



# Ventilatory management of Respiratory Failure in COVID-19

Therapeutic options

6. May 2020



# Disclaimer

- The understanding of Covid-19 and knowledge of its management is incomplete and continually evolving. Meanwhile, scientists and healthcare professionals will find themselves increasingly confronted by the pandemic
- This presentation is based on the latest published information and recommendations on Covid-19, as well as practical findings collected from the clinical community to date. Given that these are expected to change as new data comes to light, this presentation will be regularly updated.
- This document aims to assist in understanding the application of ResMed devices in providing ventilation support to patients with clinical syndromes due to COVID-19 infection. It is based on current information, which is changing rapidly. The purpose is not to direct clinical practice, but to provide clear information on available ResMed products and their application.
- As such, it can not be considered as a recommendation itself.

# Glossary

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**CPAP**

Continues Positive Airway Pressure

**EI**

Endotracheal Intubation

**ET**

Endotracheal Tube

**ER**

Emergency Room

**HFOT**

High Flow Oxygen Therapy

**HMV**

Home Mechanical Ventilation

**ICU**

Intensive Care Unit

**IV**

Invasive Ventilation

**NIV**

Non Invasive Ventilation

**NV Mask**

Non Vented Mask

**LS**

Life Support

**NLS**

Non Life Support

**RR**

Respiratory Rate

# Pathology





# Coronavirus Disease 2019 (Covid-19)

Coronavirus disease 2019 (Covid-19) is a respiratory tract infection caused by [severe acute respiratory syndrome coronavirus 2](#) (SARS-CoV-2).<sup>[1]</sup>

The disease was first identified in December 2019 in [Wuhan](#), the capital of China's [Hubei](#) province, and has since spread globally, resulting in the ongoing [2019–20 coronavirus pandemic](#).<sup>[2][3]</sup>

Common [symptoms](#) include [fever](#), [cough](#), and [shortness of breath](#).<sup>[4]</sup>

[1] [Naming the coronavirus disease \(COVID-19\) and the virus that causes it](#). [World Health Organization](#) (WHO).

Retrieved 2 april 2020

[2] Hui DS et al. The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health—The latest 2019 novel coronavirus outbreak in Wuhan, China". *Int J Infect Dis.* **91**: 264–66. [doi:10.1016/j.ijid.2020.01.009](#)

[3] [WHO Director-General's opening remarks at the media briefing on COVID-19](#)". [World Health Organization](#) (WHO) (Press release). 11 March 2020. Retrieved 2 April 2020

[4] [Symptoms of Novel Coronavirus \(2019-nCoV\)](#)". [www.cdc.gov](#). 10 February 2020. Retrieved 2 April 2020

# Key points about Covid-19

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## **Covid-19 is a viral Infection which is highly contagious (1)**

It is therefore critical to respect recommended measures to avoid being exposed to the virus, such as social distancing, hand washing, wearing PPE, and cleaning and disinfecting frequently touches surfaces



## **Clinical syndromes associated with Covid –19 (2)**

- Mild illness : Patients with an uncomplicated upper respiratory tract viral infection may have non-specific symptoms such as fever, fatigue, cough (with or without

sputum production), anorexia, malaise, muscle pain, sore throat, dyspnea, nasal congestion, or headache

- Pneumonia : adults with pneumonia but no signs of severe pneumonia and no need for supplemental O<sub>2</sub>
- Severe pneumonia : ever or suspected respiratory infection, plus one of the following: respiratory rate > 30 breaths/min; severe respiratory distress; or SpO<sub>2</sub> ≤ 93% on room air
- Acute respiratory distress syndrome (ARDS)
- Sepsis

(1) <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html>

(2) <https://www.who.int/docs/default-source/coronaviruse/clinical-management-of-novel-cov.pdf>

# Possible evolution of the pathology over time

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- Influenza syndrome (dry cough, fever...)
- Acute respiratory failure (ARF): dyspnea, hypoxemia, asthenia,...
  - Usually appears between the 6th and the 11th day of symptoms(1)
  - Type I ARF mainly (Hypoxemic and not hypercapnic), in the absence of severe respiratory comorbidity such as severe COPD, Overlap syndrome...
  - Most rarely type II (Hypercapnic), most commonly in the case of previous Chronic Respiratory Failure
- Acute Respiratory Distress Syndrome ARDS: hypoxemic respiratory failure (1)
  - Can be very sudden

In its severe forms, the disease predominantly causes a default in blood oxygenation as a consequence of severe hypoxemic Respiratory Insufficiency.

Consequently, patients predominantly present with hypoxemia and more rarely hypercapnia.

Patients with respiratory comorbidities - particularly Chronic Respiratory Insufficiency - are more likely to present with hypercapnia

# The severity of diagnosed Covid-19 cases in China

## 2.3% of all cases died

1,023 of the 44,415 infected people, for which the breakdown is shown on the right, died.  
The case *fatality rate* is therefore 2.3%.

## 5% Critical cases

Critical cases include patients who suffered respiratory failure, septic shock, and/or multiple organ dysfunction/failure.

