Webinar #3

COVID-19

Sit Rep

COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)

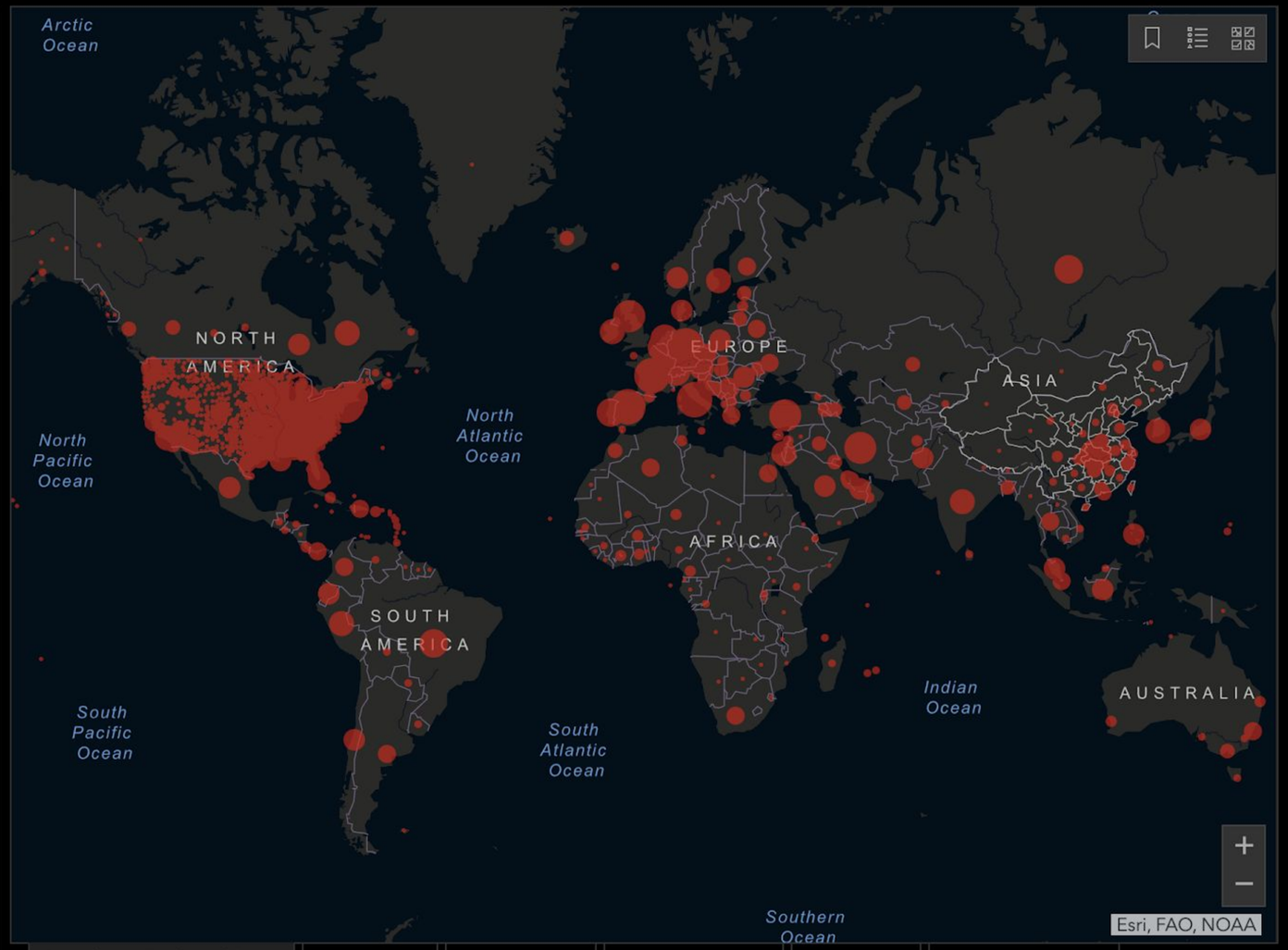
Total Confirmed
1,970,879

Confirmed Cases by Country/Region/Sovereignty

- 605,193 US
- 172,541 Spain
- 162,488 Italy
- 131,361 France
- 131,359 Germany
- 94,845 United Kingdom
- 83,306 China
- 74,877 Iran
- 65,111 Turkey
- 31,119 Belgium
- 27,580 Netherlands
- 27,035 Canada
- 25,936 Switzerland
- 25,262 Brazil
- 21,102 Russia
- 17,448 Portugal

Admin0 | Admin1 | Admin2

Last Updated at (M/D/YYYY)
4/14/2020, 4:41:11 PM



Cumulative Confirmed Cases | Active Cases | Incidence Rate | Case-Fatality Ratio | Testing Rate | Hospitalization Rate

185
countries/regions

Lancet Inf Dis Article: Here. Mobile Version: Here.
Lead by JHU CSSE. Automation Support: Esri Living Atlas team and JHU APL. Contact US. FAQ.

Data sources: WHO, CDC, ECDC, NHC, DXY, 1point3acres, Worldometers.info, BNO, the COVID Tracking Project (testing and hospitalizations), state and national government health departments, and local media

Total Deaths
125,678

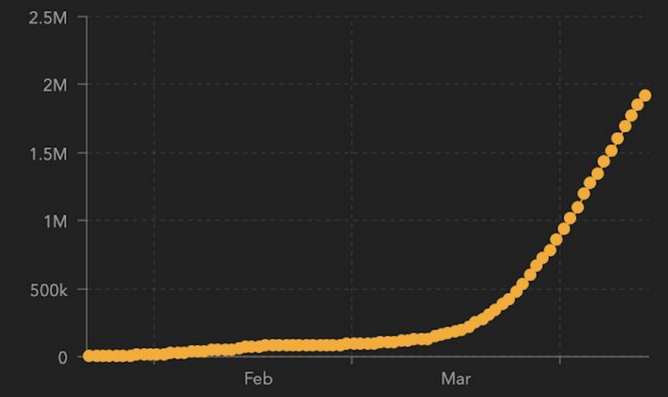
- 21,067 deaths Italy
- 18,056 deaths Spain
- 15,729 deaths France
- 12,107 deaths United Kingdom
- 7,905 deaths New York City **New York** US
- 4,683 deaths Iran
- 4,157 deaths Belgium
- 3,294 deaths

Deaths | Recovered

Total Tested in the US
3,081,620

- 499,143 tested New York US
- 203,180 tested Florida US
- 202,208 tested California US
- 146,467 tested Texas US
- 139,774 tested New Jersey US
- 133,631 tested Pennsylvania US
- 126,551 tested Massachusetts US
- 118,422 tested Louisiana US

US Tested



Confirmed | Logarithmic | Daily Cases

26,431
(1,370 new)
Reported cases

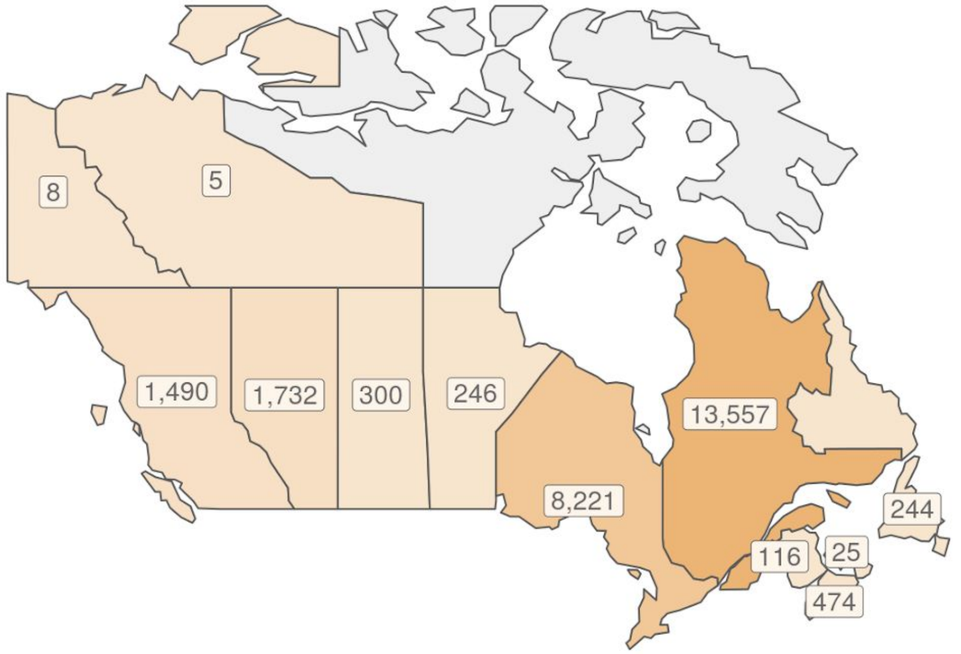
7,758
(586 new)
Total recovered

822
(76 new)
Total deaths

449,183
(17,688 new)
Total tested

Last updated: 2020-04-13 19:00 EDT

Reported cases are cumulative and include both confirmed and presumptive positive cases. Repatriated cases are included in the total but not shown in the map below.



