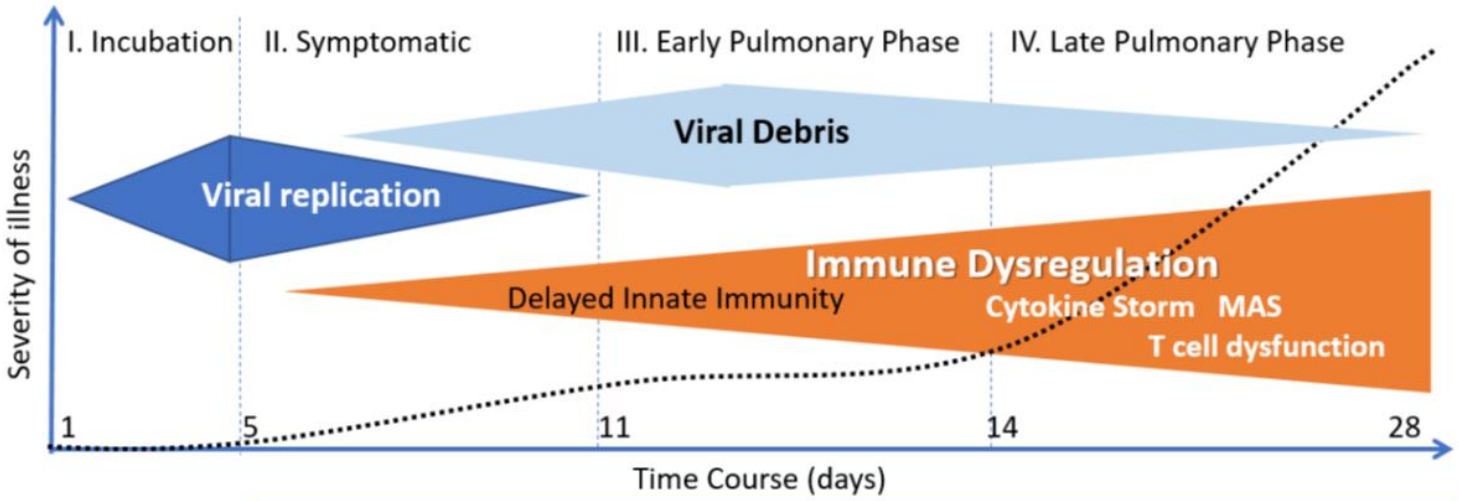

In The name of God

ICU

MANAGEMENT & PRACTICE

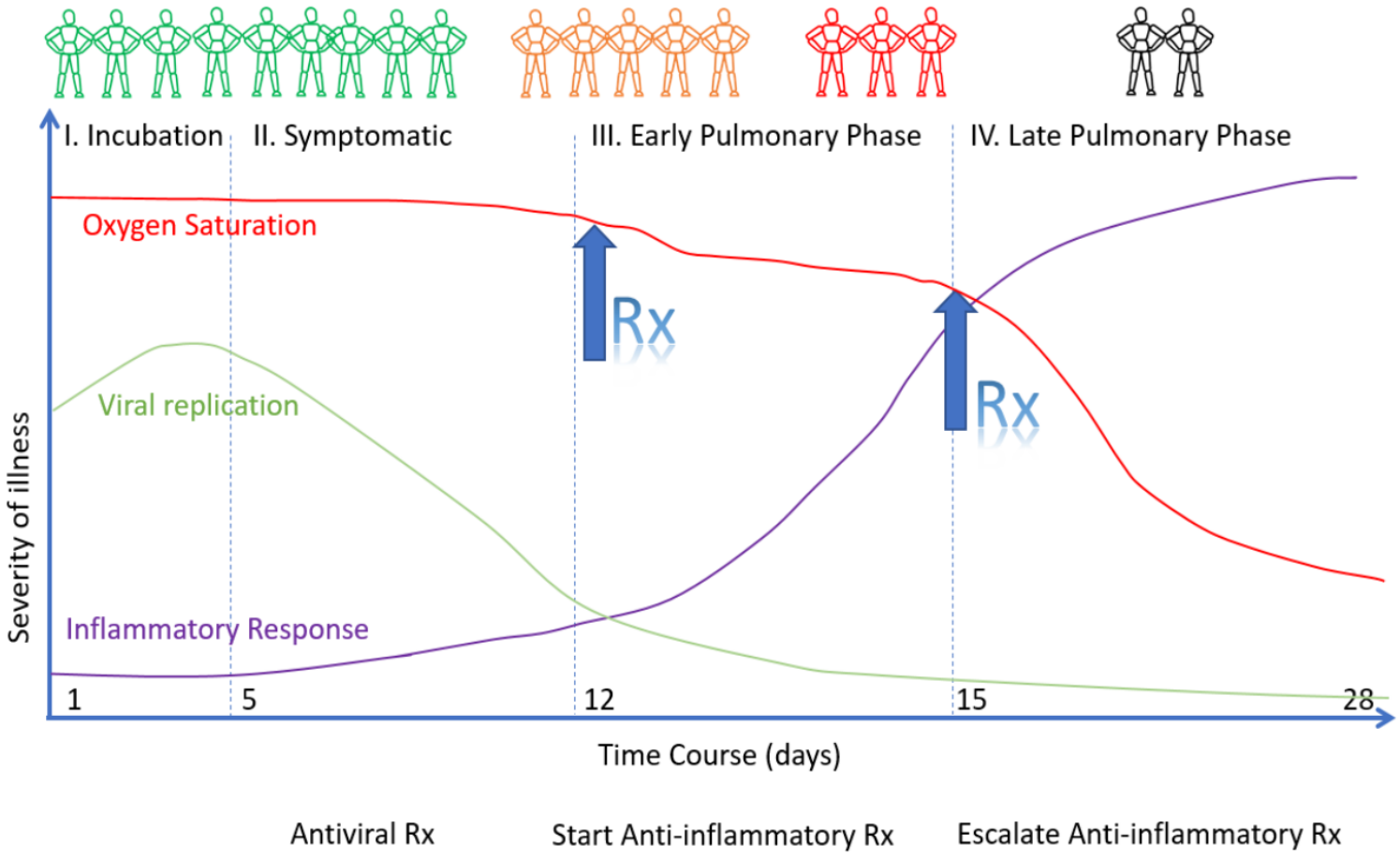
Coronavirus disease 2019 (COVID-19) is the ***third*** coronavirus infection in two decades that was originally described in Asia, after severe acute respiratory syndrome (***SARS***) and Middle East respiratory syndrome (***MERS***).