## 14% Severe cases

Severe cases include patients suffer from shortness of breath, respiratory frequency  $\geq 30$ /minute, blood oxygen saturation  $\leq 93\%$ , PaO<sub>2</sub>/FiO<sub>2</sub> ratio  $< 300$ , and/or lung infiltrates  $> 50\%$  within 24–48 hours.

## 81% Mild cases

Mild cases include all patients without pneumonia or cases of mild pneumonia.

Cases that were not identified and not diagnosed

Roser M, Ritchie H, Ortiz-Ospina E (4 March 2020). "[Coronavirus Disease \(COVID-19\)](#)". Our World in Data. [Archived](#) from the original on 19 March 2020. Retrieved 12 March 2020

# Resource sites and recommendations



# Relevant guidelines

**WHO: Clinical management of severe acute respiratory infection (SARI) when COVID - 19 disease is suspected - Interim guidance - 13 March 2020**

<https://www.who.int/docs/default-source/coronaviruse/clinical-management-of-novel-cov.pdf>



**US - CDC:** Interim Clinical Guidance for Management of Patients with Confirmed Coronavirus Disease (COVID-19)

- <https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html>



**EU - ESICM**

- <https://www.esicm.org/blog/wp-content/uploads/2020/03/SSC-COVID19-.pdf>



**UK – NHS** Specialty guides for patient management during the coronavirus pandemic- Guidance for the role and use of non-invasive respiratory support in adult patients with coronavirus (confirmed or suspected)

- [https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/CLEARED\\_Specialty-guide\\_-\\_NIV-respiratory-support-and-coronavirus-v2-26-March-003.pdf](https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/CLEARED_Specialty-guide_-_NIV-respiratory-support-and-coronavirus-v2-26-March-003.pdf)



**Italy**

- <https://www.ersnet.org/covid-19-blog/sharing-italian-recommendations>
- [Managing the respiratory care of patients with COVID-19: Italian Thoracic Society, \(AIPO\), Italian Respiratory Society \(SIP\)](#)
- [Joint statement on the role of respiratory rehabilitation in the COVID-19 crisis: the Italian position paper](#)



**France**

- <http://splf.fr/centre-de-documentation-covid-19/>
- <https://www.srlf.org/> <https://www.srlf.org/coronavirus/#reco>
- <http://splf.fr/gavo2/>



**Spain :** <https://www.separ.es/node/1763>



**Germany :** <https://www.vpnemo.de/>



# Care management options



# Usual therapeutic options for patients presenting with confirmed Covid-19

- Oxygen via nasal canula up to 10-15 l/min
- Oxygen plus CPAP/NIV up to 10-15l/min (NLS)
- Oxygen plus CPAP/NIV up to 30 l/min (NLS)
- HFOT High FiO<sub>2</sub>
- CPAP/NIV with high FiO<sub>2</sub> oxygen (HNV with/without blender) (LS)
- IV with Endotracheal intubation (ICU/ER/Transport Ventilators) (LS)



# CPAP and Bilevel PAP in the treatment of Covid-19



Room for NIV (CPAP for hypoxaemic respiratory failure; BiPAP for hypercapnic acute on chronic respiratory failure) in the escalation path for Covid has been documented in several guidance resources (1) (2) (3) (4)

- Possible indications for NIV (CPAP for hypoxaemic respiratory failure; BiPAP for hypercapnic acute on chronic respiratory failure) are:
  - as a ceiling of treatment
  - trial to avoid intubation
  - to facilitate extubation

- Ceiling decisions are made by clinical teams depending on local clinical practice and availability of care at all decision points of the therapeutic escalation tree. They are commonly based on age and comorbidities criteria.



In the case of non-responders, CPAP/NIV continuation depends on a series of variables: bed availability – possibility of isolation –disease severity -decision about therapeutic ceiling (1)



(1) Managing the Respiratory care of patients with COVID-19 Italian thoracic society (ITS) & AIPO & SIP; Harari SA et al Version - March 23, 2020

(2) NHS Specialty guides for patient management during the coronavirus pandemic- Guidance for the role and use of non-invasive respiratory support in adult patients with coronavirus (confirmed or suspected) - V2

(3) Procédure de prise en charge pneumologique hors réanimation des patients hospitalisés dans le cadre de la pandémie COVID19 - GAVO2

(4) Empfehlung zur Behandlung respiratorischer Komplikationen bei akuter Virusinfektion außerhalb der Intensivstation. Herausgegeben vom Verband Pneumologischer Kliniken (VPK) – Voshaar T. et al.