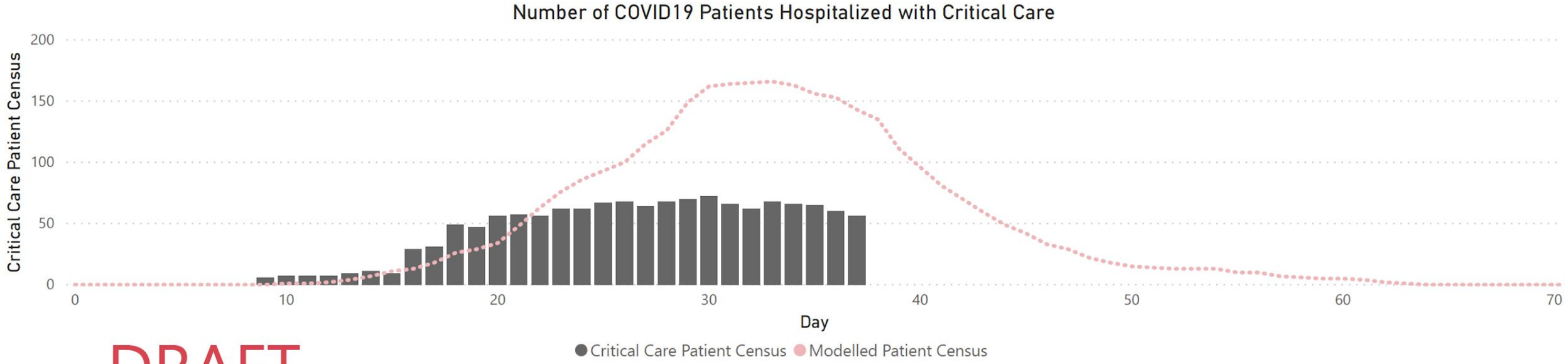
Not shown: repatriated cases (n =13).

Table 1: Epidemiological profile of reported cases by health authority, BC, January 1 – April 14, 2020 (**N=1,517**)

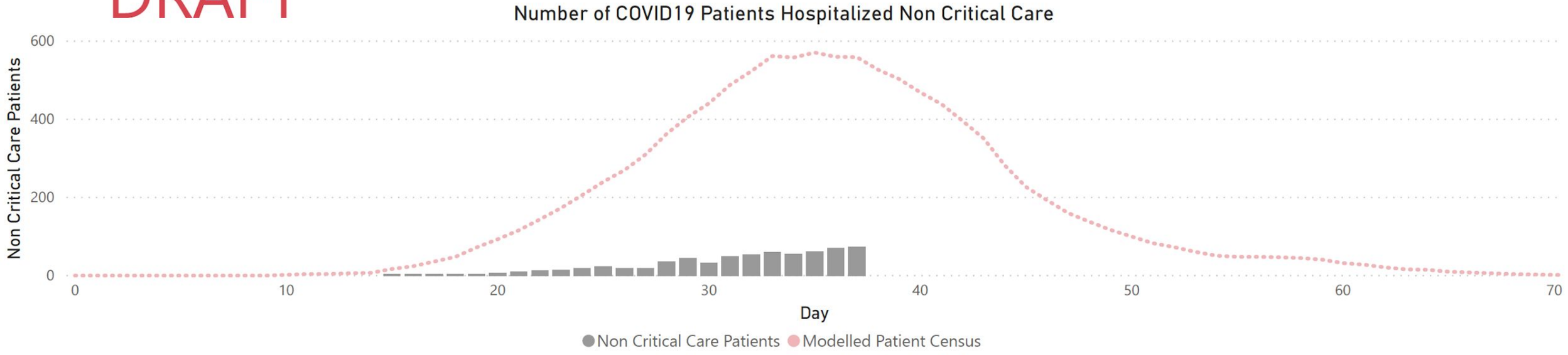
	Fraser	Interior	Vancouver Island	Northern	Vancouver Coastal	Total N (%)[a]
Total number of cases	**601**	**141**	**89**	**28**	**658**	**1,517**
New cases since yesterday	**10**	**5**	**2**	**2**	**8**	**27**
Median age in years, cases[b]	53	49	55	51	57	54 years (range 0-102 years)
Female sex, cases	308	77	47	18	361	811/1,500 (54%)
Ever hospitalized[c]	**170**	**24**	**23**	**7**	**125**	**349 (23%)**
Median age in years, ever hospitalized[b]	68	60	72	47	70	68 years (range 0-98 years)
Currently hospitalized[c]	**73**	**11**	**10**	**3**	**37**	**134**
Currently in critical care[d]	**32**	**6**	**2**	**1**	**17**	**58**
Total number of deaths[c]	**15**	**0**	**2**	**0**	**55**	**72 (5%)**
New deaths since yesterday	**1**	**0**	**0**	**0**	**2**	**3**
Median age in years, deaths[b]	79	NA	88	NA	87	86 years (range 47-101 years)
Recovered[e]	329	72	47	21	473[f]	942 (62%)

Modelled Curves

Provincial COVID19 Monitoring Solution (PCMS)



DRAFT



Health Authority Catchment Area

FHA	IHA	NHA	VCH	VIHA	Total

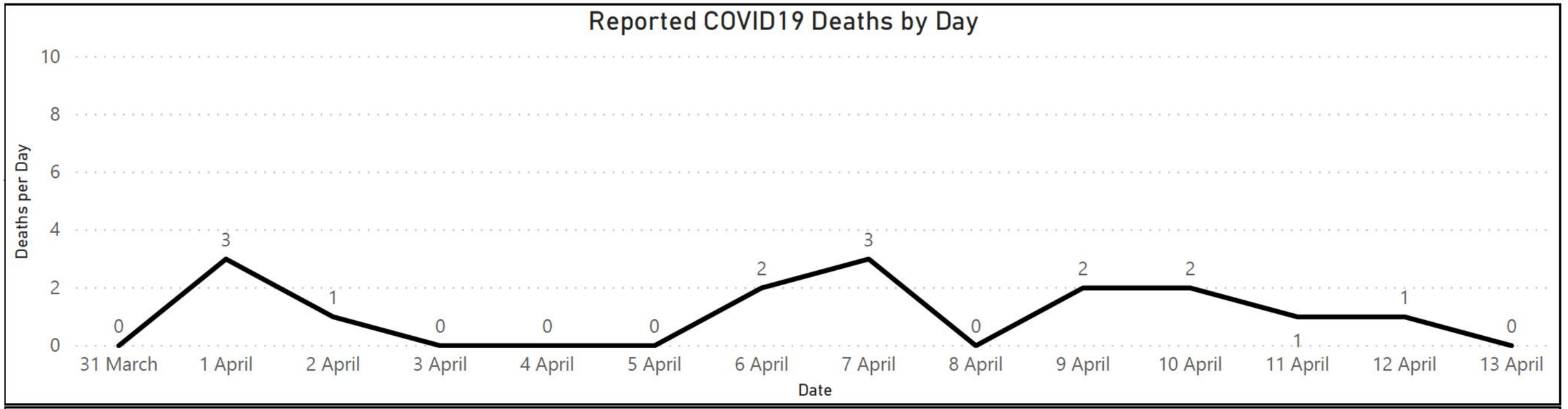
Epidemic Type

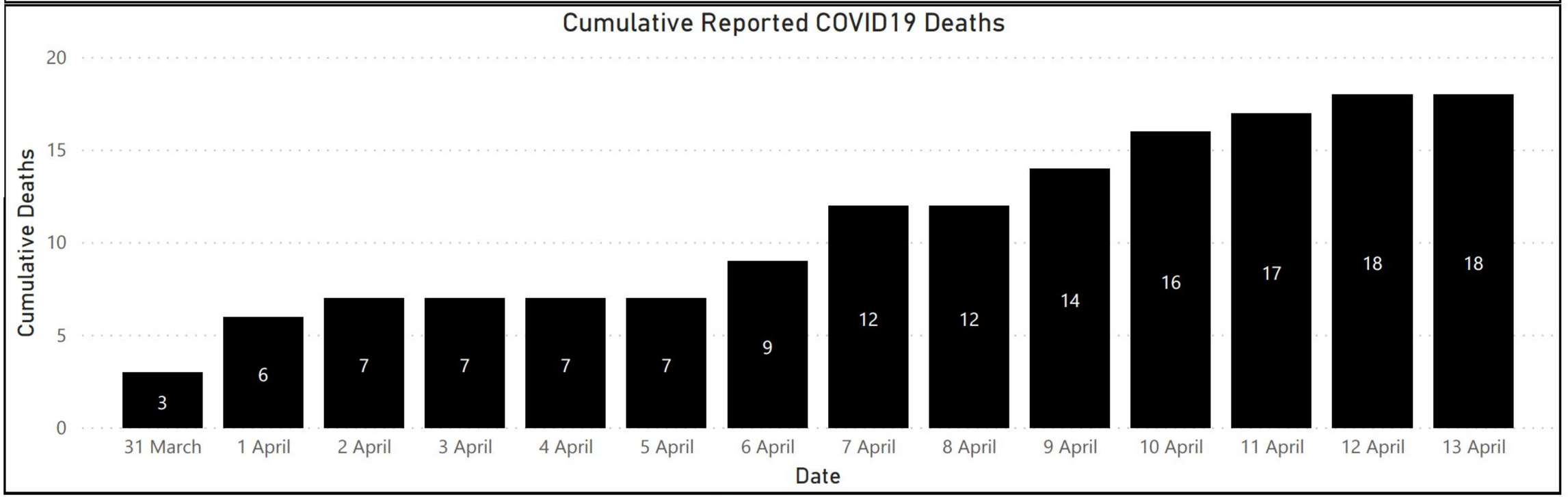
Hubei	N. Italy

Last Data Entry

13/04/2020 1:21:12 PM

Provincial COVID19 Monitoring Solution (PCMS)