The course of COVID-19

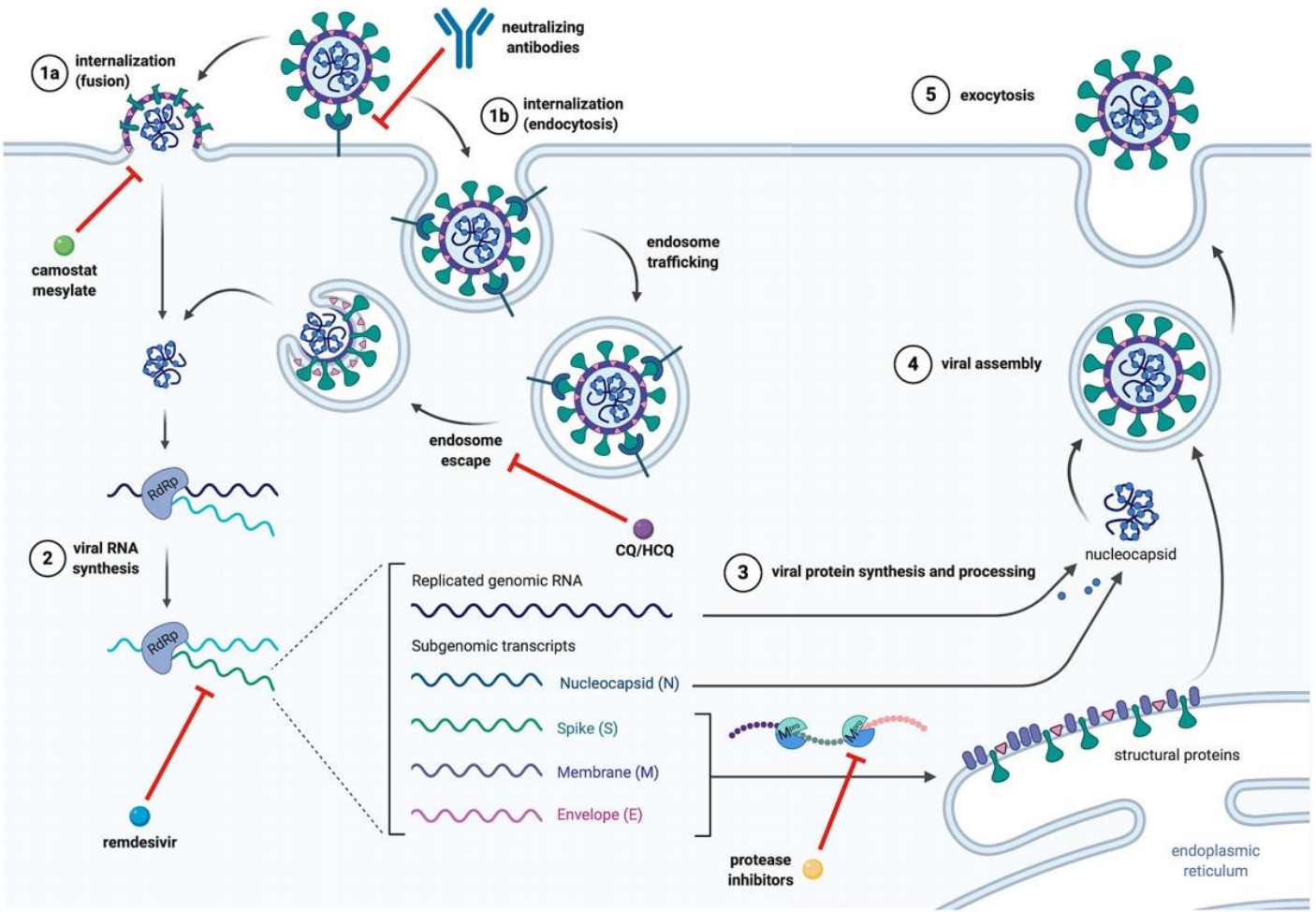


Ground-glass infiltrates	+	++	+++	++++
Clinical Symptoms	Fever, malaise, cough, headache, diarrhea	SOB – Mild hypoxia ≤4 L/min N/C & aSat < 94%	Progressive hypoxia	
Treatment approach	Antiviral Rx	Anti-inflammatory Rx		
Potential therapies	? Ivermectin	Methylprednisolone 40mg q 12 inc. to 80 mg q 12 if reqd.		
		Enoxaparin 60 mg/day	Enoxaparin 1mg/kg s/c q 12	
	? Remdesivir (IV)			
	Vitamin C + Vitamin D + Quercetin + Zinc			

The course of COVID-19



Life cycle of SARS-CoV-2



Severity of Disease

- ***Asymptomatic (I)***
- ***Mild illness (II)***
  - low-grade fever(<38°C) with few symptoms
  - no imaging findings of pneumonia
- ***Moderate illness (II & III)***
  - Fever
  - respiratory symptoms
  - SPO2: 90-94%
  - Imaging features of pneumonia