# Triaging in patients according to 4 categories: Italian recommendation

Triage:

Patient condition and proposed treatment:

GREEN	YELLOW	ORANGE	RED
SaO <sub>2</sub> >94%, RR<20 breaths/min	SaO <sub>2</sub> <94%, RR>20 and responds to oxygen 10-15 l/min	SaO <sub>2</sub> <94%, RR>20, poor response to oxygen 10-15 l/min but responds to CPAP/NIV with very high FiO <sub>2</sub>	SaO <sub>2</sub> <94%, RR>20 but poor response to oxygen 10-15 l/min and CPAP/NIV with very high FiO <sub>2</sub> or presenting respiratory distress with PaO <sub>2</sub> /FiO <sub>2</sub> <200 →EI and intensive care

Managing the Respiratory care of patients with COVID-19 Italian thoracic society (ITS) & AIPO & SIP

**Authors:** Harari SA, Vitacca M, Blasi F, Centanni S, Santus PA, Tarsia P with collaboration of Banfi PI, Bini, F, Casali W, Cassandro R, Ceriana P, Marruchella A, Massinesi G, Novelli L, Oggionni T, Riario SGG, Scarduelli C, Scartabellati A

Version - March 08, 2020

# Therapeutic escalation pathway from the Italian experience

## Managing the Respiratory care of patients with COVID-19 Italian thoracic society (ITS) & AIPO & SIP

Harari SA, Vitacca M, Blasi F, Centanni S, Santus PA, Tarsia P

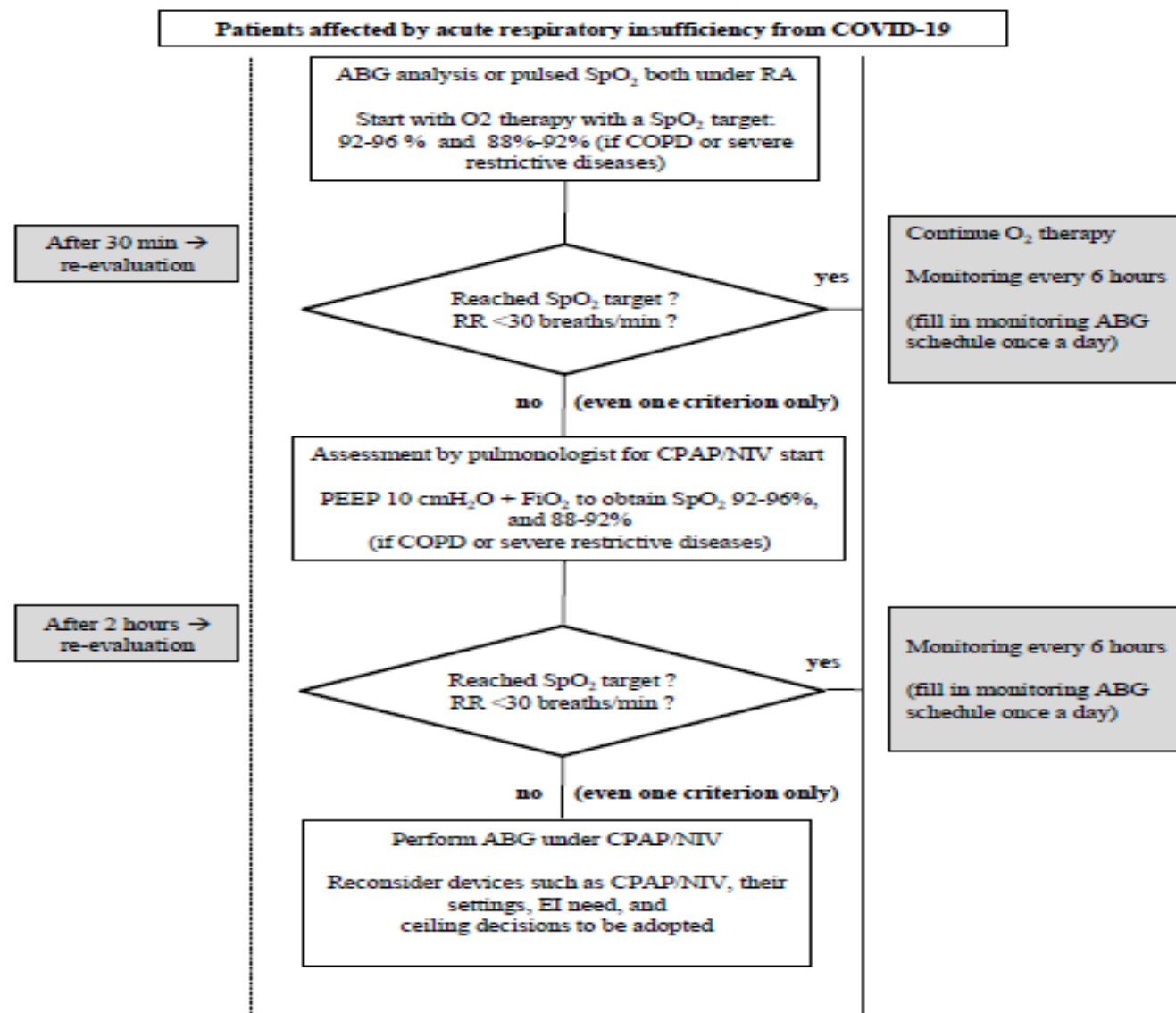


Figure 1

Legend: ABG = Arterial Blood Gases; RA = room air; SpO<sub>2</sub> = pulsed arterial saturation of oxygen; COPD= chronic obstructive pulmonary disease; O<sub>2</sub> = oxygen; RR = respiratory rate; FiO<sub>2</sub> = inspiratory fraction of oxygen; RR = respiratory rate; CPAP = continuous positive airway pressure; NIV = non invasive ventilation ; PEEP = positive end expiratory pressure; EI = endotracheal intubation