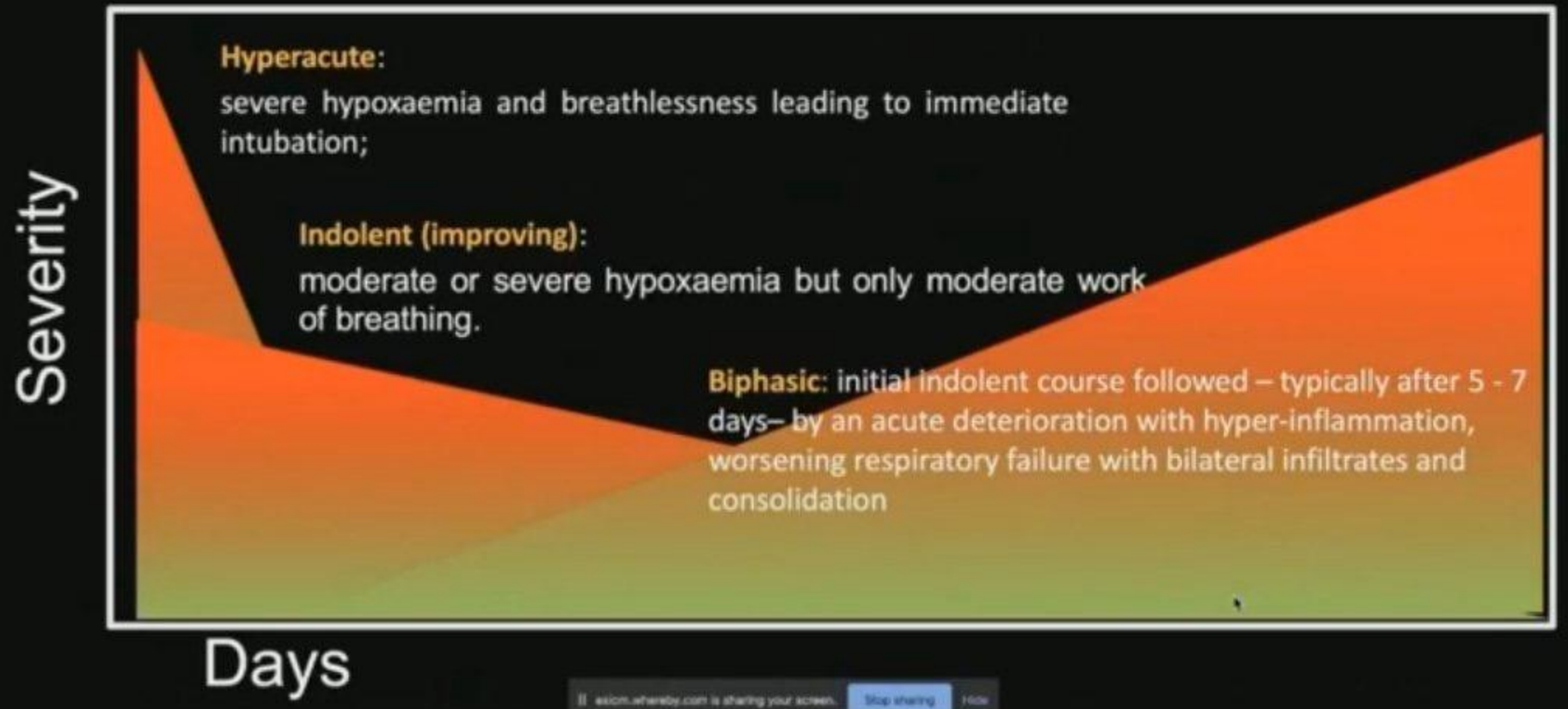




Time Frame

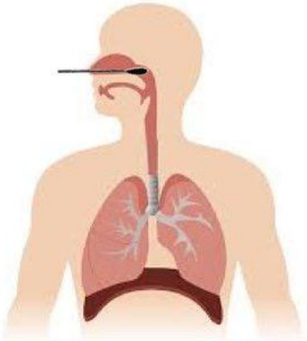
DIAGNOSIS

Disease Course and late “failures”



Covid-19 shedding

No. of samples positive for SARS-CoV-2 by RT-PCR/ total no. of samples in aggregated studies (%)

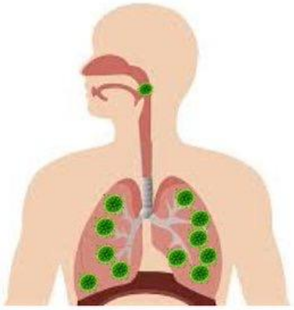


Nasopharyngeal swabs: 31/35 (88.6%)

Zou L et al, NEJM, 2020
Kujawski et al, medRxiv, 2020
Chan JF et al, Lancet

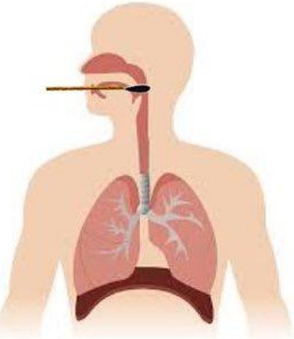
Conjunctival swabs: 2/188 (1.1%)

Xu L et al, medRxiv, 2020
Zhang X et al, medRxiv, 2020
Sun X et al, medRxiv, 2020



Sputum: 48/49 (97.9%)

Pan Y et al, Lancet Infect Dis, 2020
Kujawski et al, medRxiv, 2020
Chen L et al, Am J Gastroenterol, 2020
Lin C et al, medRxiv, 2020
Chan JF et al, Lancet, 2020



Throat swabs: 45/75 (60%)
Post. throat saliva: 31/35 (88.6%)
Oral swabs: 7/15 (46.7%)

Pan Y et al, Lancet Infect Dis, 2020
Zou L et al, NEJM, 2020
Kujawski et al, medRxiv, 2020
Chen L et al, Am J Gastroenterol, 2020
Lin C et al, medRxiv, 2020
To KKW et al, Lancet Infect Dis, 2020
To KKW et al, Clin Infect Dis, 2020
Chan JF et al, Lancet, 2020

Stool: 34/48 (70.8%)
Anal swabs: 16/78 (20.5%)
Rectal swabs: 4/23 (17.4%)

Cui P et al, medRxiv, 2020
Chen W et al, Emerg Microbes Infect
Pan Y et al, Lancet Infect Dis, 2020
To KKW et al, Lancet Infect Dis, 2020
Kujawski et al, medRxiv, 2020
Xie C et al, IJID, 2020
Young BE et al, JAMA, 2020
Zhang L et al, JMV, 2020

Urine: 0/76 (0%)

Pan Y et al, Lancet Infect Dis, 2020
To KKW et al, Lancet Infect Dis, 2020
Kujawski et al, medRxiv, 2020
Xie C et al, IJID, 2020
Young BE et al, JAMA, 2020
Wolfel R et al, medRxiv, 2020

Blood: 20/162 (12.3%)

Chen W et al, Emerg Microbes Infect, 2020
To KKW et al, Lancet Infect Dis, 2020
Kujawski et al, medRxiv, 2020
Xie C et al, IJID, 2020
Young BE et al, JAMA, 2020
Chan JF et al, Lancet, 2020
Wolfel R et al, medRxiv, 2020

Vaginal swabs: 0/35 (0%)

