ROSC and **4 (2.9%)** still alive at day 30.

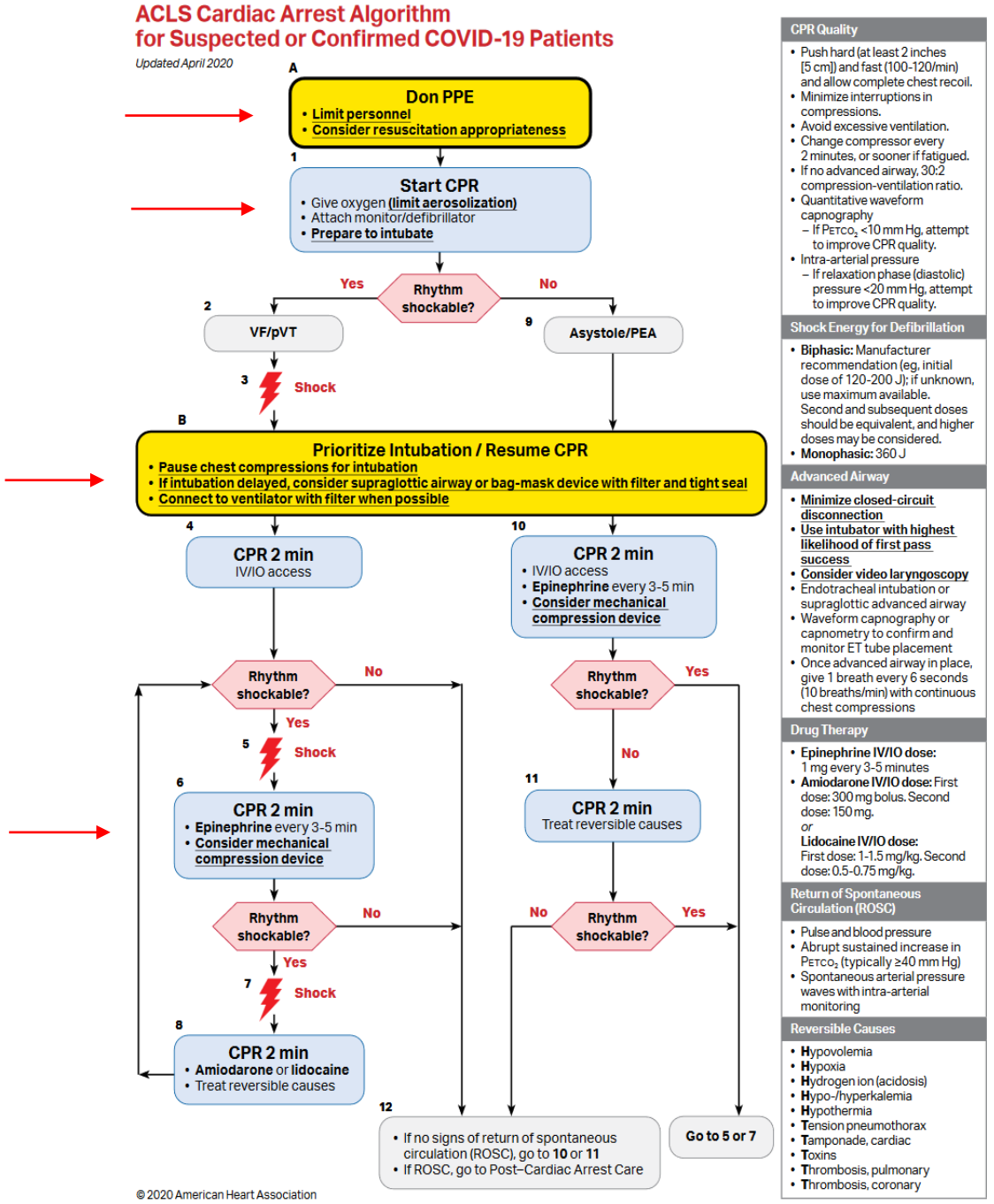
Shao F et al Resuscitation April 2020

In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China

Aetiology, n (%)	
Cardiac	10 (7.4)
Respiratory	119 (87.5)
Others	7 (5.1)
Location, n (%)	
ICU	23 (16.9)
General ward	113 (83.1)
Initial rhythm, n (%)	
VF/VT	8 (5.9)
PEA	6 (4.4)
Asystole	122 (89.7)

Shao F et al Resuscitation April 2020

Cardiac arrest guidelines in COVID-19: what's different?