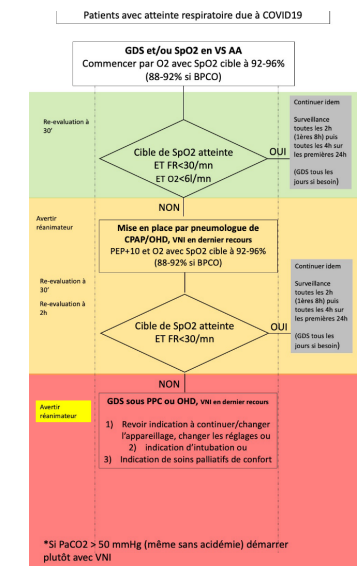
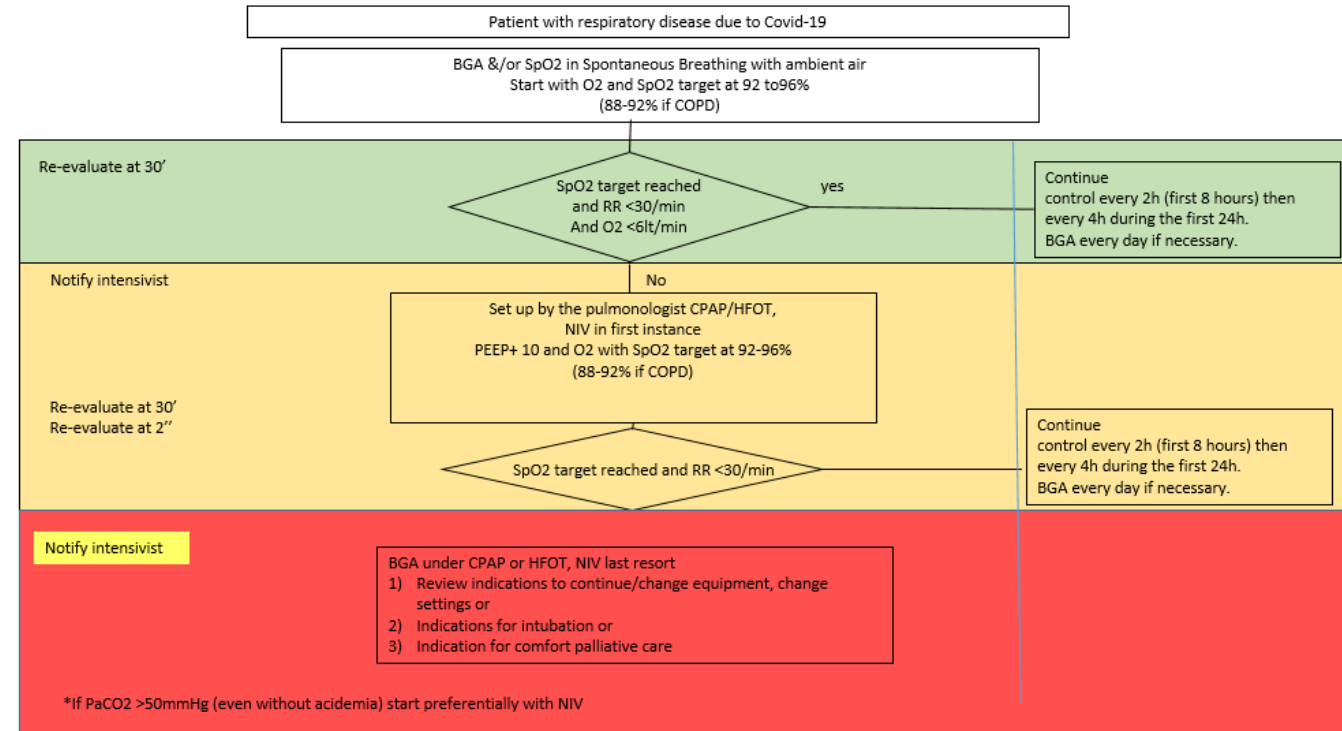
# Triaging in patients according to 4 categories: French GAVO2 recommandation

Procedure for non-intensive care pneumological management of hospitalized patients in the context of the COVID 19 pandemic.