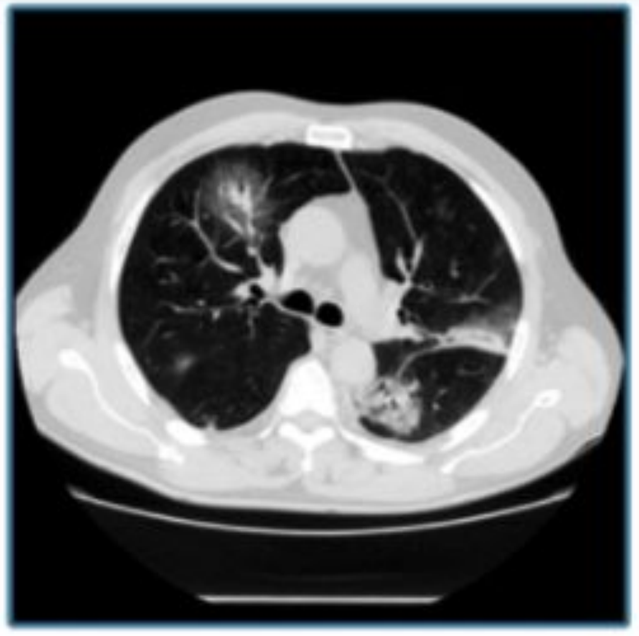
Cui P et al, medRxiv, 2020

TREATMENT PROTOCOLS

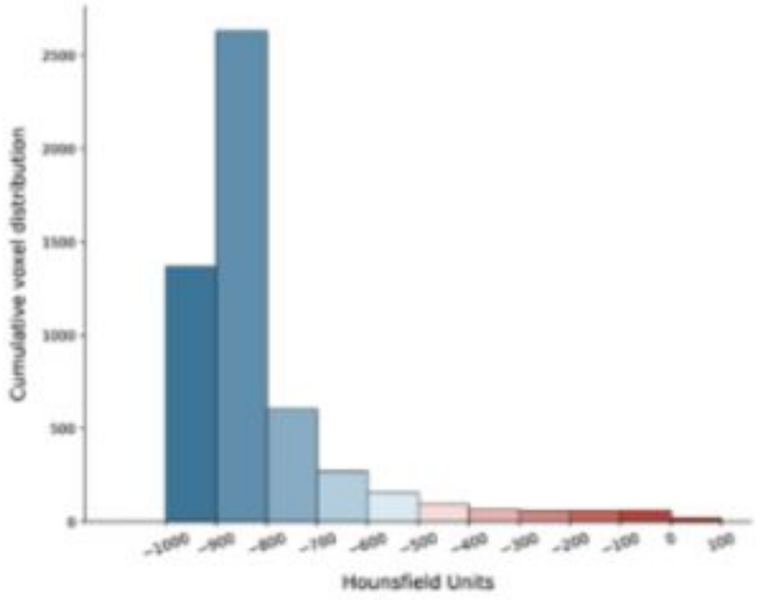
Type L

Type H

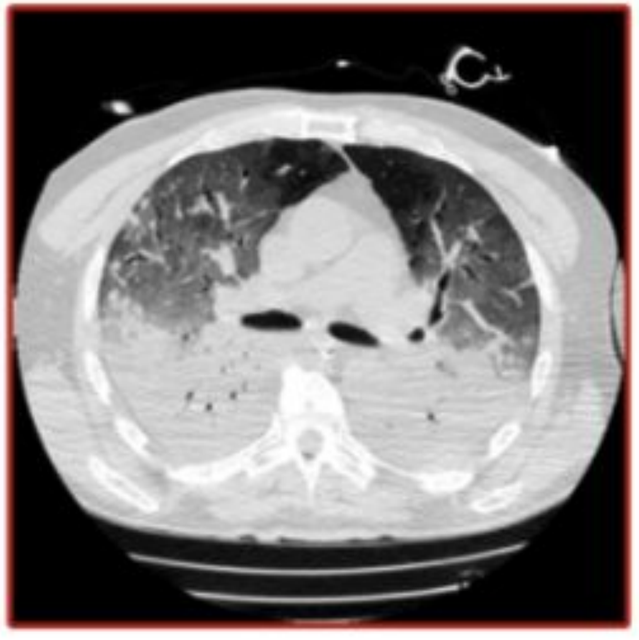
A



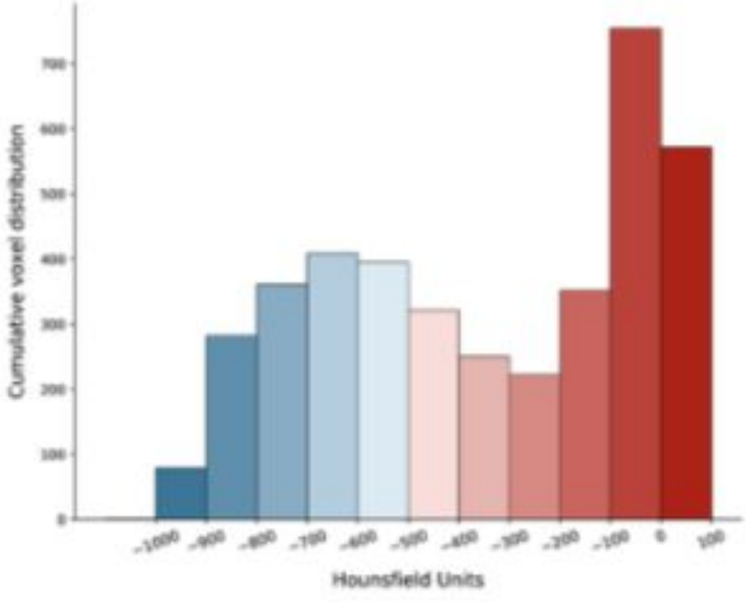
PaO_2/FiO_2
95 mmHg



B

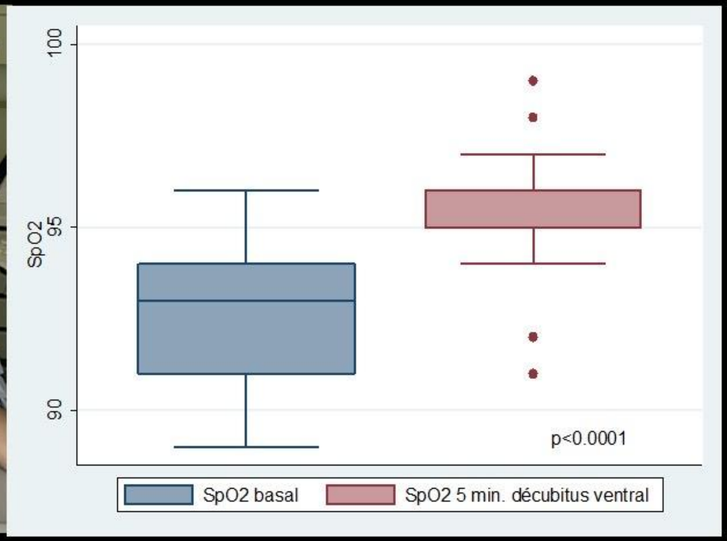


PaO_2/FiO_2
84 mmHg



RESPIRATORY SUPPORT

	People with more effective HPV	People with less effective HPV
People with Stronger Hypoxic Ventilatory Drive	Short of breath but near normal SpO2 ***"Uncomfortable normal"***	Very uncomfortable with very low SpO2 ***Respiratory distress***
People with weaker Hypoxic Ventilatory Drive	Well feeling with near normal SpO2 ***Normal appearing***	Minimal distress with very low SpO2 ***"Happy hypoxemic"***


100
95
90
SpO2
p<0.0001
SpO2 basal
SpO2 5 min. décubitus ventral

TRIAGE

HYPOXIC SpO_2<90%

LIKELY OR KNOWN COVID? N → RESUS 1-2

Y

UNSTABLE / CRASHING? Y → RESUS 4

N

- NASAL PRONG OXYGEN 4L/MIN + SURGICAL MASK ON PATIENT
- SENIOR DR REVIEW

RESUS

RESPIRATORY ASSESSMENT POD

SIGNIFICANT INCREASED WORK OF BREATHING?

Chest discomfort & pleuritic pain may result in fast shallow breaths without other features. The patient may otherwise appear abnormally comfortable for their degree of hypoxia

Y

NEGATIVE PRESSURE ROOM

- CLINICAL EVALUATION, CXR, POCUS
- INCREASE FiO_2
- ASSESS PRONING RESPONSIVENESS IF TOLERATED
- D/W ICU
- *CONSIDER* HIGH FLOW NASAL CANNULA WITH SURGICAL MASK OVER CANNULA (STAFF IN FULL PPE / N95)

TYPE H 😨

Significant dyspnoea may represent a more advanced stage of lung injury and greater need for invasive ventilation

N

- CLINICAL EVALUATION, CXR, POCUS
- ASSESS PRONING RESPONSIVENESS
- CONSIDER INCREASE FiO_2

TYPE L 🙂

Hypoxia partly due to abnormalities in pulmonary blood flow, which may respond to changes in patient positioning. Because the lungs are not severely affected, the patient does not feel as breathless

⚠ PATIENTS MAY PROGRESS TO TYPE H NEED FREQUENT MEDICAL REVIEW ⚠

OXYGEN DELIVERY OPTIONS

- NASAL PRONGS PLUS 😷
- SIMPLE FACEMASK PLUS 😷
- NON-REBREATHER PLUS 😷

PRONING

- PATIENT ALERT, COOPERATIVE, ABLE TO TURN THEMSELVES
- REMOVE ECG LEADS BEFORE TURNING
- CAUTION WITH IV LINES, IDC, ETC
- DOCUMENT ANY CHANGE IN RR AND SPO2
- PATIENT CAN ALSO TRY LYING ON EITHER SIDE

Graded Oxygen Administration

@MRamzyDO

Suspected or COVID+
Clinical Symptoms
Imaging Findings
SpO2 < 90%

- Ground-glass opacities
- Dense consolidations
- Subtle bilateral infiltrates on CXR
- B-Lines & +/- subpleural consolidations on Ultrasound

- Dyspnea / SOB
- Tachypnea
- Shallow, sustained rapid breathing
- Anxiety
- High compliance
- Anosmia

NRB + NC

First apply surgical mask
Start with NC at 6LPM
Upgrade to Venturi Mask if available
Upgrade to NRB + NC if SpO2 still < 88%

HFNC

FiO2 always @ 100%, Start at 20 LPM
Titrate up to 50 LPM
Goal Sp02 > 88%
Comfortable & preferred over NPPV

NPPV

FiO2 always @ 100%
EPAP Set to 5
Ensure viral filter connected
Perform in Negative Pressure Room

+

Proning

Awake proning buys time > alveolar recruiting
Have patients change positions q 1 hour if able
Frequently re-evaluate patient

Intubation

Have lower threshold to perform if rising pCO2 +/- change in mental status
Vitals should be same before & after intubation
Sharp drop in SpO2 will occur & come back up slowly afterwards
If SpO2 < 88% = Consider if PEEP vs Low SpO2 is more harmful to patient