Modification 1: provider protection and resource allocation

- Don’t enter the room without aerosol-appropriate PPE
  - Limited evidence from mannequin/cadaver studies, observational data from SARS
- Limit who is in the room
- Considering appropriateness of CPR
  - (more on this later)

Modification 2/3: establish a closed-circuit airway

- AHA 2019: bag-valve mask or advanced airway ok

- COVID-19 guidance focuses on achieving a closed airway circuit ASAP
  - Most experienced intubator
  - Pause compressions during airway insertion
  - Consider no bag-mask ventilation prior to intubation, or use HEPA filter and tight seal
  - Consider video laryngoscopy to increase distance between intubator and patient

- Consider leaving intubated patients on the ventilator

Modification 4: consider mechanical CPR device

- Generally NOT recommended for routine use
  - no evidence for improved outcome
  - suggestion of worse neurologic outcome in some studies[1]
  - Previously suggested when manual CPR is difficult or poses risk to providers

- COVID-19 interim guidance:
  - “In settings with protocols and expertise in place for their use, consider replacing manual chest compressions with mechanical CPR devices to reduce the number of rescuers required for adults and adolescents who meet the manufacturers height and weight criteria.”[2]

1. Perkins et al, Mechanical Versus Manual Chest Compression for Out-Of-Hospital Cardiac Arrest (PARAMEDIC): A Pragmatic, Cluster Randomised Controlled Trial, Lancet 2015
2. Edelson et al.: Interim Guidance for Life Support for COVID-19, Circulation 2020

Goals of Care

- Considering appropriateness of CPR
  - Should this be emphasized for COVID-19?
  - Initial concerns re: need for resource allocation have not been realized in most of the US
  - Very limited data on COVID-19 cardiac arrest outcomes to-date
  - Poor outcomes reported from overwhelmed center with patients arrested on improvised, poorly monitored wards

The prone patient

PRONE CPR

What does the AHA Say?

Circulation

CONSENSUS REPORTS

Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates With Suspected or Confirmed COVID-19

From the Emergency Cardiovascular Care Committee and Get With The Guidelines-Resuscitation Adult and Pediatric Task Forces of the American Heart Association

In Collaboration With the American Academy of Pediatrics, American Association for Respiratory Care, American College of Emergency Physicians, The Society of Critical Care Anesthesiologists, and American Society of Anesthesiologists

Supporting Organizations: American Association of Critical Care Nurses and National Association of EMS Physicians

Prone Patients at the Time of Arrest

- For patients with suspected or confirmed COVID-19 who are in a prone position without an advanced airway, attempt to place in the supine position for continued resuscitation.
- Although the effectiveness of CPR in the prone position is not completely known, for those patients who are in the prone position with an advanced airway, it may be reasonable to avoid turning the patient to the supine position, unless able to do so without risk of equipment disconnections and aerosolization. If unable to safely transition the patient to a supine position, place the defibrillator pads in the anterior-posterior position and provide CPR with the patient remaining prone with hands in the standard position over the T7/10 vertebral bodies.[18]

18. Mazer SP, Weisfeldt M, Bai D, Cardinale C, Arora R, Ma C, Sciacca RR, Chong D, Rabbani LE. Reverse CPR: a pilot study of CPR in the prone position. *Resuscitation*. 2003;57:279–285. doi: 10.1016/s0300-9572(03)00037-6

RESUSCITATION 151 (2020) 135 –136

Available online at www.sciencedirect.com

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Letter to the Editor

A need for prone position CPR guidance for intubated and non-intubated patients pandemic

COVID-19 Curbside Consults

Cardiopulmonary resuscitation in COVID-19 patients

Cardiopulmonary Resuscitation in the Prone Position: A Good Option for Patients With COVID-19

k, MD

://doi.org/10.3949/ccjm.87a.ccc040

Ludwin, Kobi MSc, EMT-P; Szarpak, Lukasz PhD; Ruetzler, K
Böttiger, Bernd W. PhD, MD; Jaguszewski, Milosz PhD, MD;

Author Information

Anesthesia & Analgesia: September 2020 - Volume 131 - Is

Letter | Open Access | Published: 26 May 2020

Prone ventilation of critically ill adults with COVID-19: how to perform CPR in cardiac arrest?

Wioletta Mędrzycka-Dąbrowska, Katarzyna Lewandowska, Daniel Ślęzak & Sebastian Dąbrowski

Critical Care **24**, Article number: 258 (2020) | Cite this article

A Little History Behind Prone CPR

- Initially proposed by E.L. McNeil in 1989

RE-EVALUATION OF CARDIOPULMONARY RESUSCITATION

EDWARD L. McNEIL
Bedford, NY 10506-0507 (U.S.A.)
(Accepted January 26th, 1989)

- A modification of apneic ventilation from 1932!!

Nielsen H. En oplivningsmetode (method of resuscitation). Ugesk f Laeger 1932;94:1201–3.