Severity of Disease

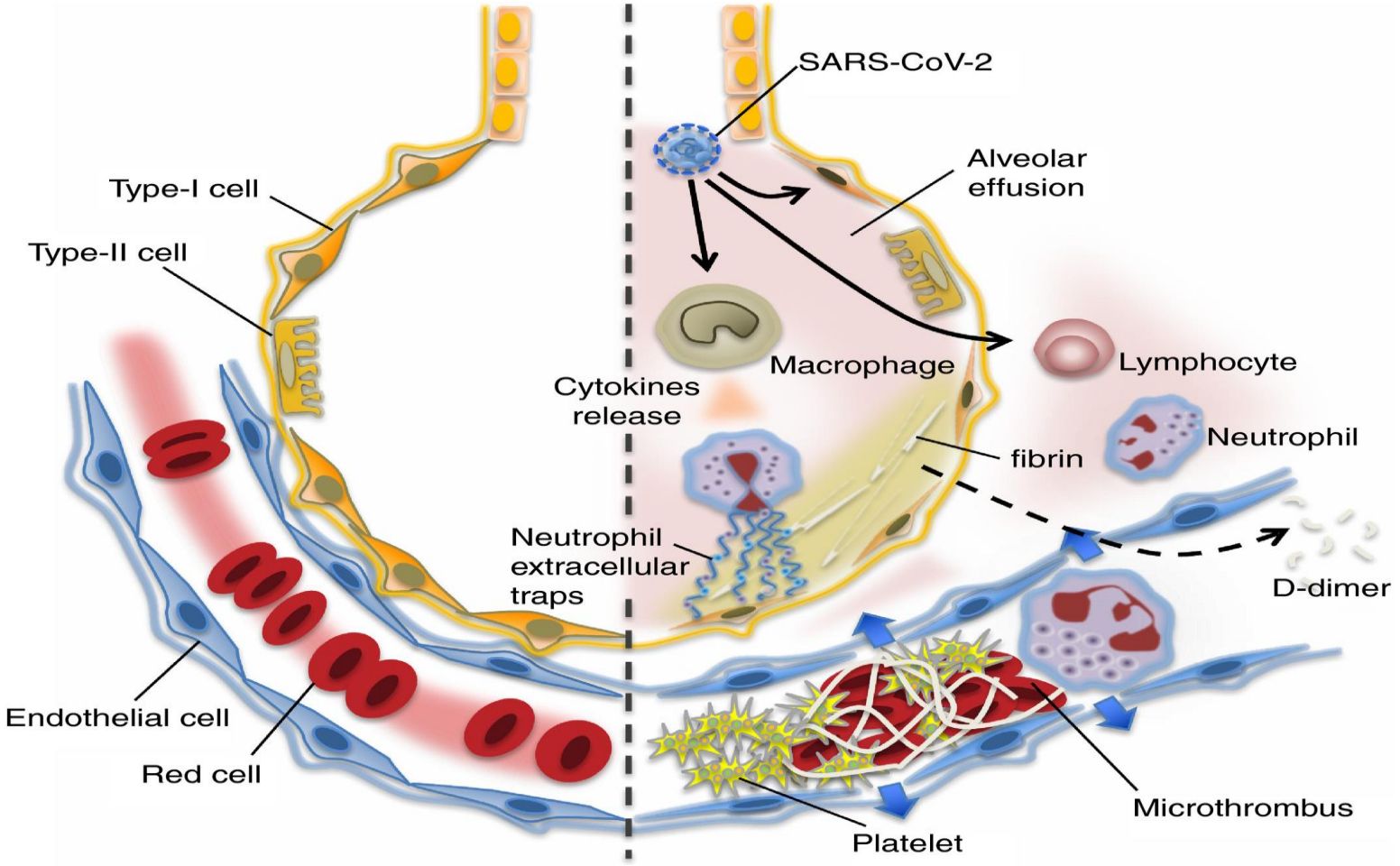
- ***Severe disease(respiratory distress) (III)***
  - Respiratory rate ≥ 30/min
  - SPO2 < 93% at rest
  - PaO2/FIO2 ≤ 300mmHg
- ***critical disease (IV)***
  - respiratory failure with the need for mechanical assistance
  - Shock
  - extrapulmonary organ failure requiring ICU management

Pathology of covid 19

- Three core pathologic processes lead to multi-organ failure and death in COVID-19:
- ***Hyper-inflammation (Cytokine storm)***
- ***Hyper-coagulability***
- ***Severe Hypoxemia***


Cytokine Storm in
COVID-19
BioLegend®

Hypercoagulability



Severe Hypoxemia

- lung inflammation caused by the cytokine storm, together with microthrombosis in the pulmonary circulation severely impairs oxygen absorption resulting in oxygenation failure.