Procédure de prise en charge pneumologique hors réanimation des patients hospitalisés dans le cadre de la pandémie COVID19

Claudio Rabec (1), Jésus Gonzalez-Bermejo (2)

- (1) Service de pneumologie et Soins Intensifs Respiratoires, Centre Hospitalier Universitaire de Dijon, Dijon, France
- (2) Sorbonne université, INSERM, UMRs1158 Neurophysiologie Respiratoire Expérimentale et Clinique; AP-HP, Groupe Hospitalier Universitaire APHP-Sorbonne Université, site Pitié Salpêtrière, Service de Pneumologie, Médecine Intensive et Réanimation (Département R3S), Paris, France





# NHS Guidelines

## Specialty guides for patient management during the coronavirus pandemic

- Guidance for the role and use of non-invasive respiratory support in adult patients with COVID-19 (confirmed or suspected) 6. April 2020, Version 3

Table: Adult escalation plan following initial assessment and treatment for patients in hospital

Category	Clinical Status	Suggested action
Green	RR $\geq$ 20bpm with SpO <sub>2</sub> $\leq$ 94%	Administer O <sub>2</sub> $<$ 40% by face mask. If SpO <sub>2</sub> rises to $>$ 94%, observe and monitor
Yellow	RR $\geq$ 20bpm with SpO <sub>2</sub> $\leq$ 94% on FiO <sub>2</sub> $\geq$ 40%	Start 15L/min O <sub>2</sub> via non-rebreathe mask  <i>Senior clinical review to consider:</i>  If orientated and able to tolerate well-fitted non-vented face mask, trial CPAP 10cmH <sub>2</sub> O with FiO <sub>2</sub> 0.6  If further escalation appropriate, consider increasing CPAP 12-15 cmH <sub>2</sub> O + 60-100% oxygen if needed  If not, IMV if in accordance with TEP
Red	RR $\geq$ 20bpm with SpO <sub>2</sub> $\leq$ 94% on 15L/min O <sub>2</sub> via non-rebreathe mask and/or patient unable to tolerate CPAP mask, obtunded/disorientated, rising FiO <sub>2</sub> needs, significant clinical decline	Urgent critical care review and prepare for intubation if in accordance with TEP

Abbreviations: RR = respiratory rate; SpO<sub>2</sub> = oxygen saturation; CPAP = continuous positive airways pressure; FiO<sub>2</sub> = fraction of inspired oxygen, IMV = invasive mechanical ventilation, TEP = treatment escalation plan.

# Positionspapier zur praktischen Umsetzung der apparativen Differenzialtherapie der akuten respiratorischen Insuffizienz bei COVID-19

Deutsche Gesellschaft für Pneumologie und Beatmungsmedizin e.V. (DGP)

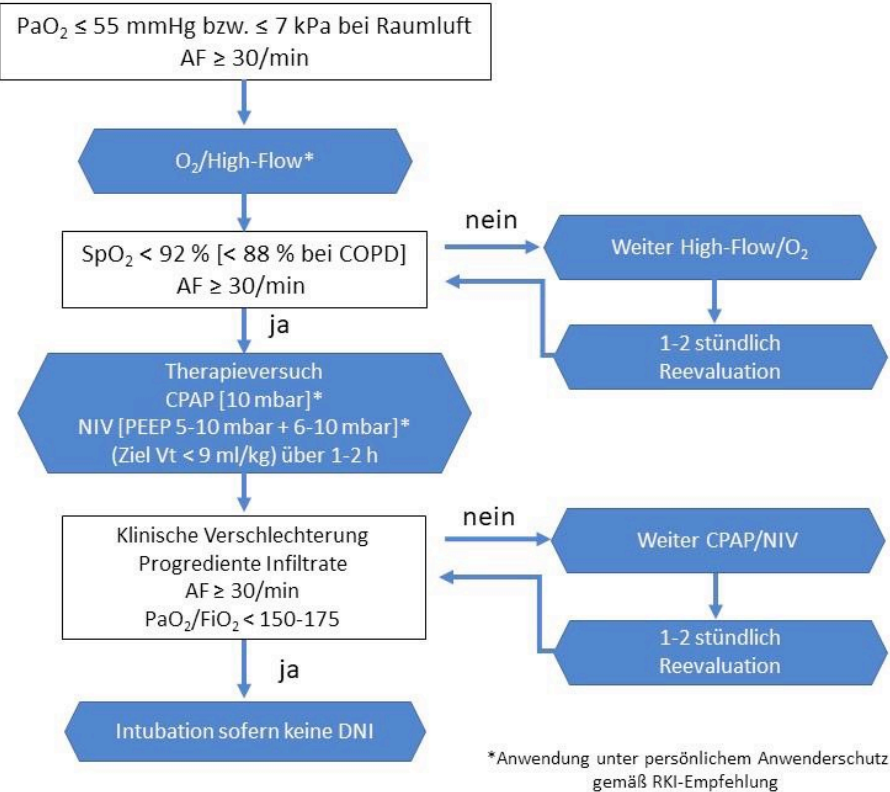
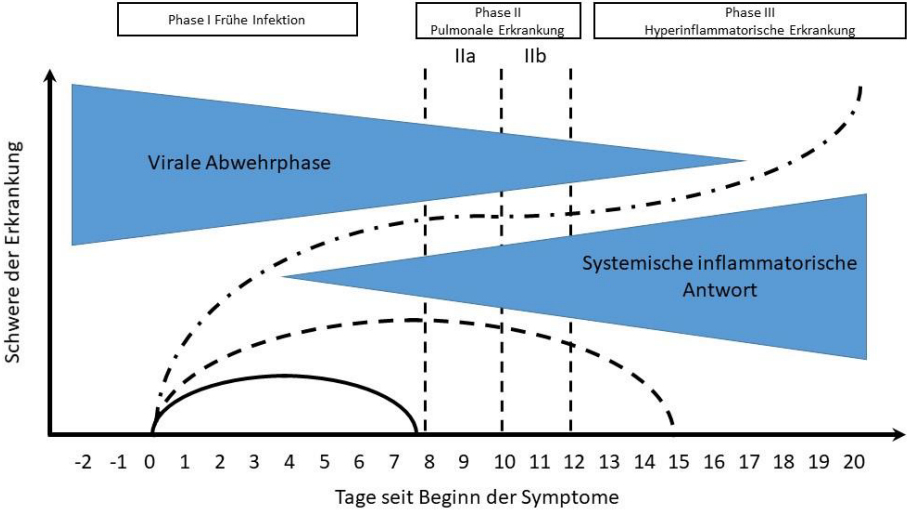