Ventilator Settings

FiO2: 100%
Vt: 6-8 cc/kg
PEEP: 5-10
SpO2 Target > 80%

Post Intubation Medications

- Rocuronium 100mg 30-60 minutes after
- Opioids > Benzodiazepines for sedatives
- Continue Paralytic + Sedation for 24 hours
- Avoid ventilator desynchrony

Management of Respiratory Failure

Suspected or Confirmed COVID-19

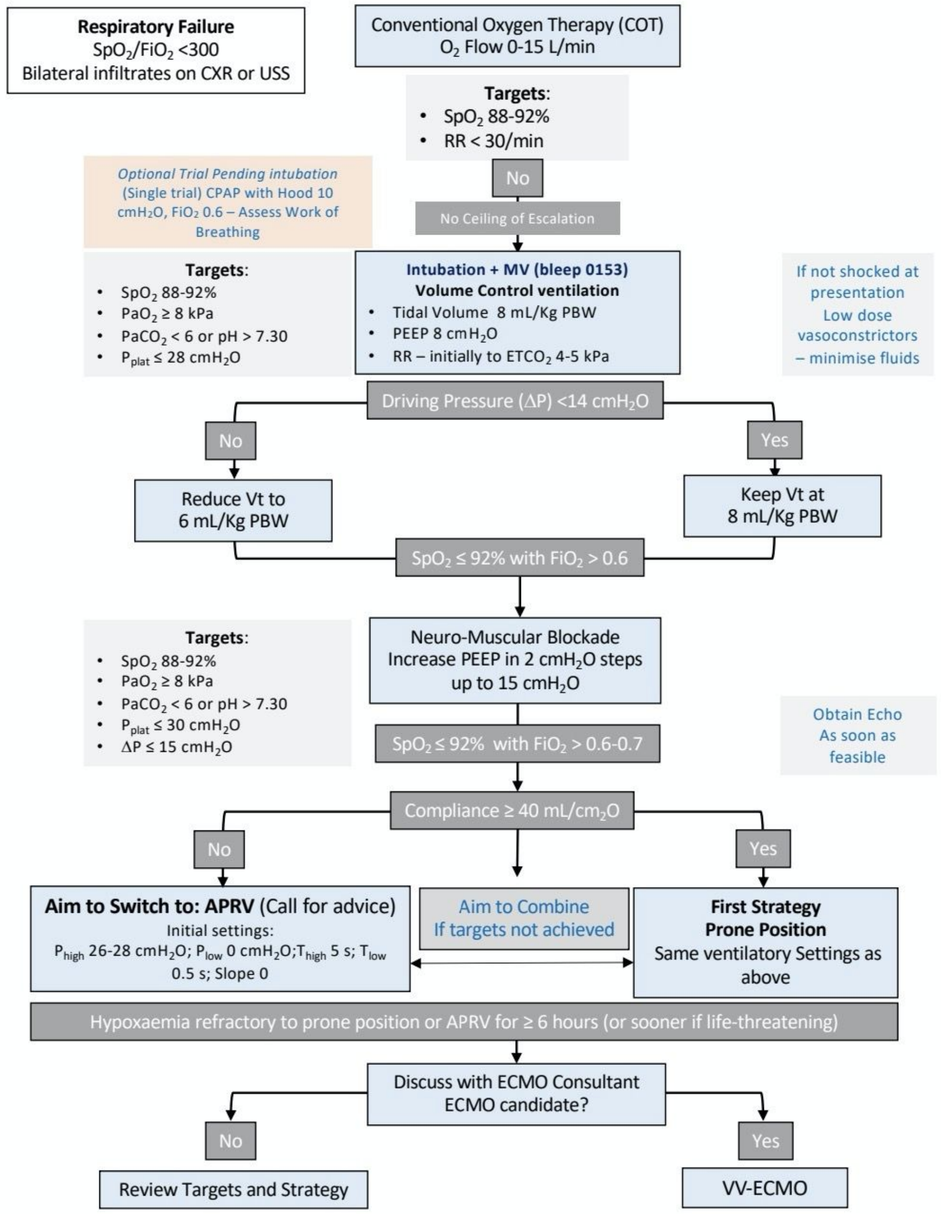
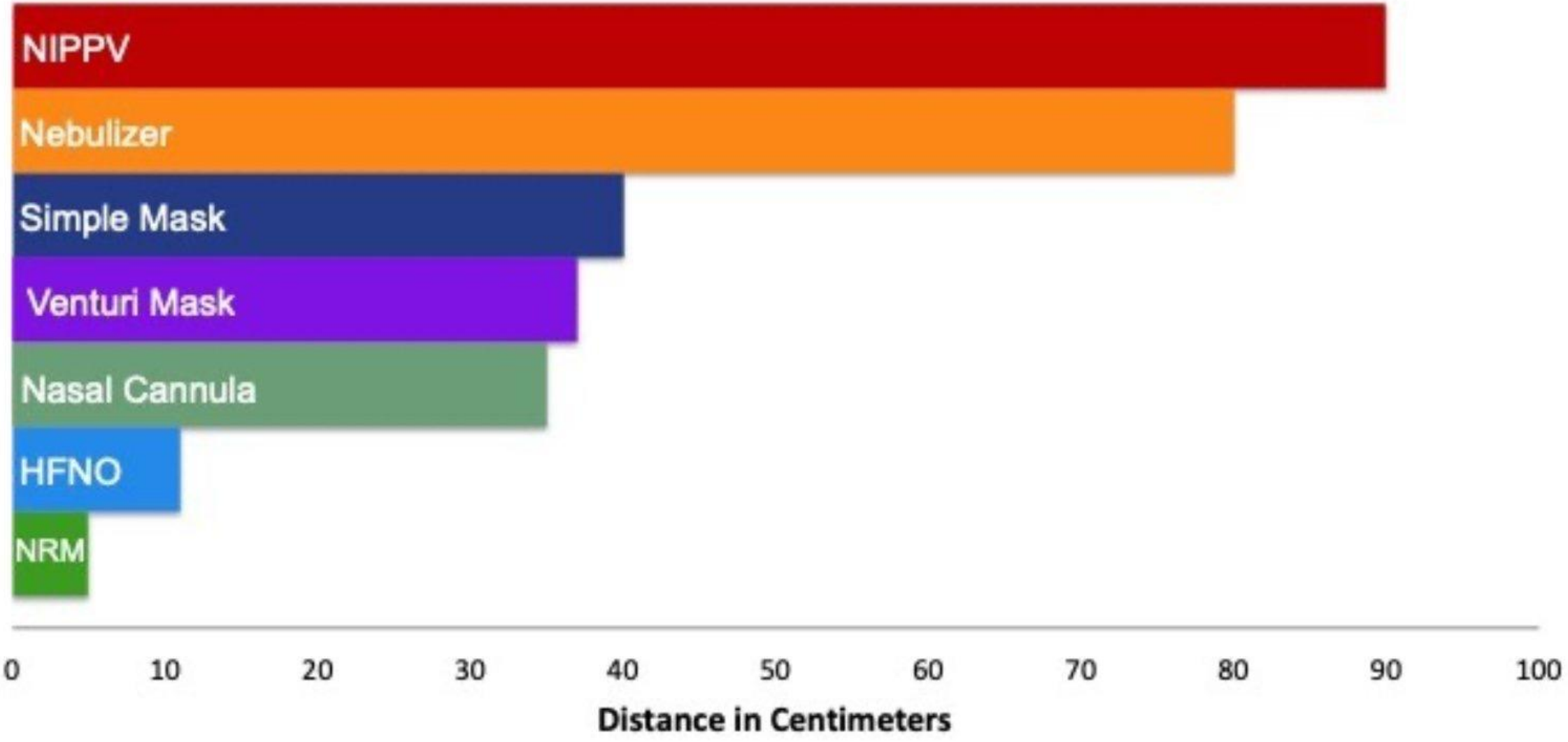


Figure 1. Comparison of aerosol dispersion differences (cm) using various treatment modalities.