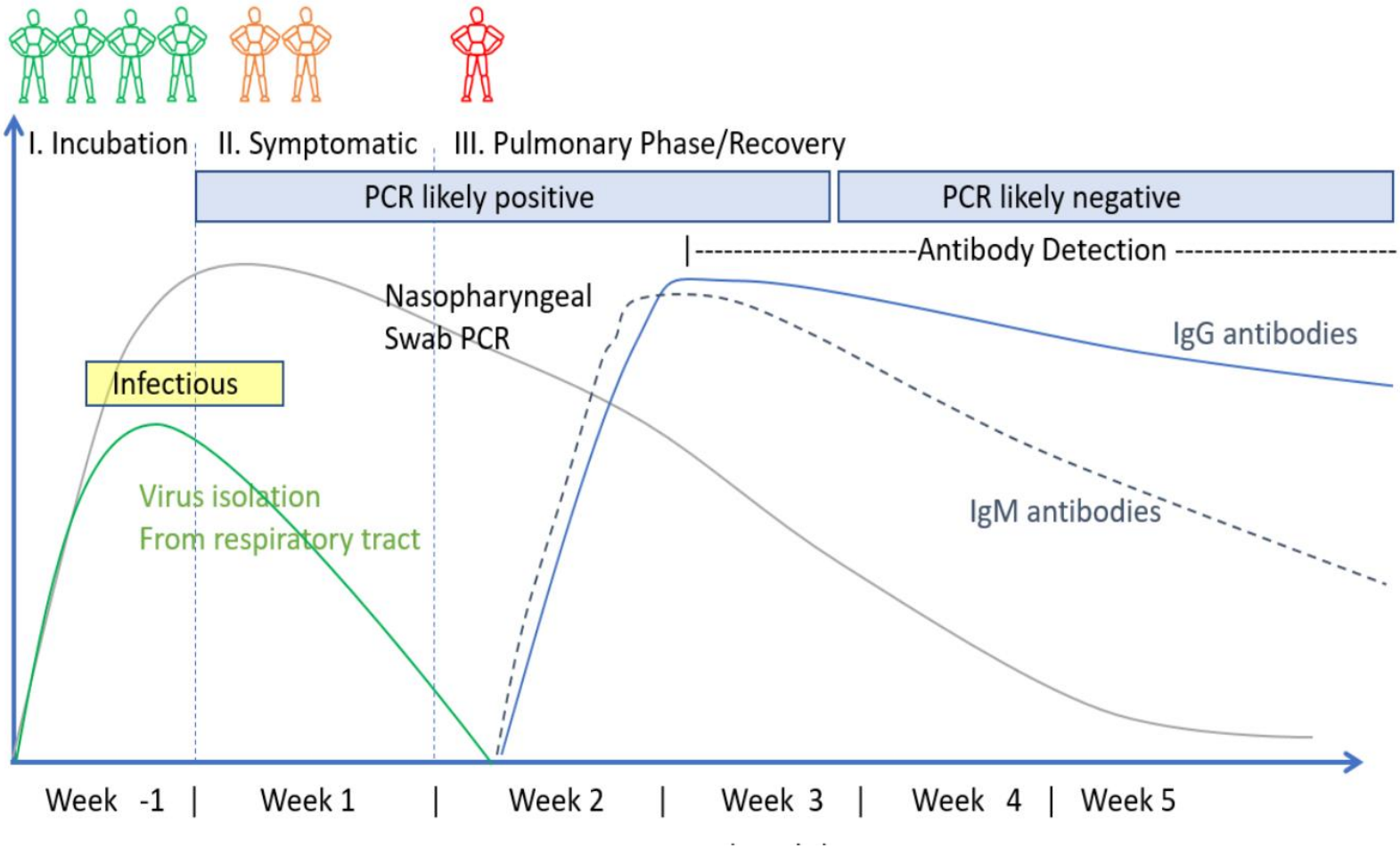
ICU admission

- ***Respiratory distress***
  - RR > 30/min
  - P/F < 200 or PaO2 < 60 mmHg or SPO2 < 90% (FIO2> 50%)
- ***MAP < 60mmHg***
- ***↓ LOC***
- ***MOF***

Paraclinic

- FBS, BUN,Cr,Na, K, CBC
- PT, PTT, INR
- CRP, LDH, Feritin, D-Dimer
- IL6
- PCT
- ABG
- Ca, P, Mg, Alb, ALT, AST, Bil
- sputum and blood cultures
- ECG
- Cardiac enzyme

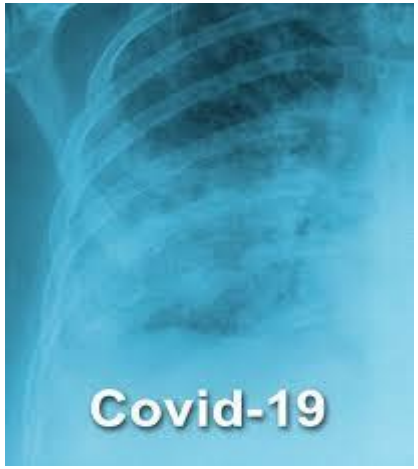
Time course of laboratory tests for COVID-19



Chest Imaging

- ***abnormalities on chest imaging typically bilateral:***
  - Patchy ground glass opacities
  - consolidation

- ***SARS-CoV-2 has been associated with a preferentially:***
  - peripheral distribution of opacities
  - absence of pleural effusions
  - absence of lymphadenopathy



Respiratory Support

- Try to avoid intubation if at all possible
- Accept "***permissive hypoxemia***" (keep SO2 > 84%)

O2 Therapy

- Nasal Cannula up to 6 L/min ***(SPO2: 90-92%)***
- Face Mask 7-10 L/min ***(SPO2: 85-89%)***
- NRBFM or Reservoir mask (good fit) 10-15 L/min ***(SPO2< 85%)***
- High Flow Nasal Cannula (HFNC) titer to target SpO2
- Non-invasive Ventilation (NIV) with high flow oxygen (10-20 L/min)
- Intubation and Mechanical Ventilation

Nasal Cannula

flow	Flo2
1	24%
2	28%
3	32%
4	36%
5	40%
6	44%

Simple face mask

flow	FIO2
5-6	40%
6-7	50%
7-8	60%

Mask with reservior bag

flow	FIo2
6	60%
7	70%
8	80%
9	80%
10	80%

High-flow Nasal Cannula (HFNC)

- Heated(37°C) and humidified(99.9%) oxygen up to 60 L/min
- Deliver high-flow oxygen directly to the nasopharynx throughout the respiratory cycle
- ***The physiologic consequences of HFNC include:***
  - ↑TV
  - ↓RR
  - ↑PEEP (1CmH2O/10lit/min)
  - ↑expiratory end tidal volume
  - improvement of physiologic dead space(co2 wash out)
  - improved work of breathing and oxygenation

High-flow Nasal Cannula (HFNC)