Abbildung 1: Klinischen Verläufe von CoVID-19 (leicht -; schwer --; kritisch -.-)



Modifiziert nach: Siddiqi, H.K., und Mehra, M.R. COVID-19 Illness in Native and Immunosuppressed States: A Clinical-Therapeutic Staging Proposal. *The Journal of Heart and Lung Transplantation*, doi:10.1016/j.healun.2020.03.012.

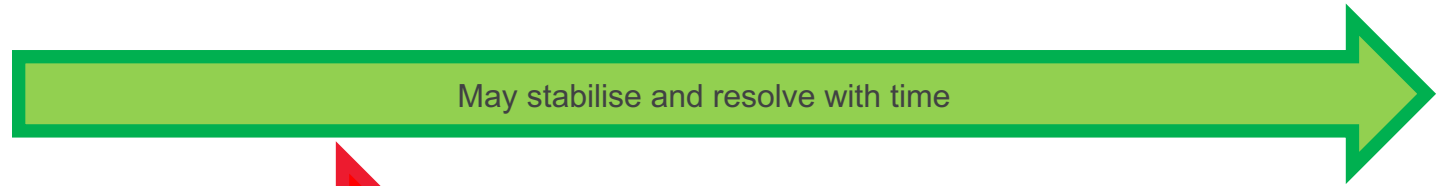
The German Respiratory Society together with other important stakeholders in the field reached a consensus for the respiratory care of patients with COVID-19. The consensus was reached under the circumstance in Germany, where overcrowding of hospitals has not taken place, due to effective epidemiologic measures such as social distancing (April 14, 2020). This statement contains five different topics with the important recommendations outlined

# Pathophysiology of Covid-19 according to the latest publication from Gattinoni et al.

Specific disease whose distinctive features are **severe hypoxemia** often associated with **near normal respiratory system compliance**, a combination almost never seen in severe ARDS. Present itself with strong non-uniformity

## COVID-19 pneumonia, Type L

- *Low elastance.* The nearly normal compliance indicates that the amount of gas in the lung is nearly normal
- *Low ventilation-to-perfusion (VA/Q) ratio.* Since the gas volume is nearly normal, hypoxemia may be best explained by the loss of regulation of perfusion and by loss of hypoxic vasoconstriction. Accordingly, at this stage, the pulmonary artery pressure should be near normal.
- *Low lung weight.* Only ground-glass densities are present on CT scan, primarily located subpleurally and along the lung fissures. Consequently, lung weight is only moderately increased.
- *Low lung recruitability.* The amount of non-aerated tissue is very low; consequently, the recruitability is low
- The normal response to hypoxemia is to increase minute ventilation, primarily by increasing the tidal volume (up to 15–20 ml/kg), which is associated with a more negative intrathoracic inspiratory pressure. *Undetermined* factors other than hypoxemia markedly stimulate, in these patients, the respiratory drive. The near normal compliance, however, explains why some of the patients present without dyspnea as the patient inhales the volume he expects. This increase in minute ventilation leads to a decrease in PaCO<sub>2</sub>.



## COVID-19 pneumonia, Type H

- *High elastance.* The decrease in gas volume due to increased edema accounts for the increased lung elastance.
- *High right-to-left shunt.* This is due to the fraction of cardiac output perfusing the non-aerated tissue which develops in the dependent lung regions due to the increased edema and superimposed pressure.
- *High lung weight.* Quantitative analysis of the CT scan shows a remarkable increase in lung weight (> 1.5 kg), on the order of magnitude of severe ARDS
- *High lung recruitability.* The increased amount of non-aerated tissue is associated, as in severe ARDS, with increased recruitability order of magnitude of severe ARDS
- The Type H pattern, 20–30% of patients in our series, fully fits the severe ARDS criteria: hypoxemia, bilateral infiltrates, decreased the respiratory system compliance

# Covid-19 specific physiological challenges and requirements



## Patient in acute hypoxemic respiratory distress, present:



## What does that mean for the patient:



## Which requirements are needed:

Very high inspiratory flow rate 80l/min

→ High WOB; respiratory distress, accessories inspiratory muscles involvement

→ Verify pressure stability with device, especially HMV devices.