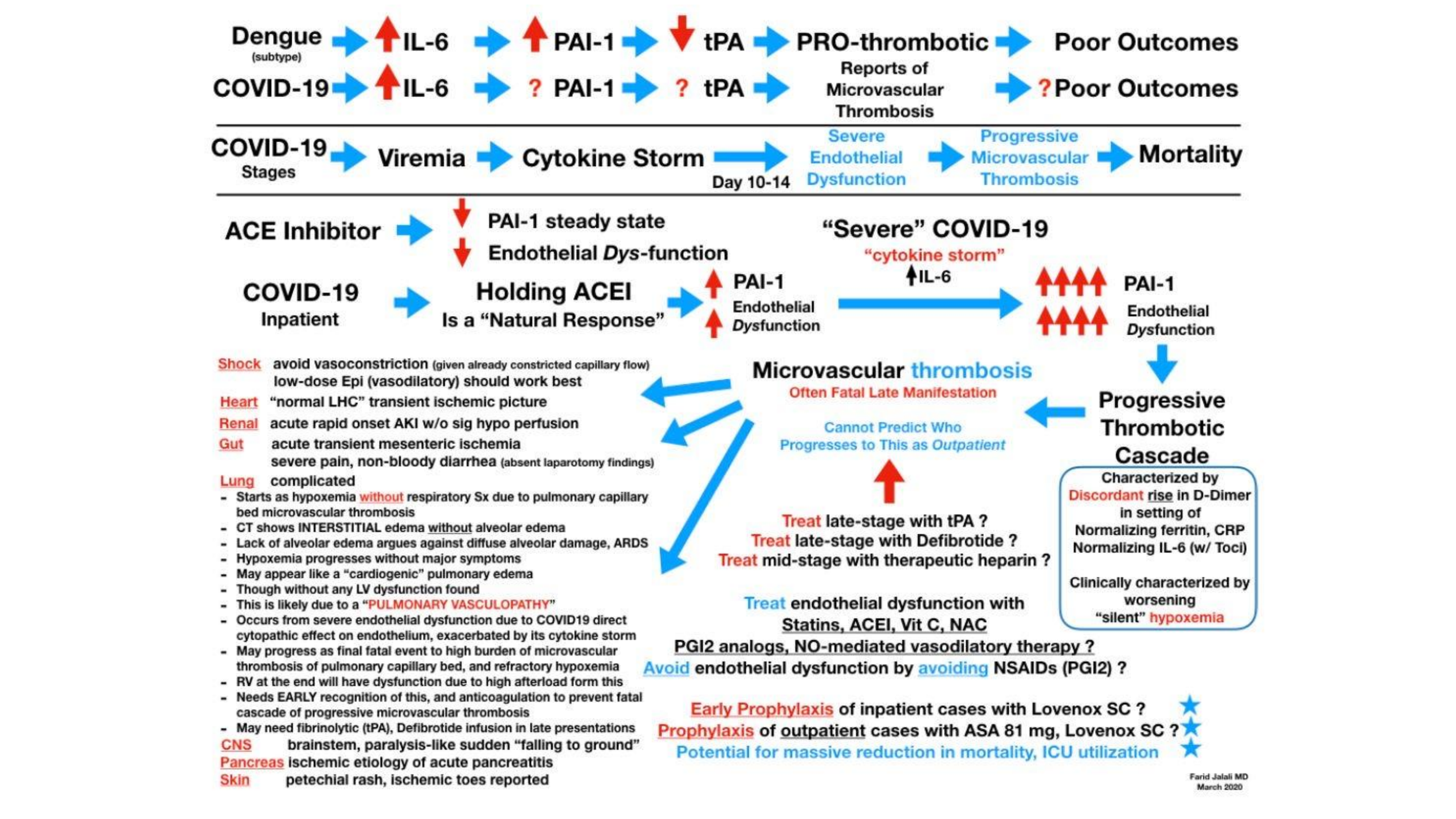


ANTIVIRALS


EQUATION
CRISIS
WRONG
MATH
LOSE
TRUE
FALSE
BUSINESS
INVEST
PROFIT
LOSER
INCOME MIND
2 < 3 < 5
VOLUME
+60% OFF
SUFFICIENCE
PRINT
CLOUD

IMMUNE MODULATION

Hypercoagulopathy


Dengue (subtype) → ↑IL-6 → ↑PAI-1 → ↓tPA → PRO-thrombotic → Poor Outcomes
COVID-19 → ↑IL-6 → ? PAI-1 → ? tPA → Reports of Microvascular Thrombosis → ?Poor Outcomes
COVID-19 Stages → Viremia → Cytokine Storm → Day 10-14 → Severe Endothelial Dysfunction → Progressive Microvascular Thrombosis → Mortality
ACE Inhibitor → ↓PAI-1 steady state
↓Endothelial Dys-function
COVID-19 Inpatient → Holding ACEI Is a "Natural Response" → ↑PAI-1 ↑Endothelial Dysfunction
"Severe" COVID-19
"cytokine storm"
↑IL-6
↑↑↑↑PAI-1 ↑↑↑↑Endothelial Dysfunction
Microvascular thrombosis
Often Fatal Late Manifestation
Cannot Predict Who Progresses to This as Outpatient
Progressive Thrombotic Cascade
Characterized by Discordant rise in D-Dimer in setting of Normalizing ferritin, CRP Normalizing IL-6 (w/ Toci)
Clinically characterized by worsening "silent" hypoxemia
Shock avoid vasoconstriction (given already constricted capillary flow)
low-dose Epi (vasodilatory) should work best
Heart "normal LHC" transient ischemic picture
Renal acute rapid onset AKI w/o sig hypo perfusion
Gut acute transient mesenteric ischemia
severe pain, non-bloody diarrhea (absent laparotomy findings)
Lung complicated
- Starts as hypoxemia without respiratory Sx due to pulmonary capillary bed microvascular thrombosis
- CT shows INTERSTITIAL edema without alveolar edema
- Lack of alveolar edema argues against diffuse alveolar damage, ARDS
- Hypoxemia progresses without major symptoms
- May appear like a "cardiogenic" pulmonary edema
- Though without any LV dysfunction found
- This is likely due to a "PULMONARY VASCULOPATHY"
- Occurs from severe endothelial dysfunction due to COVID19 direct cytopathic effect on endothelium, exacerbated by its cytokine storm
- May progress as final fatal event to high burden of microvascular thrombosis of pulmonary capillary bed, and refractory hypoxemia
- RV at the end will have dysfunction due to high afterload form this
- Needs EARLY recognition of this, and anticoagulation to prevent fatal cascade of progressive microvascular thrombosis
- May need fibrinolytic (tPA), Defibrotide infusion in late presentations
CNS brainstem, paralysis-like sudden "falling to ground"
Pancreas ischemic etiology of acute pancreatitis
Skin petechial rash, ischemic toes reported
Treat late-stage with tPA ?
Treat late-stage with Defibrotide ?
Treat mid-stage with therapeutic heparin ?
Treat endothelial dysfunction with Statins, ACEI, Vit C, NAC
PGI2 analogs, NO-mediated vasodilatory therapy ?
Avoid endothelial dysfunction by avoiding NSAIDs (PGI2) ?
Early Prophylaxis of inpatient cases with Lovenox SC ?
Prophylaxis of outpatient cases with ASA 81 mg, Lovenox SC ?
Potential for massive reduction in mortality, ICU utilization
Farid Jalali MD
March 2020

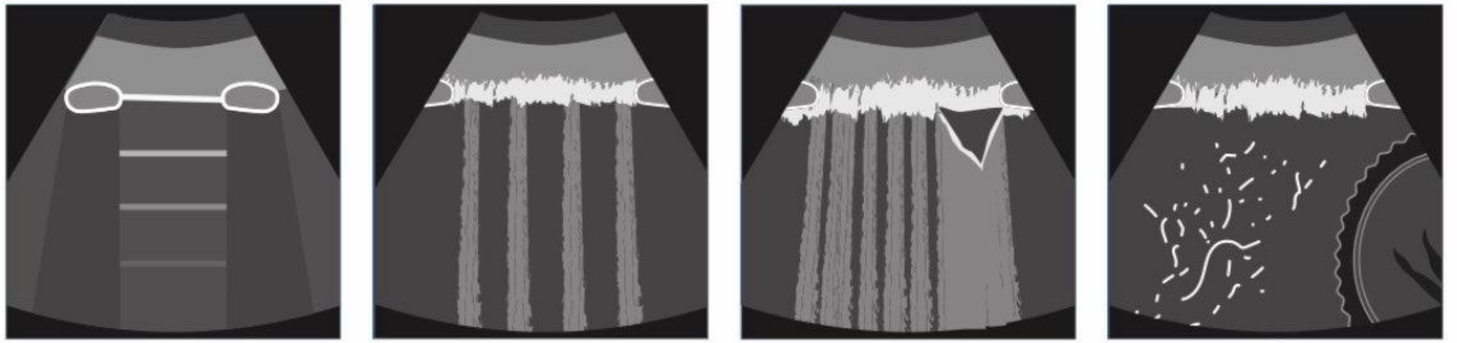
Lung U/S

AERATED
A-lines

PARTIALLY
AERATED
B-lines

COMPLETELY
DE-AERATED
Consolidation

DETERIORATION



IMPROVEMENT

MODERATE

SEVERE

CRITICAL

Lung aeration

100%

0%

LUS:	Lung sliding A-lines	Irregular pleura B-lines - Increase in number and distribution (multifocal, discrete)	Coalescent B-lines Small pleural consolidations Increased involvement of upper and anterior areas.	Consolidation (non-translobar & translobar) Air bronchograms Pleural effusion (rare)