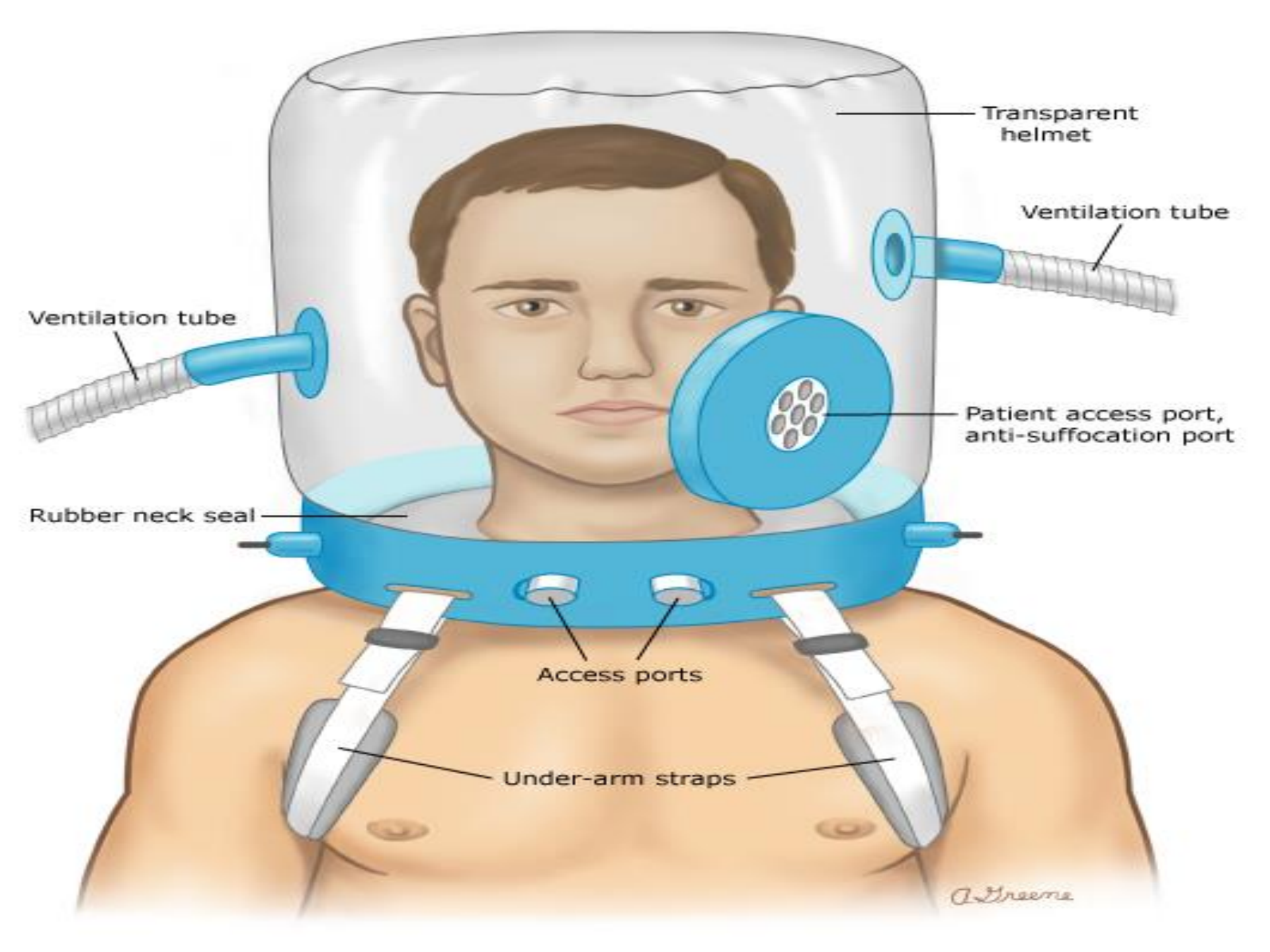
HFNC

- Hypercapnia
- Hemodynamic instability
- Multiorgan failure
- Abnormal mental status

NIV

- Tight fit mask ،helmet if available
- CPAP : 10 - 16 cmH2O
- BIPAP : I/E = 10-24 cmH2O/4-10 cmH2O (results in PS of 6 to 14)
- It depends on patient’s tolerance
- Staff availability to control delivery of NIV


CPAP


Transparent helmet
Ventilation tube
Ventilation tube
Patient access port, anti-suffocation port
Rubber neck seal
Access ports
Under-arm straps

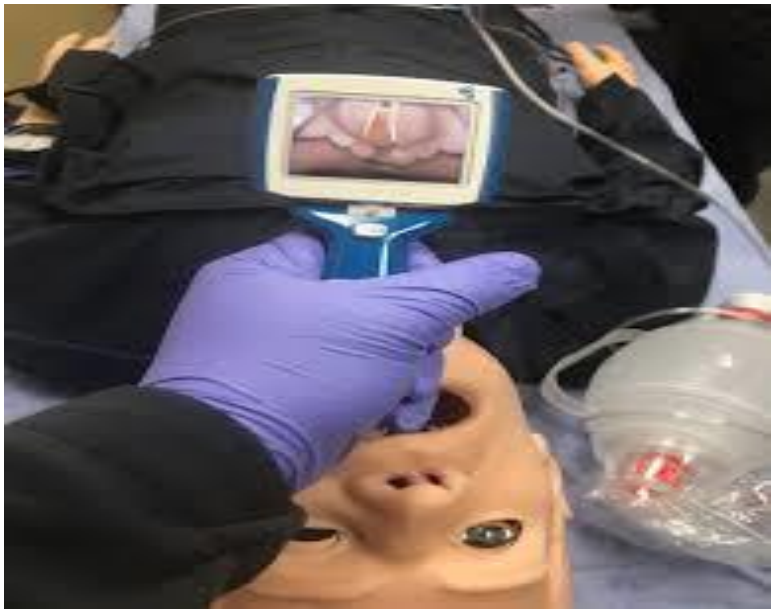

RESPIRONICS

NIV

- Hemodynamic instability
- Multi-organ failure
- Abnormal mental status

Decision to Intubate

- increased work of breathing(accessory muscle use, tachypnea)
- persistent hypoxemia despite supplemental oxygen
- agitation/altered mental status