High oxygen requirement

→ Hypoxemic, low SpO2

→ Need devices able to deliver high FiO2 levels

High respiratory rate

→ above 25 breath/minutes

→ Monitoring

Requiring prolonged ventilation support

→ 23/24 hours for at least 3 days

→ Device resistance/adaptivity/stability over time

# Conditions to avoid virus mitigation

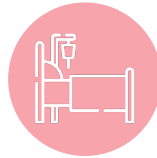
Mitigating the risk of droplet dispersion when using invasive or non-invasive ventilation

## ISOLATION WARD



### PERSONAL PROTECTIVE EQUIPMENT

- Disposable surgical cap
- Medical protective mask (N95)
- Disposable medical protective uniform
- Disposable latex gloves
- Face shield
- Goggles



### LOCATION

- Suspected or confirmed cases should be isolated
- Negative pressure isolation rooms should be utilised where possible



### PATIENT SET\_UP

- Full face mask **NV** recommended for the patient
- Ensure proper fit (e.g. good mask seal) to reduce air leakage
- Use a **filter** between the mask and **exhalation valve /leak valve** when using a single circuit

# Care organisation

- Experience from the countries most affected by Covid-19 so far highlight the need for:
  - Identification of « clean » and « unclean » areas and paths
  - Isolated area for the different categories of patients
  - Maximal flexibility in care organisation among units created in response
- In general, it is recommended to deliver PAP therapies in a negative pressure room with air exchanges greater than the regulatory threshold (10 cycles per hour) with/without a lobby. However, it is recognised that availability may be limited.

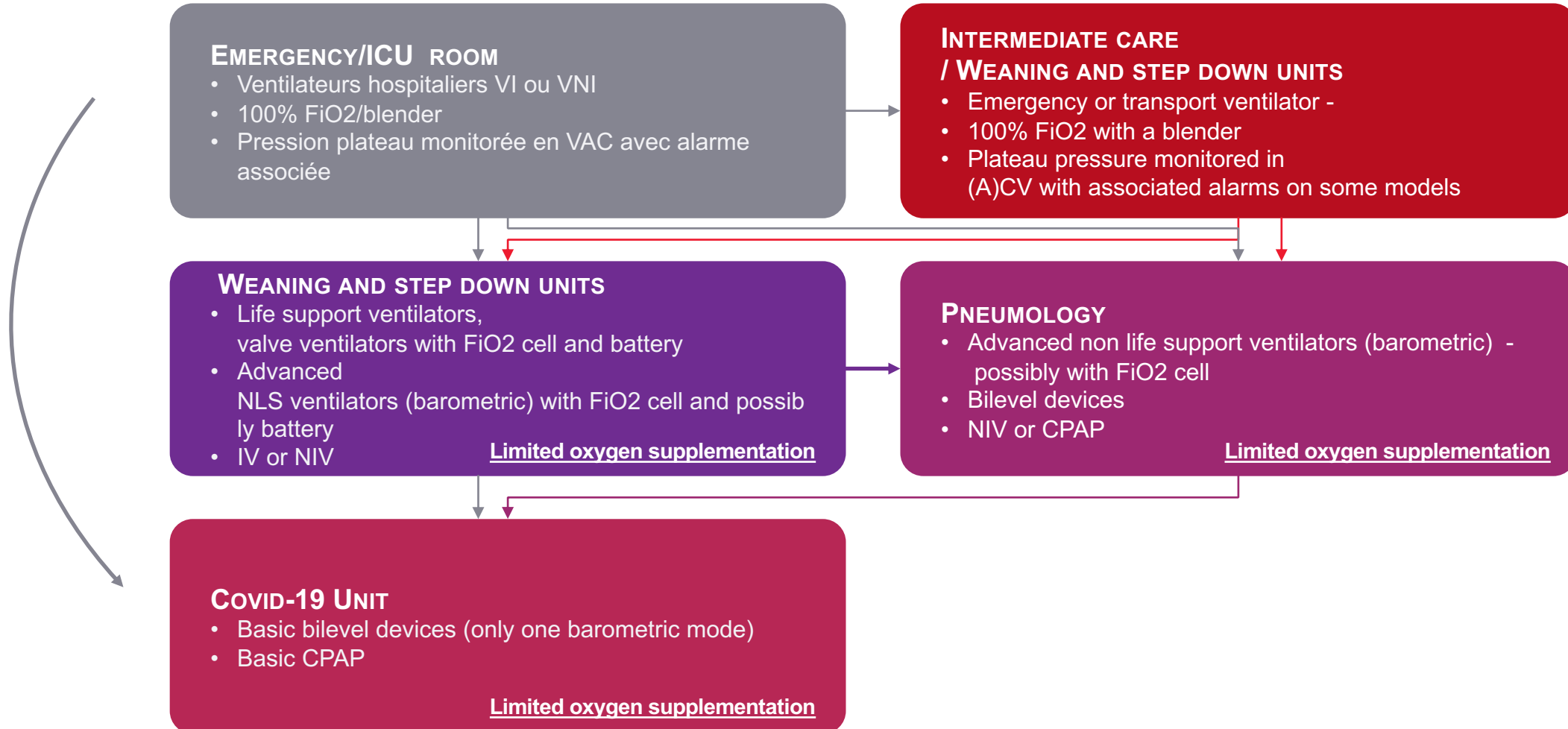
(1) Managing the Respiratory care of patients with COVID-19 Italian thoracic society (ITS) & AIPO & SIP; Harari SA et al  
Version - March 23, 2020