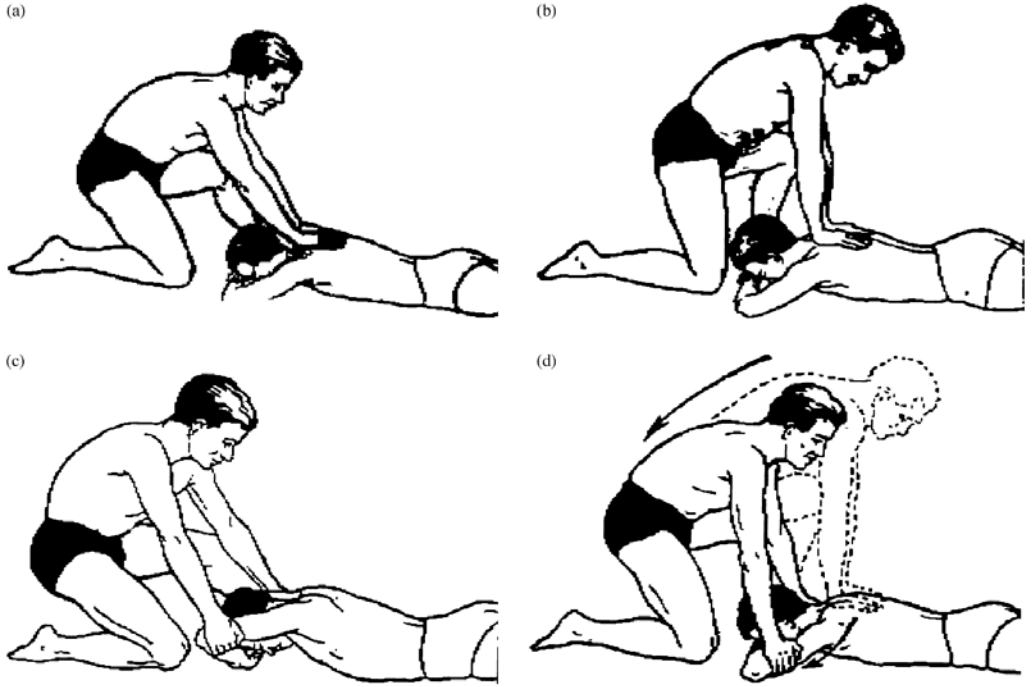


Figure 2 The Holger Nielsen method of resuscitation.[8]

- A few case reports and 1 review article in the literature in the subsequent 14 years until…

- The Mazer et al study from 2003

Reverse CPR: a pilot study of CPR in the prone position

Sean P. Mazer [a], Myron Weisfeldt [c], Diane Bai [a], Carol Cardinale [a], Rohit Arora [d], Cecilia Ma [a], Robert R. Sciacca [b], David Chong [b], LeRoy E. Rabbani [a,*]

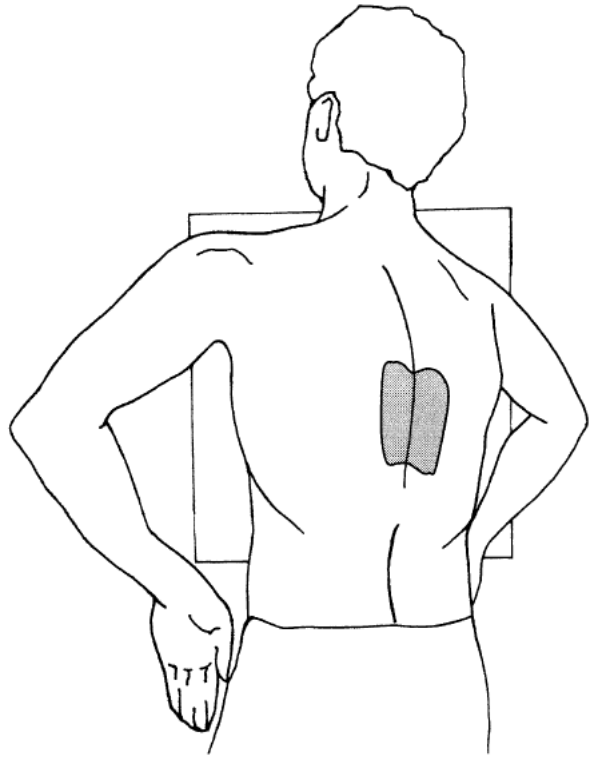
A (Very) Quick Look at the Mazer Article

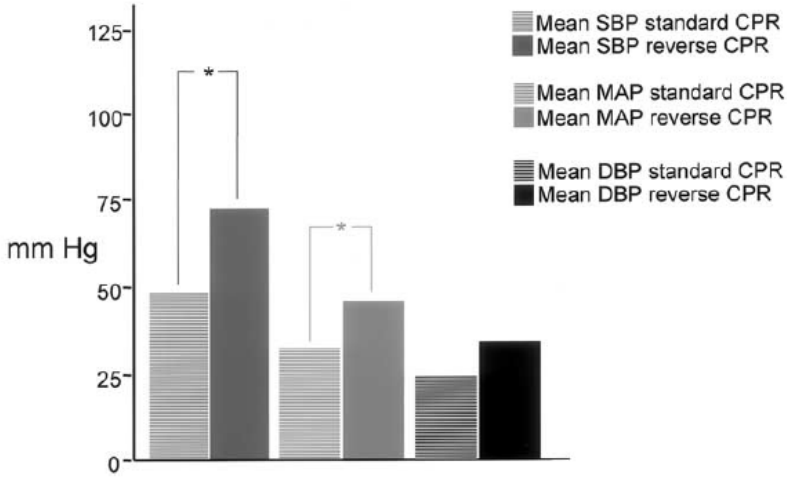
Patients: Cardiac Arrest w/o ROSC after 30min of Standard CPR (N=6**!**)