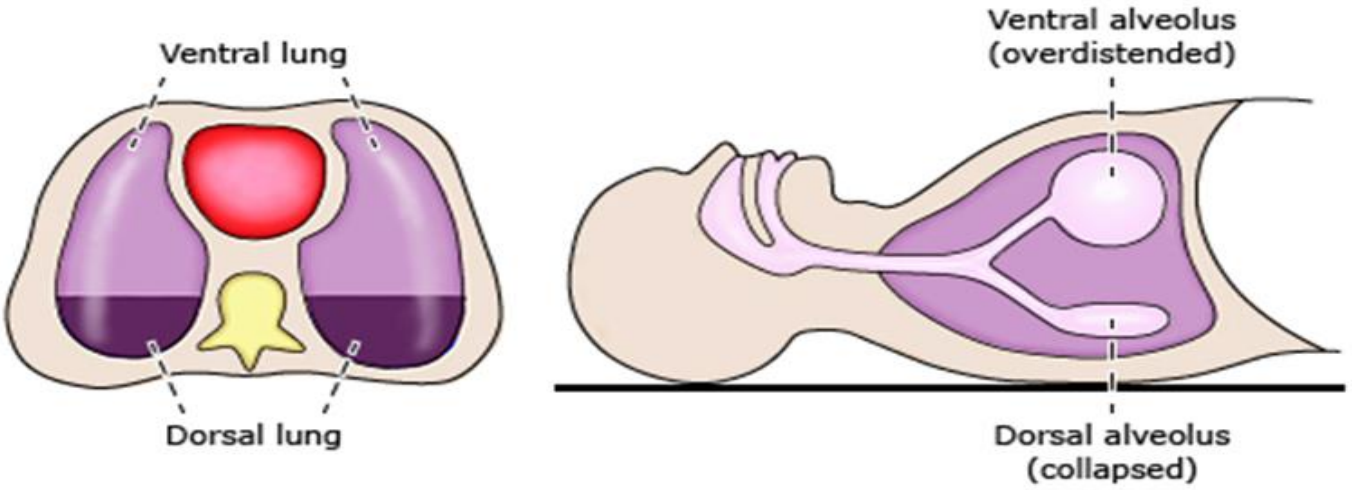
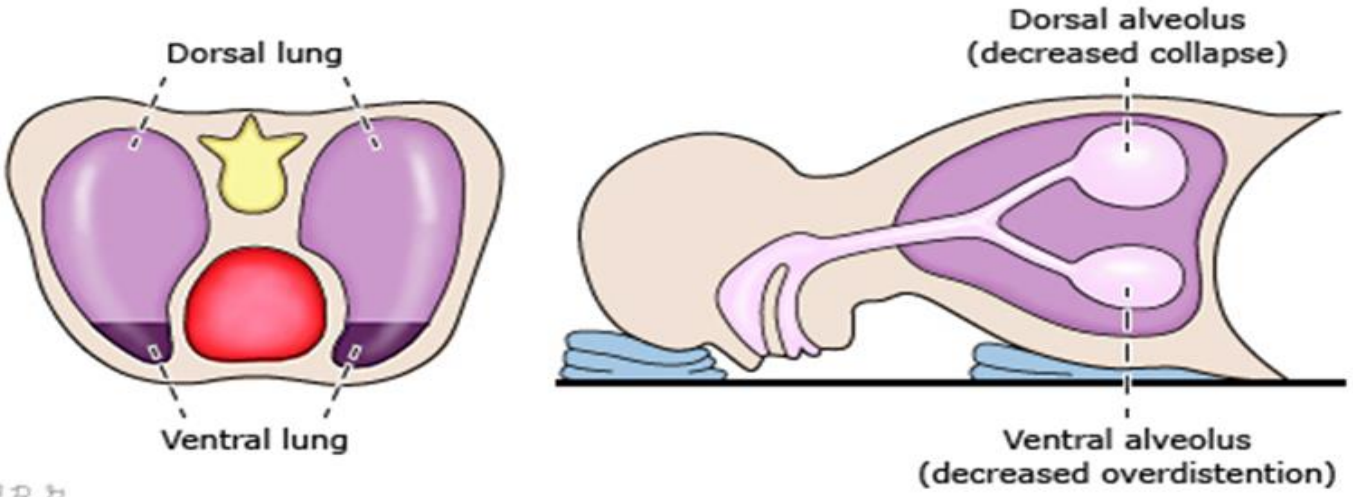


Mechanical Ventilation

- Volume protective ventilation
- Lowest driving pressure(Keep driving pressures < 15 cmH2O)
- lowest PEEP

Prone Ventilation

- ***Physiological benefits associated with prone positioning:***
  - improved recruitment
  - decreased inhomogeneity of ventilatory units
  - improved V/Q matching
  - decreased pulmonary vascular resistance

	PTP	Blood flow
Supine position		
	+ + + – – –	
Prone position		
	+ –	

Prone Ventilation

Prone Ventilation

- indications for prone ventilation include:
  - persistent moderate to severe ARDS
  - P:F ratio <100-150
  - FiO2 >0.6