CPR

Outcome of CPR in patients with COVID19 who arrest in hospital

136 patients had CPR attempted

of these, it was initially ‘successful’ in 18

‘successful’= ROSC (return of spontaneous circulation) achieved

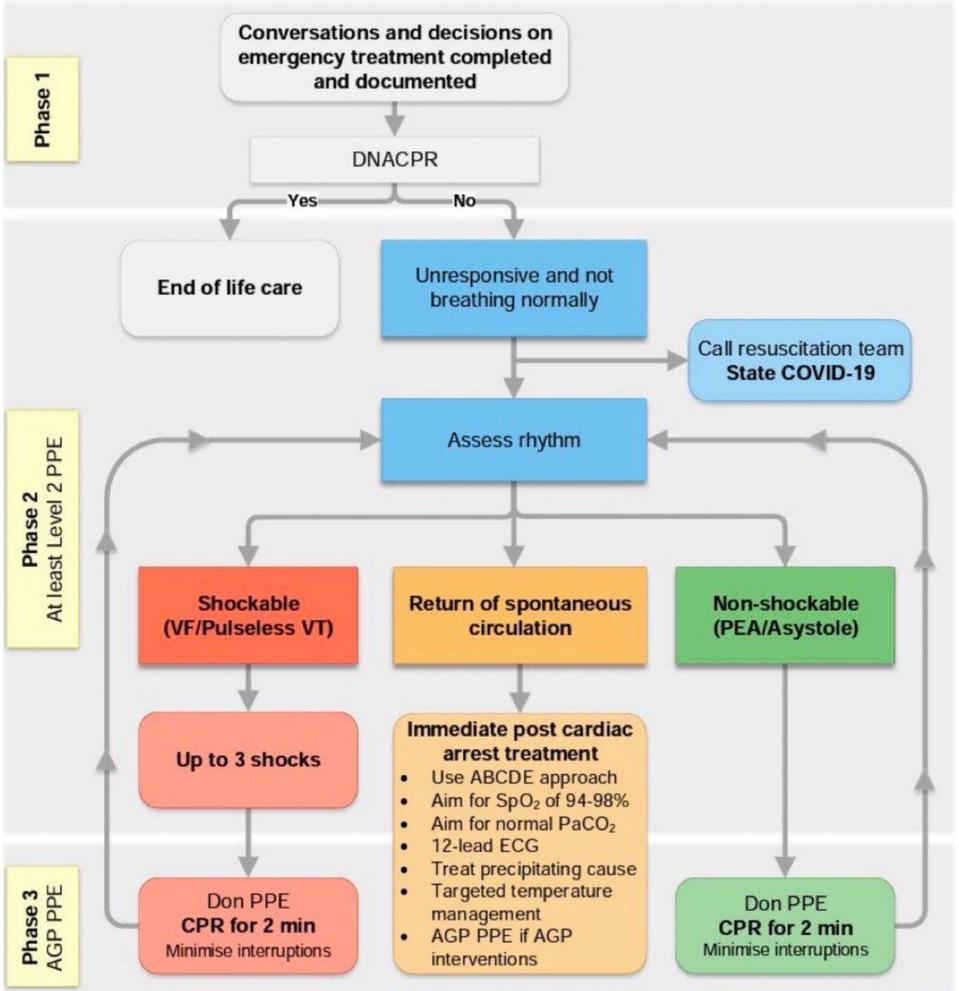
4 survived at least 30 days

1 had a favourable neurological outcome

Source: Shao, F. et al. In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China. Resuscitation. 2020. In press, available at https://doi.org/10.1016/j.resuscitation.2020.04.005

Resuscitation Council UK

Adult Advanced Life Support for COVID-19 patients



During CPR

- Ensure high quality chest compressions
- Minimise interruptions to compressions
- Give oxygen
- Consider reversible causes 4Hs and 4Ts
- Use waveform capnography
- Continuous compressions when advanced airway in place
- Vascular access (IV or IO)
- Give adrenaline every 3-5 min
- Give amiodarone after 3 shocks

Recommended PPE

Level 2 PPE

- Disposable gloves
- Disposable apron
- Fluid resistant surgical mask
- Disposable eye protection

Level 3 AGP (aerosol generating procedures) PPE

- Disposable gloves
- Disposable gown
- Filtering face piece (FFP3) respirator
- Disposable eye protection

Consider

- Ultrasound imaging
- Mechanical chest compressions to facilitate transfer/treatment
- Coronary angiography and percutaneous coronary intervention
- Extracorporeal CPR

25/03/2020

Vent References

VOLUME ASSIST/CONTROL VENTILATION

by Nick Mark MD

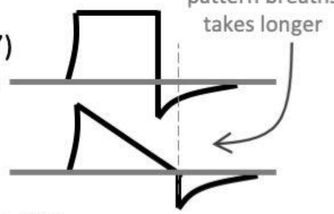
ONE onepagericu.com @nickmmark Link to the most current version →

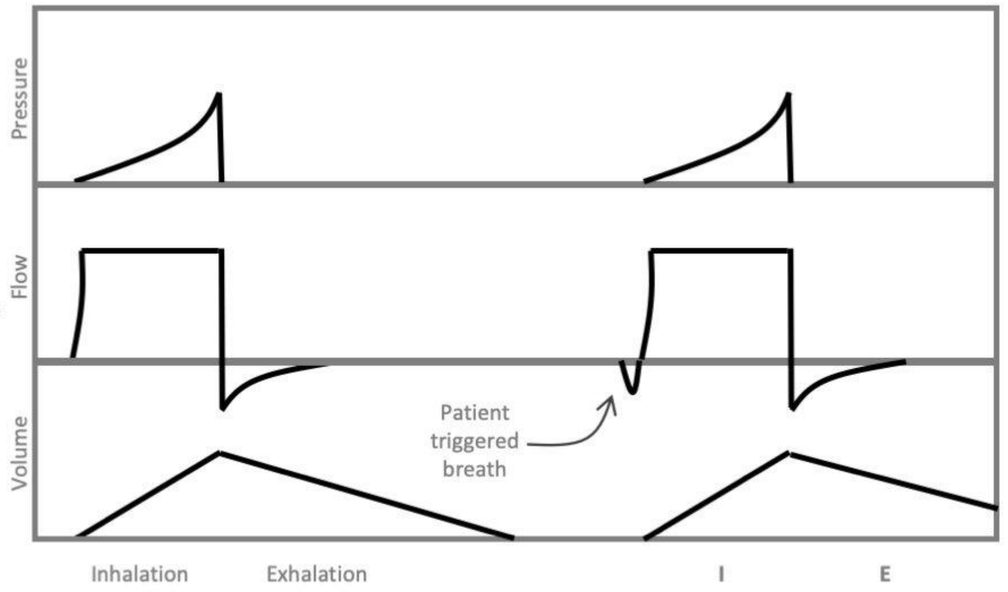
How does this mode work?

- Delivers a set volume of air with each breath; patient triggered breaths are identical to machine triggered breaths
- Time and patient triggered, volume cycled, volume limited mode

What are the variables I set?

- ***RR*** **–** respiratory rate
- ***TV*** **–** tidal volume (better to express in terms of cc/kg PWB than ccs)
- **PEEP –** positive end expiratory pressure (typically at least +5)
- **FiO2** – fraction of inhaled oxygen (typically at least 30%)
- $\dot{V}$ – ("v dot) inspiratory flow rate (typically 30-60 lpm)
- **Flow pattern** – is the flow constant (e.g. square wave) or decelerating ('decel') Decel may be more comfortable but it prolongs the inspiratory phase





When should I use this mode?

- Ensures that a patient receives a minimum MV
- This is a good general-purpose mode; good for providing Lung Protective Ventilation (LPV)
- PRVC may have lower peak pressures; pressure modes may be more comfortable for select patients

What do I need to monitor?

- Need to make sure the peak pressure and plateau pressure do not exceed safe limits.
  → If P_{plat} is too high decrease the Tv
- You will also need to monitor MV. If the patient is triggering excessively (or auto-triggering), they can become alkalemic.

Choosing Initial settings

- RR - Try to match the persons initial minute ventilation by selecting a rate to match their pre-intubation MV needs.
- TV - Use 8cc/kg PBW and adjust as needed. For patients with ARDS (or at high risk) consider starting at 6cc/kg PBW.
- Start with low PEEP and high FiO2 and wean to maintain SpO2 goal (typically > 90%).

ABG: **pH / PCO_2 / PaO_2 / HCO_3**

	VENTILATION		OXYGENATION	
SETTINGS:	**RR**	**Tv**	**PEEP**	**FiO2**
EXAMPLE:	**12**bpm	**6**cc/kg	**+5**	**50%**
	If you want to **increase** the pH → **increase** the minute ventilation (MV) by changing the RR and TV		If you want to **increase** the PaO2 or SpO2 **increase** the FiO2 and PEEP	

Advanced settings

I:E RATIO		TRIGGER
$\dot{V}$	Flow Pattern	
40lpm	Square wave Decelerating	Flow Pressure
If you want to decrease Inhalation time (increase the I:E ration) → increase the inspiratory flow rate (V) and use square wave flow pattern		Flow trigger is may be more sensitive that pressure; adjust to limit autotriggering

v1.0 (2020-04-09)

VENT TROUBLESHOOTING: HIGH PEAK PRESSURES

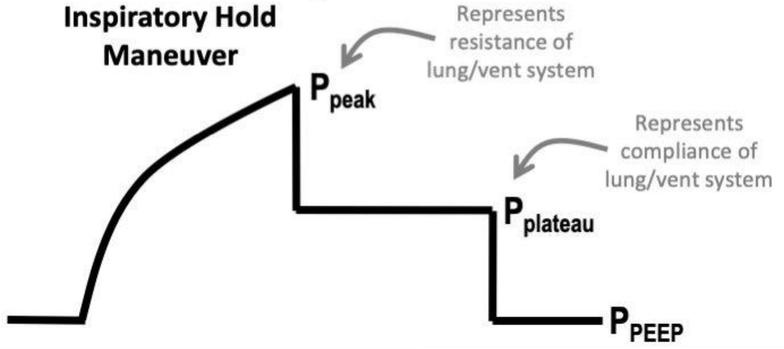
ONE
onepagericu.com
@nickmmark
Link to the most current version →

High Peak Inspiratory Pressures (PIP)