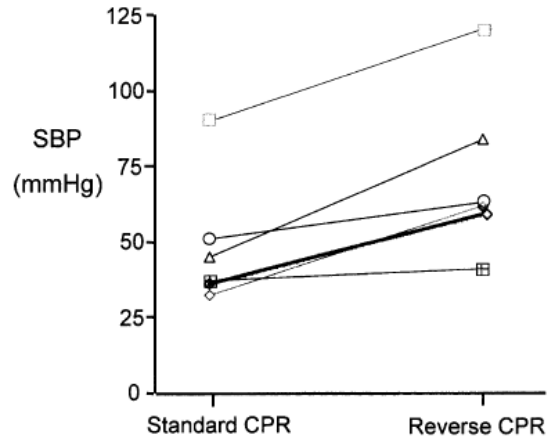
Intervention: Standard CPR for 15min followed by Reverse CPR for 15min

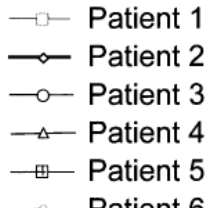
Control: Standard CPR (Crossover Trial)

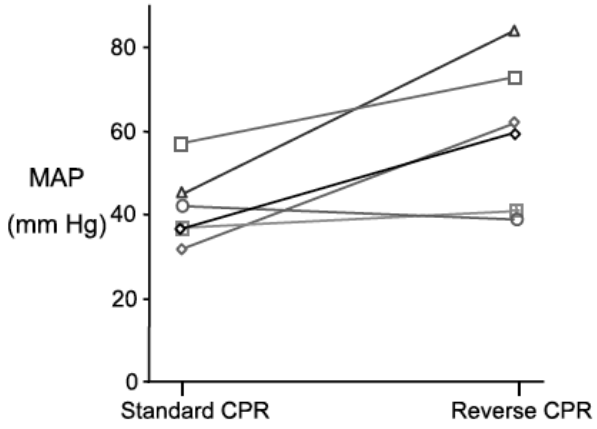
Outcome: Increase in SBP or MAP

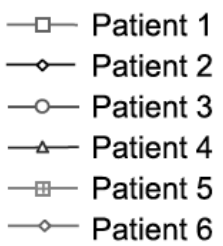


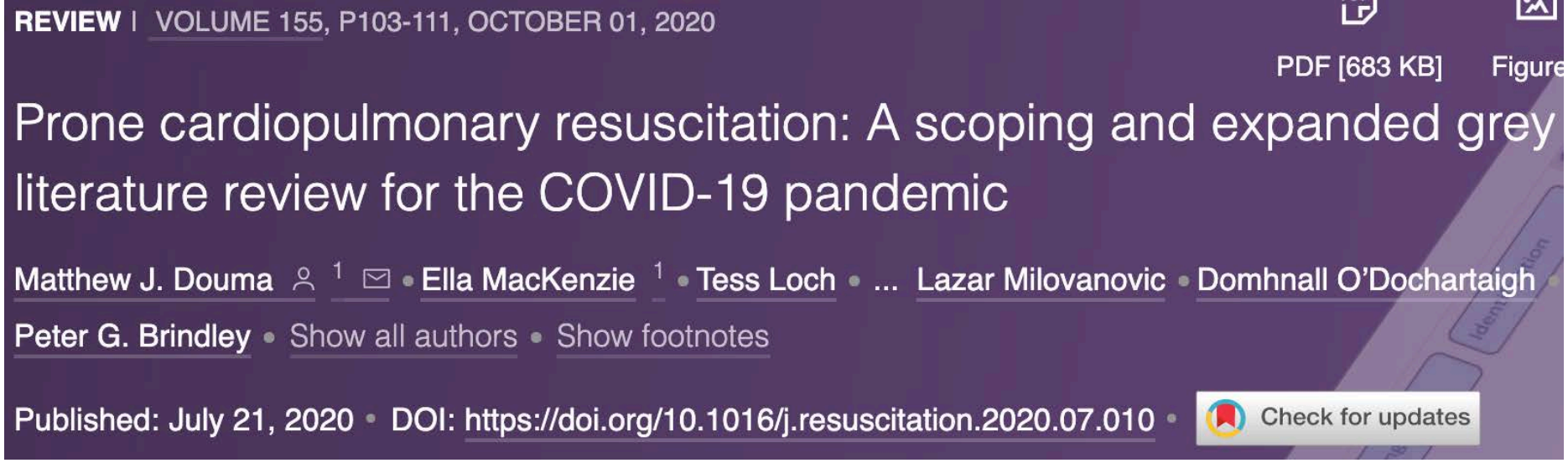












Details:

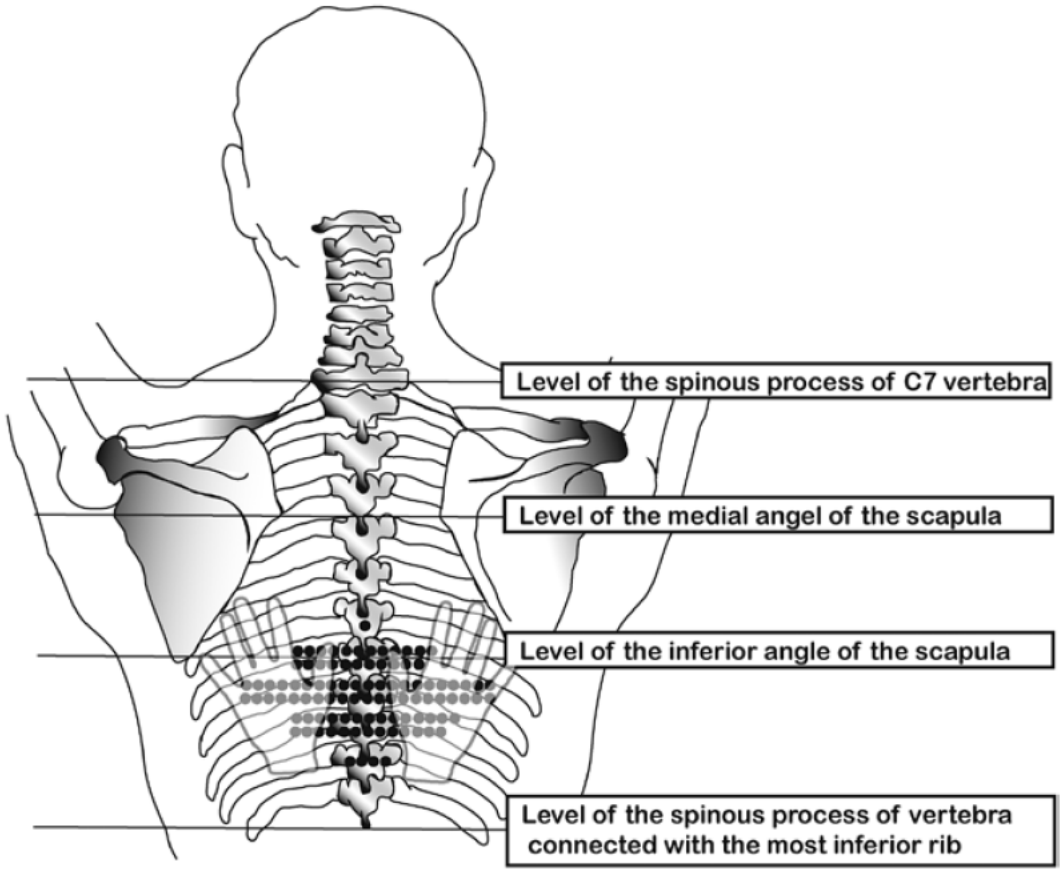
24 manuscripts (453 papers identified!)