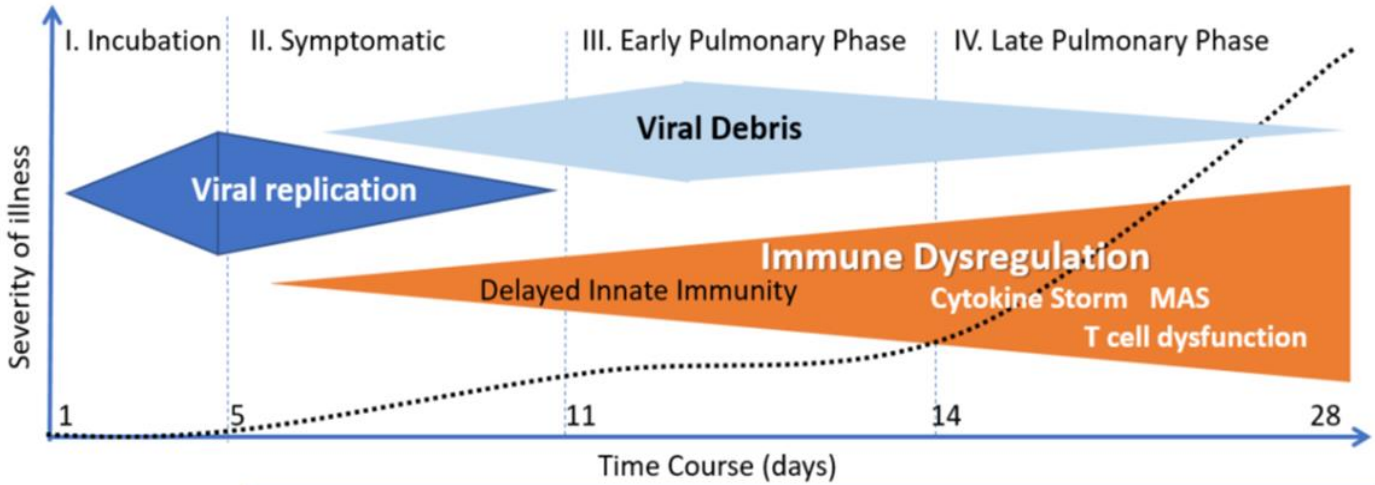
Prone Ventilation

- Contraindications to prone ventilation:
  - fresh tracheostomy
  - anterior chest wall thoracostomy tubes
  - hemoptysis
  - cardiac arrhythmias
  - Unstable spine fractures
  - Abdominal compartment syndrome
  - >1st trimester of pregnancy
  - inability to turn the neck (fixed or unstable c-spine)

Prone Ventilation

- The decision to discontinue prone ventilation at the end of a 2 hour period of supine ventilation on PEEP<10 cmH2O:
  - P/F >150-200
  - driving pressure <15 cmH2O

Treatment



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	Vitamin C + Vitamin D + Quercetin + Zinc			

Antiviral Drugs

- remdesivir
- Favipiravir
- Chloroquine
- Hydroxychloroquine
- Sovodak(sofosbuvir400 - daclatasvir60)
- ivermectin
- …

Treatment in ICU

- corticosteroids
- Anticoagulants
- Broad-spectrum antibiotics
- Famotidine
- Ascorbic acid (Vitamin C)
- Vitamin D3
- Atorvastatin
- Melatonin
- montelukast
- Thiamine

Treatment in ICU

- Magnesium
- Maintain euvolemia
- Early norepinephrine for hypotension

Corticosteroid

- Use in the pulmonary phase of COVID-19
- steroid therapy should be considered standard of care in hospitalized COVID-19 patients requiring supplemental oxygen, mechanical ventilation

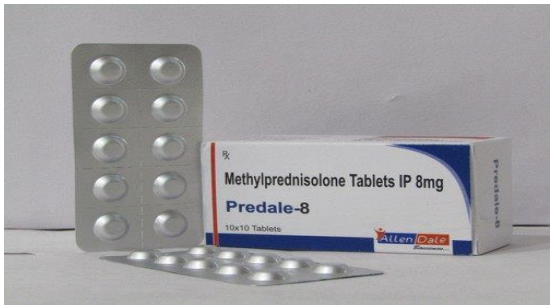
the only therapy proven to reduce the mortality in patients with COVID-19

Corticosteroid

- ***Methylprednisolone(corticosteroid of choice)***
  - better lung penetration
  - genomic data specific for SARS-CoV-2
  - successful use in inflammatory lung diseases
- ***Dexamethasone***

Methylprednisolone

- Methylprednisolone(80mg loading then 40mg Bd for 7 days and until transferred out of ICU.
- In patients with an increasing CRP or worsening clinical status 80mg Bd then 125mg Bd, then titrate down as appropriate.
- Pulse methylprednisolone 250 -500 mg /day may be required



- The combination of steroids and ascorbic acid (vitamin C) is essential. Both have powerful synergistic ***anti-inflammatory actions***.
- Vitamin C ***protects the endothelium*** from oxidative injury.
- vitamin C Increases the ***expression of interferon-alpha*** while corticosteroids (alone) decease expression of this important protein.

Anticoagulant Therapy

- Enoxaparin (1 mg kg s/c q 12 hourly)
- Heparin

high intensity anticoagulation reduces mortality of hospitalized patients with COVID-19

Atorvastatin

- Atorvastatin(80 mg/day)

- anti-inflammatory
- Immunomodulator
- Antibacterial
- antiviral

- Due to numerous drug-drug interactions simvastatin should be avoided

Treatment

- Melatonin 10 mg at night (the optimal dose is unknown).
- Famotidine 40 mg BID (20-40 mg/day in renal impairment)
- Vitamin D3 20 000 – 60 000 iu single oral dose then 2000-4000 unit/d
- Thiamine 200 mg IV q 12 hourly
- Magnesium: 2 g stat IV. Keep Mg between 2.0-2.4 mmol/l. Prevent hypomagnesemia (increases the cytokine storm and prolongs Qtc).
- Montelukast: 10mg/day

Salvage Treatment

- Immunomodulators
  - IVIG
  - interferons
  - Anti IL6 receptor(actemra)
  - Kinase inhibitors(imatinib)(imatinib reverses pulmonary capillary leak)
- Convalescent plasma
- Plasmapheresis
- Hemoperfusion
- ECMO
- rtPA

Complications

- ***acute respiratory distress syndrome (the most common in 60–70%)***
- ***shock (30%)***
  - Distributive shock (sepsis)
  - cardiogenic shock (acute heart failure)
- ***myocardial dysfunction(20–30%)***
  - Myocartditis
  - arrhythmia
- ***acute kidney injury (10–30%)***
  - Sepsis
  - Macro & micro thromboemboly

ICU Discharge

- PaO_2 > 60mmHg & $PaCO_2$ < 50mmHg without respiratory support
- MAP > 60mmHg without vasopressor & inotropic support
- No metabolic & acid-base disturbances
- Organ failure improvement

Personal Protective Equipment (PPE) Kit

Eye Goggle

2 Face Mask
(3 Ply Disposable Face Mask)

Surgical Gloves

Shoe Cover

PACK OF 500

Full Body protecting suit
with cap attached

Disposable Bag

Viral Transmission

droplet transmitted?