Try in-line suctioning

Perform an **inspiratory hold maneuver**

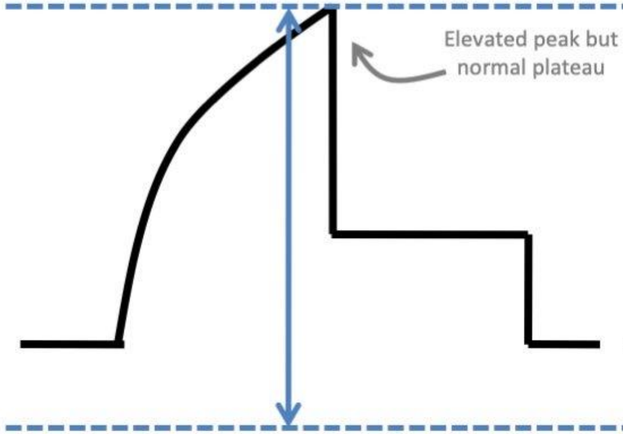
Pressure Tracing During Inspiratory Hold Maneuver



$$\text{Resistance} = \frac{\Delta P}{\text{Flow}} = \frac{\Delta P}{P_{plat} - P_{PEEP}}$$

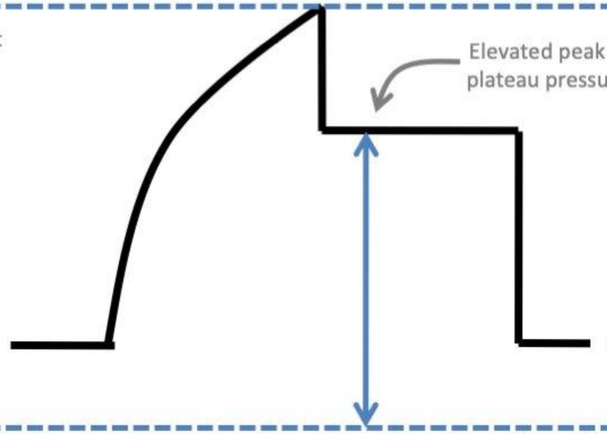
$$\text{Compliance} = \frac{\Delta V}{\Delta P} = \frac{V_T}{P_{plat} - P_{PEEP}}$$

High Ppeak, Normal Pplat
Resistance Problem



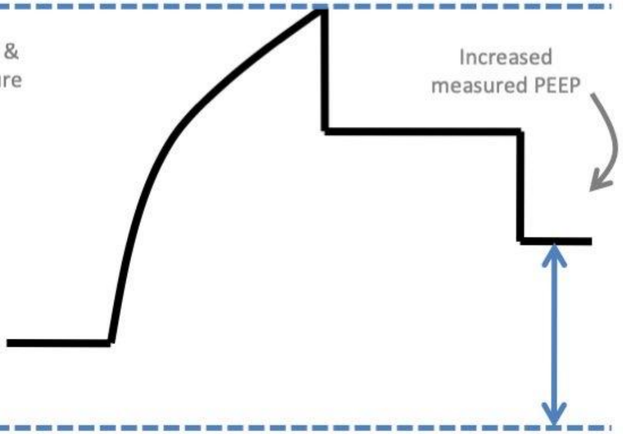
- Tubing problems
- Mucous plugging
- Bronchospasm

High Peak, High Pplat
Compliance Problem



- Parenchymal Problem
  - Pulmonary Edema
  - ARDS
- Abdominal Problem
- Chest Wall Problem
  - TLSO, Burns,
  - Fentanyl wooden chest
- Mainstem Intubation
- Pneumothorax

Elevated Baseline
PEEP Problem

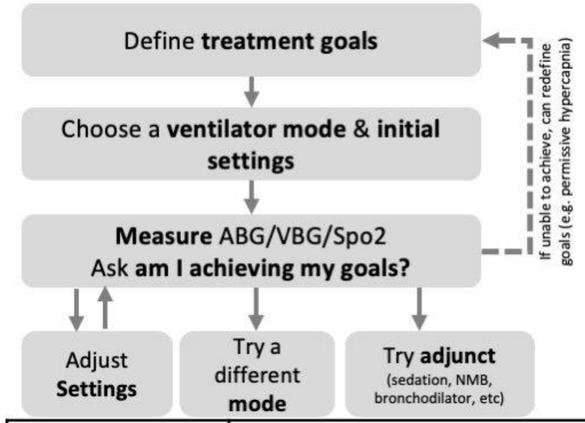


- Auto-PEEP

v1.1 (2020-04-09)

OVERVIEW OF VENTILATOR MODES by Nick Mark MD

ONE
onepagericu.com
@nickmmark
Link to the most current version →



Goals for mechanical ventilation:

1. **Oxygenation** – support PaO2/SpO2
2. **Ventilation** – maintain pH
3. **Patient comfort** – vent synchrony, ↓ sedation
4. **Facilitate weaning** – minimize muscle loss, promote readiness to wean from support

Ventilator Modes:

Fall into two broad categories: ***pressure*** and ***volume*** modes. *Each mode has three features*:

- Trigger (T) – what initiates a breath?
- Cycle (C) – what ends a breath?
- Limit (L) – what stops a breath early?

Each mode has **Pros** and **Cons** to consider.

Measurement and optimization:

ABG: **pH / PCO2 / PaO2 / HCO3** — Pulse Ox: **SpO2**

VENTILATION
If you want to increase the pH → increase the ventilation parameters

OXYGENATION
If you want to change the PaO2 or SpO2 adjust oxygenation parameters (FiO2 and PEEP)

v1.0 (2020-04-03)

Mode	Description	Pros	Cons	Major settings / example	Monitor
VC Volume Control (a.k.a. assist control volume)	Every breath delivered (mandatory and patient triggered) is the same set **volume (TV)** T – time/pressure/flow, C – volume, L – volume	Good general-purpose mode; Ensures a minimum MV is achieved. Good mode for lung protective ventilation (LPV)	Requires you to monitor pressures to avoid barotrauma. (See my *OnePager* on ARDS for details.)	**RR, TV, PEEP, FIO2** **12 bpm, 450cc, +8, 60%** *(RR – respiratory rate, TV – tidal volume)*	Pressures (Ppeak, Pplat)
PC Pressure Control (a.k.a. assist control pressure)	Every breath delivered (mandatory & patient triggered) is a set **pressure (IP)** for a **set time (T_I)** T - time/pressure/flow, C – time, L - pressure	Good for limiting pressure; may be more comfortable for select patients. Also can be used for LPV (no difference in mortality)	Requires you to monitor volumes to avoid volutrauma or hypoventilation	**RR, IP, T_I, Risetime, PEEP, FIO2** **12 bpm, 25 cmH_2O, 0.9 sec, 0.15 sec, +8, 60%** *(IP – inspiratory pressure, T_I – inspiratory time)*	Volumes (TV, MV)
PRVC Pressure Regulated Volume Control (a.k.a. VC+, APV, Autoflow)	***Hybrid*** PC mode that dynamically changes inspiratory pressure to deliver a desired volume T - time/pressure/flow, C – volume, L - volume	Guarantees TV but delivers pressure-controlled breaths; (e.g. low risk of causing VILI), which potentially may be more comfortable for patients	In patients who are struggling (e.g. high WOB) this mode will provide ***less*** support	**RR, TV, T_I, Risetime, P_{max}, PEEP, FIO2** **12 bpm, 450cc, 0.9 sec, 0.15 sec, 30 cmH_2O, +8,60%** *(P_{max} – maximum pressure)*	Pressures & volumes
SIMV Synchronous Intermittent Mandatory Ventilation	Delivers mandatory breaths with a fixed volume but patient **can't** trigger (patient breaths are not the same as mandatory breaths); can use PS T – time , C – volume, L - volume	May be useful for patients with hiccups to avoid alkalemia	Seldom used; not effective for weaning; often found to be uncomfortable	**RR, TV, PEEP, FIO2** **12 bpm, 450 cc, +8, 60%**	Pressure (Ppeak Pplat)
PS Pressure Support	**All** breaths are patient initiated; ventilation determined solely by patient (no backup rate). T – pressure/flow, C – flow, L - pressure	Ideal weaning mode (used in SBTs and for prolonged periods); most comfortable because it allows patient to control ventilation	Does not guarantee a rate; need to monitor to ensure adequate ventilation	**PS, PEEP, FiO2** **+10, +5, 40%** *Note that **PS** is above **PEEP** so "Ten over Five" PIP = 15cmH2O*	Volumes (TV, MV)
APRV Airway Pressure Release Ventilation (a.k.a. Bi-Vent)	**Inverse ratio ventilation** (e.g. I time > E time) that allows patient to breath spontaneously; can combine w/ PS T – time, C – time, L - pressure	Great for ARDS patients who are spontaneously breathing (e.g. not on NMB); *may improve comfort & oxygenation* ***(but** no mortality benefit**)***	Complex mode/settings; Risk of VILI if settings are done improperly; doesn't make sense if on NMB	**T_{High}, T_{Low}, P_{high}, P_{low}, FIO2** **5.5 sec, 0.5 sec, 25 cmH_2O, 0 cmH_2O, 60%** *($T_{High/low}$ – time high/low, $P_{High/low}$ – pressure high/low, also note that **Plow** is analogous to **PEEP**)*	Volumes & gas exchange PCO2 / EtCO2