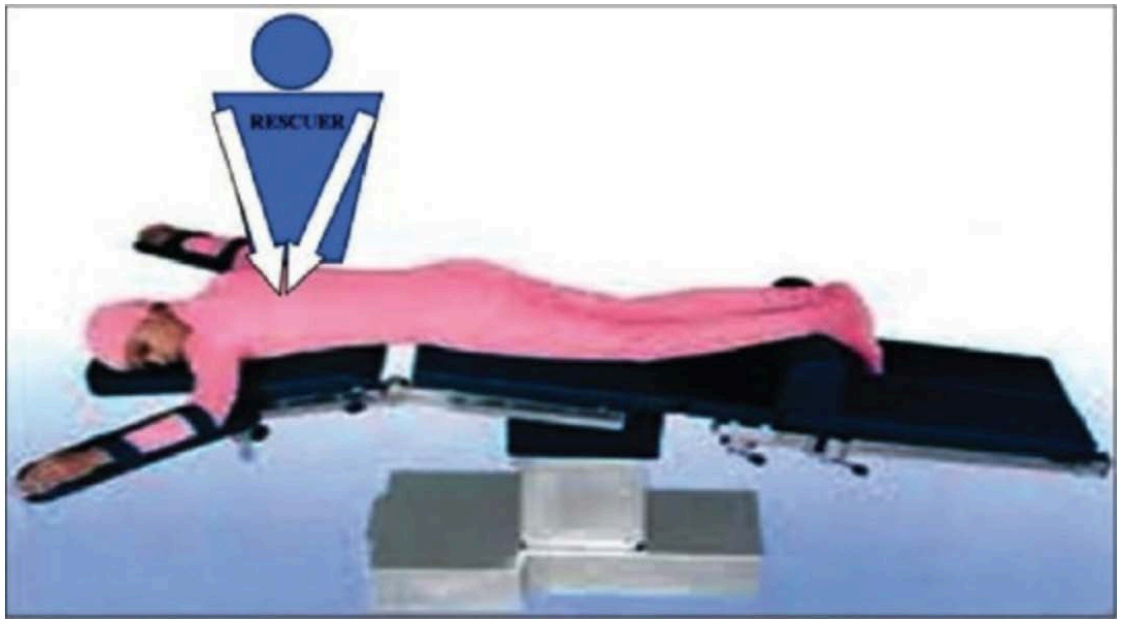
4 original research studies

20 case reports/series with a total of 25 prone patients undergoing CPR…

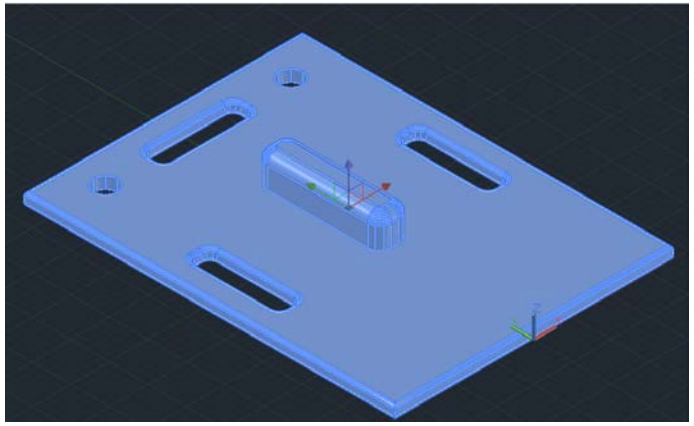
- 20/25 patients arrested in the OR (all neuro or ortho cases)
- 14 pediatric patients
- 20/25 patients had post-resuscitation survival
- 5 respiratory cases, but **only 1** in an adult with ARDS from pneumonia…

If You Must…





We found that in prone patients, the largest LV cross-sectional area is located 0 to 2 vertebral segments below the line crossing both the inferior angles of the scapula in at least 86% of patients.

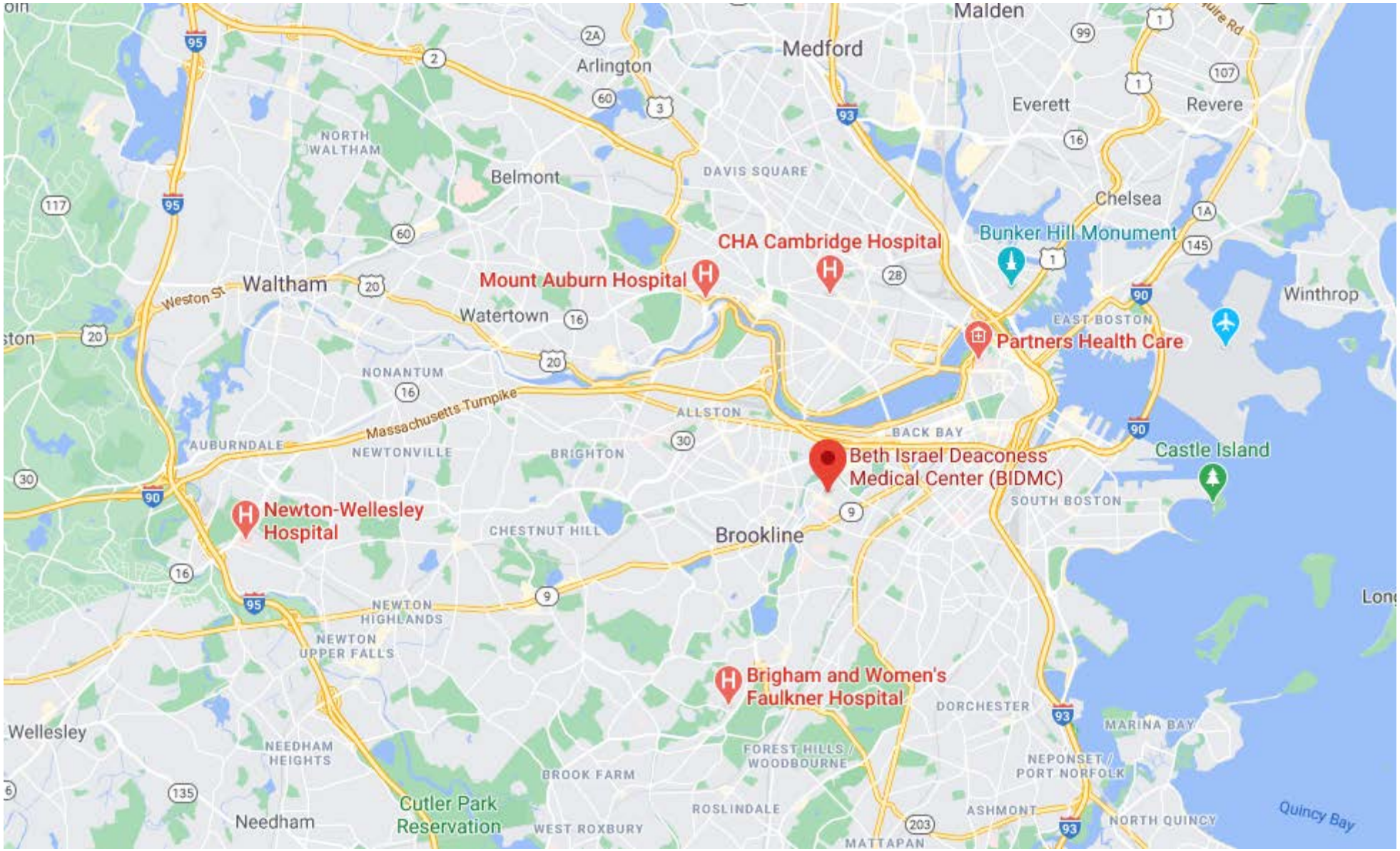


Other recommended changes to workflow

Revisions to Standard Cardiopulmonary Resuscitation Workflow with Potential Problems and Suggested Solutions