Airborne transmitted?

Key difference in transmission

DROPLET

Coughs and sneezes can spread droplets of saliva and mucus

AIRBORNE

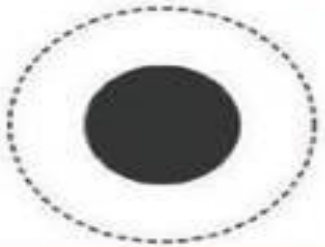
Tiny particles, possibly produced by talking, are suspended in the air for longer and travel further

More than 5 microns

Less than 5 microns

DROPLETS

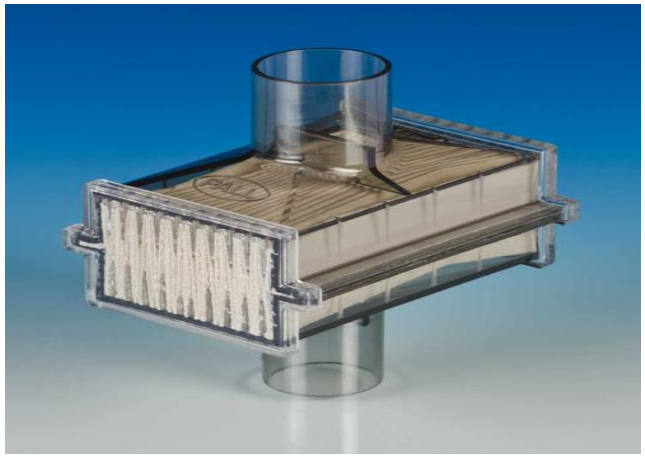
Human hair: 60 - 120 microns wide

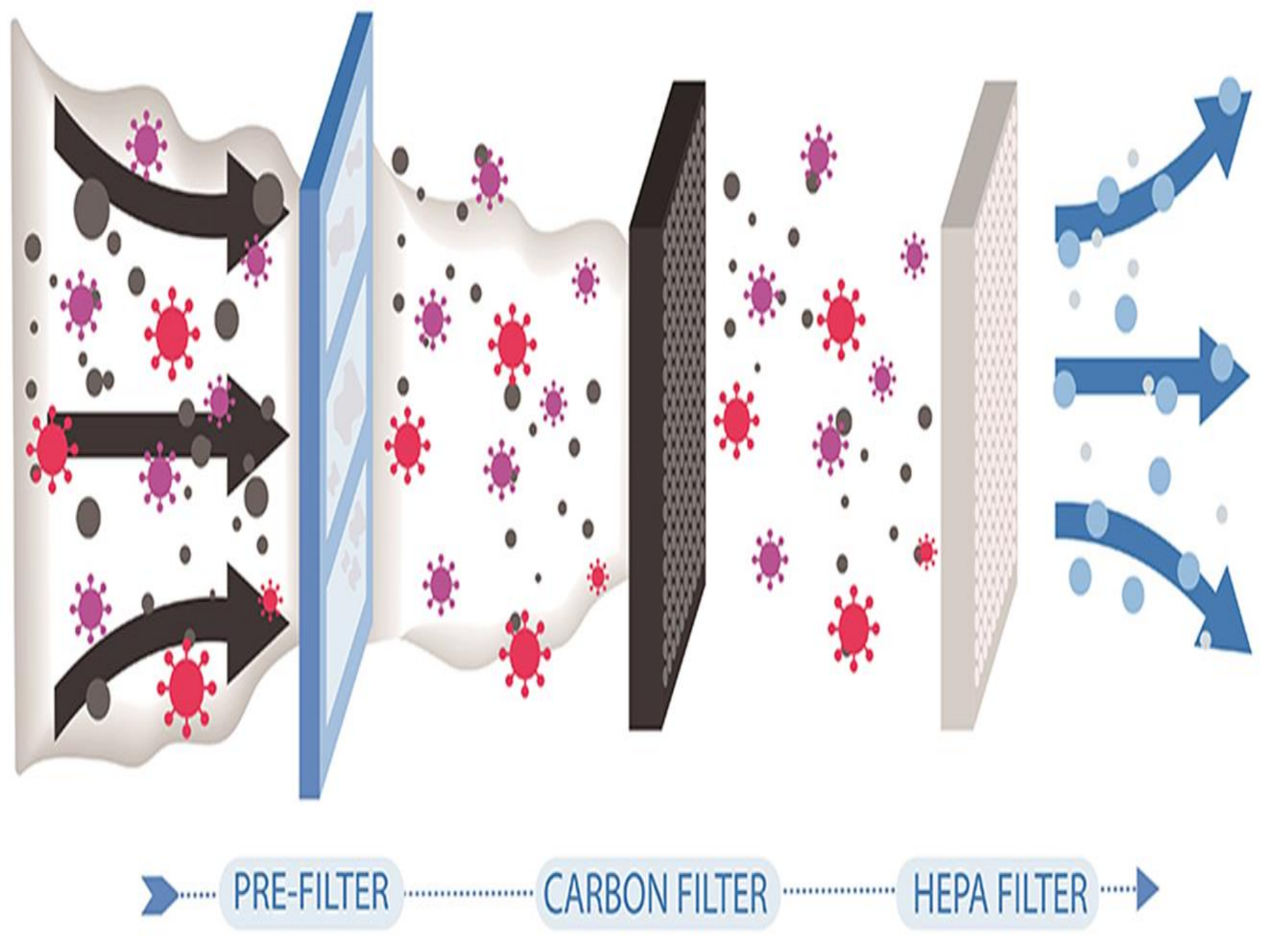


Aerosol Generating Procedures

- Intubation
- Extubation
- Bronchoscopy
- Sampelling of respiratory secresion
- BAL
- Airway suction
- Manual ventilation
- nebulizer administration
- CPR
- Pron position
- Tracheostomy

HEPA filter




PRE-FILTER
CARBON FILTER
HEPA FILTER


Thank
You


ANY
QUESTIONS