CPR Revision	Potential Problems	Solutions
Mechanical chest compressions	Communicating instructions to pause or resume CPR by external team Communicating the presence or absence of a pulse by internal team	Telecommunications Videoconferencing Handheld laminated cards
External medication delivery	Increased dead space and delay in delivery Inadvertent disconnection of intravenous tubing	Low-volume, microbore tubing Periodic monitoring of intravenous connections by internal team
External laboratory draws	Dilution of laboratory sample Theoretical risk of viral transmission in blood	Low-volume, microbore tubing Measurement of tubing volume to determine wasted blood before drawing laboratory sample Protective equipment (gloves, mask) while drawing laboratory samples
External defibrillation	Communicating “all clear” by external team Communicating acknowledgement of “all clear” by internal team	Telecommunications Videoconferencing Handheld laminated cards
External ventilator management	Communicating confirmation of endotracheal intubation by external team to proceduralist	Telecommunications Videoconferencing

Cheruku S et al J Cardiothoracic Vasc Anesth Oct 2020

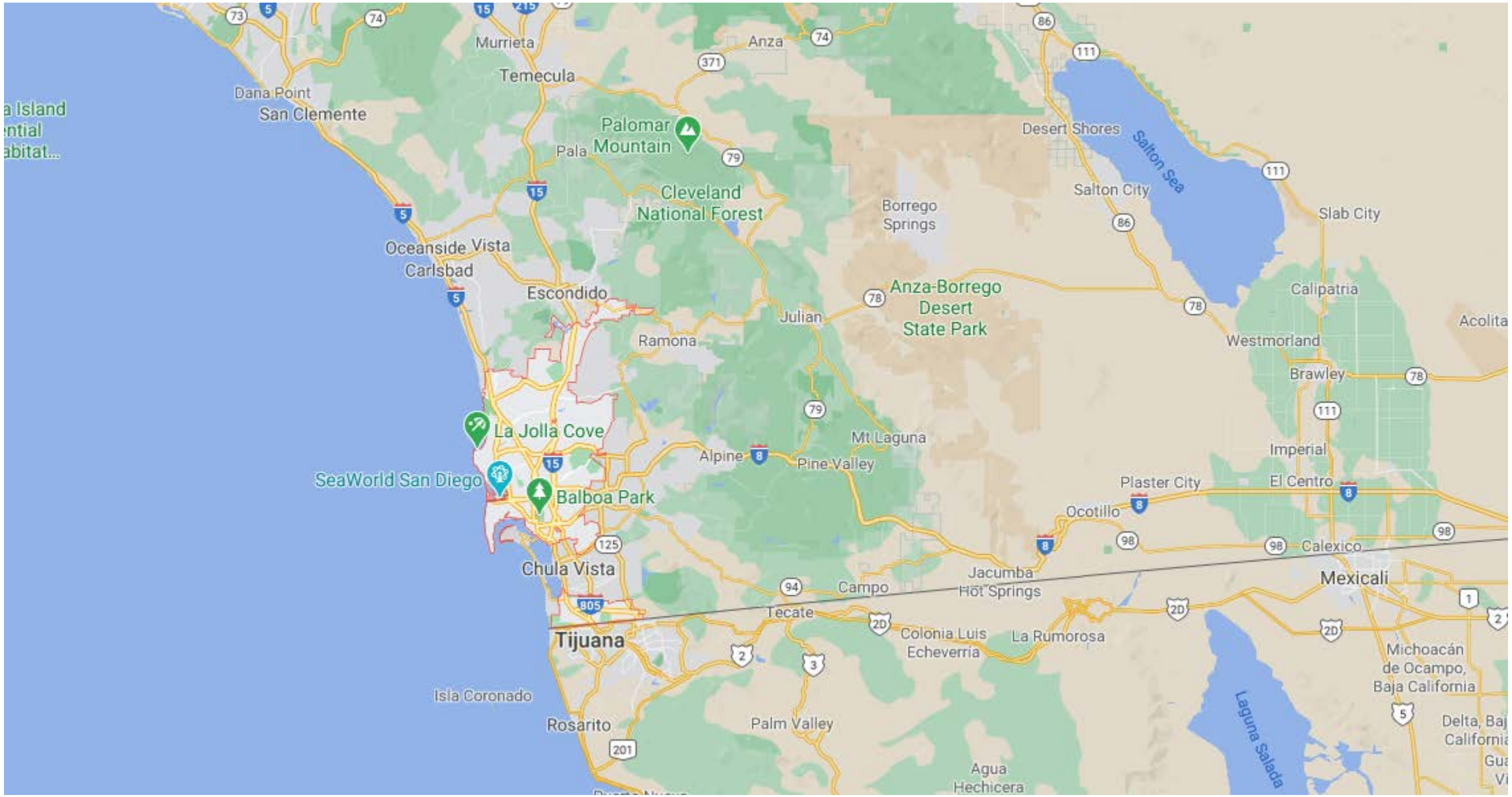

Malden
Medford
Arlington
Everett
Revere
NORTH WALTHAM
Belmont
DAVIS SQUARE
Chelsea
Bunker Hill Monument
CHA Cambridge Hospital
Mount Auburn Hospital
Waltham
Weston St
Watertown
EAST BOSTON
Partners Health Care
Winthrop
NONANTUM
Massachusetts Turnpike
ALLSTON
BACK BAY
AUBURNDALE
NEWTONVILLE
BRIGHTON
Beth Israel Deaconess Medical Center (BIDMC)
Castle Island
SOUTH BOSTON
Newton-Wellesley Hospital
CHESTNUT HILL
Brookline
NEWTON HIGHLANDS
NEWTON UPPER FALLS
Brigham and Women's Faulkner Hospital
DORCHESTER
MARINA BAY
Wellesley
NEEDHAM HEIGHTS
FOREST HILLS / WOODBOURNE
NEPONSET / PORT NORFOLK
BROOK FARM
Cutler Park Reservation
ROSLINDALE
ASHMONT
NORTH QUINCY
Needham
WEST ROXBURY
MATTAPAN
Quincy Bay

BIDMC Code Blue Modifications

- Safety officer to insure proper PPE at the door
- Limit who goes in
  - Baby monitors for communication with pharmacy/other personnel
- LUCAS device to minimize those needed for CPR
  - Multiple trainings, interns delegated to bring to codes
- Early intubation
  - No BVM beforehand

BIDMC outcomes/causes (during surge March-May)

- 9 IHCA in COVID+ patients
- ROSC in 5/9
- Survival to hospital discharge in 2/9
- Survival to 30 days in 2/9
- Likely causes:
  - Pulmonary embolism-1
  - Dislodged endotracheal tube-3
  - Aspiration event-2
  - VT-1
  - Bradycardia/suspected mucous plug -2


Murrieta
Temecula
Anza
Dana Point
San Clemente
Palomar Mountain
Pala
Cleveland National Forest
Desert Shores
Salton Sea
Salton City
Borrego Springs
Slab City
Oceanside
Vista
Carlsbad
Escondido
Julian
Anza-Borrego Desert State Park
Calipatria
Ramona
Westmorland
Brawley
La Jolla Cove
Mt Laguna
Alpine
Pine Valley
Imperial
SeaWorld San Diego
Balboa Park
Plaster City
El Centro
Ocotillo
Calexico
Chula Vista
Jacumba Hot Springs
Mexicali
Campo
Tecate
Tijuana
Colonia Luis Echeverría
La Rumorosa
Michoacán de Ocampo, Baja California
Isla Coronado
Rosarito
Palm Valley
Laguna Salada
Agua Hechicera

UC San Diego experience

- Unit charge nurse is responsible for managing traffic in and out of room.
- An adequate supply of PPE is readily available.
- Only the minimum number of staff in room at a time.
- Intubate early if possible.
- Use 2 hand seal and HEPA filter for ventilation if possible.

UCSD Inpatient Adult Code Blue and Rapid Response for Patients on contact, droplet and airborne precautions such as those with Proven or Suspected COVID-19

Protocol Name	UCSD Inpatient Code Blue and Rapid Response for patients on contact, droplet and airborne precautions such as with Proven or Suspected COVID-19
Division/Unit:	Pulmonary and Critical Care/Medical ICU
Effective Date:	
Revision Date(s):	

THE FOLLOWING IS AN INTERIM POLICY AND/OR PROCEDURE THAT IS EFFECTIVE IMMEDIATELY. THIS INTERIM POLICY AND/OR PROCEDURE IS A RESULT OF ACTIONS TAKEN IN ACCORDANCE WITH UCSDHP 801.3, UNIVERSITY OF CALIFORNIA SAN DIEGO HEALTH EMERGENCY OPERATIONS PLAN. THIS POLICY AND/OR PROCEDURE REMAINS IN EFFECT UNTIL FURTHER NOTICE.

Implementation Date: March 19, 2020

UCSD experience

- Over 495 patients have been admitted with COVID19
- 6 have experienced an IHCA (all 6 with ROSC, 1 survived to discharge)
  - Hypoxia coded on arrival from OSH
  - LVAD and VF arrest
  - Hypoxia when switched to transport ventilator
  - Septic shock from perforated diverticulitis
  - On ECMO, hypoxia during vent change
  - Autoimmune encephalitis developed complete heart block and PEA arrest

Key take away points

- Minimal published data on IHCA in patients with COVID19
- Minimize staff exposure – utilize a traffic cop/safety officer
- With adequate PPE, risk of transmission is low – encourage/enforce use of PPE
- Early intubation
- Offer CPR to those who may benefit