(2) NHS Specialty guides for patient management during the coronavirus pandemic- Guidance for the role and use of non-invasive respiratory support in adult patients with coronavirus (confirmed or suspected) - V2





# Examples of typically available equipment in different types of Covid care units



# ResMed Solutions



# Patient triage, treatments and ResMed solutions

GREEN	YELLOW	ORANGE	RED
SaO <sub>2</sub> >94%, RR<20 breaths/min	SaO <sub>2</sub> <94%, RR>20 and responds to oxygen 10-15 l/min	SaO <sub>2</sub> <94%, RR>20, poor response to oxygen 10-15 l/min but responds to CPAP/NIV with very high FiO <sub>2</sub>	SaO <sub>2</sub> <94%, RR>20 but poor response to oxygen 10-15 l/min and CPAP/NIV with very high FiO <sub>2</sub> or presenting respiratory distress with PaO <sub>2</sub> /FiO <sub>2</sub> <200 →EI and intensive care

Ventilator classification	Life Support homecare ventilators	Non life support homecare ventilator	Non life support homecare ventilator	Sleep devices	Sleep devices
	Astral 150/100- CPAP & NIV considering oxygen supplementation up to 30l/min	Stellar 150/100- CPAP & NIV considering oxygen supplementation up to 30l/min	Lumis 150/100- CPAP & NIV considering oxygen supplementation up to 15l/min	AirCurve 10 VAuto- CPAP considering oxygen supplementation up to 15l/min	AirCurve 10 VAuto- CPAP considering oxygen supplementation up to 15l/min
<b>Green</b> (SaO <sub>2</sub> >94%, RR<20 breaths/min)	no	no	no	no	No
<b>Yellow</b> (SaO <sub>2</sub> <94%, RR>20 but responds to oxygen 10-15 l/min)	no	no	no	no	no
<b>Orange</b> (SaO <sub>2</sub> <94%, RR>20 but poor response to oxygen 10-15 l/min and needing CPAP/NIV with very high FiO <sub>2</sub> )	yes	yes	yes	yes	yes
<b>Red</b> (SaO <sub>2</sub> <94%, RR>20 but poor response to oxygen 10-15 l/min, CPAP/NIV with very high FiO <sub>2</sub> or	yes	yes	yes		yes
Ventilator classification	ICU ventilators	Emergency ventilators	Life Support homecare ventilators	Non life support homecare ventilator	
<b>Red</b> (SaO <sub>2</sub> <94%, RR>20 but poor response to oxygen 10-15 l/min, <b>presenting respiratory distress with PaO<sub>2</sub>/FiO<sub>2</sub>&lt;200 and needing endotracheal intubation [EI] and intensive care</b> )	=> No ResMed solutions	=> ResMed Solutions: Elisées 350 & 250- ACV considering oxygen blender (21%-100%)	=> ResMed Solutions: Astral 150/100- ACV considering oxygen supplementation up to 30l/min	=> ResMed Solution: Stellar 150/100- PAC considering oxygen supplementation up to 30l/min	
Weaning process for <b>Red</b> patients	Tracheostomy in PS & FiO <sub>2</sub> <40%=> Elisee, Astral, Stellar, VSIII CPAP/NIV with FiO <sub>2</sub> <40% => ResMed Solutions (CF orange) Nasal oxygen low flow supplementation or nothing=>No ResMed solution				

# Circuit configuration with Astral

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WITH DUAL LIMB CIRCUIT



WITH SINGLE LIMB CIRCUIT WITH LEAK



With leak valve with anti-asphyxia valve

With leak port

# Circuit configuration with Stellar/Lumis proximal O2 & oximetry option

## SINGLE LIMB CIRCUIT WITH LEAK

- *This low dispersion circuit is not the intended use for these devices, but emerging clinical practice in treating COVID-19 shows that it is a likely need given the ventilator shortage and the concern of infection risk to healthcare workers during the COVID-19 pandemic. For further information, please refer to the related product "warning & caution" section and the national guidelines.*
- *The use of two filters is based on availability and national guidelines.*

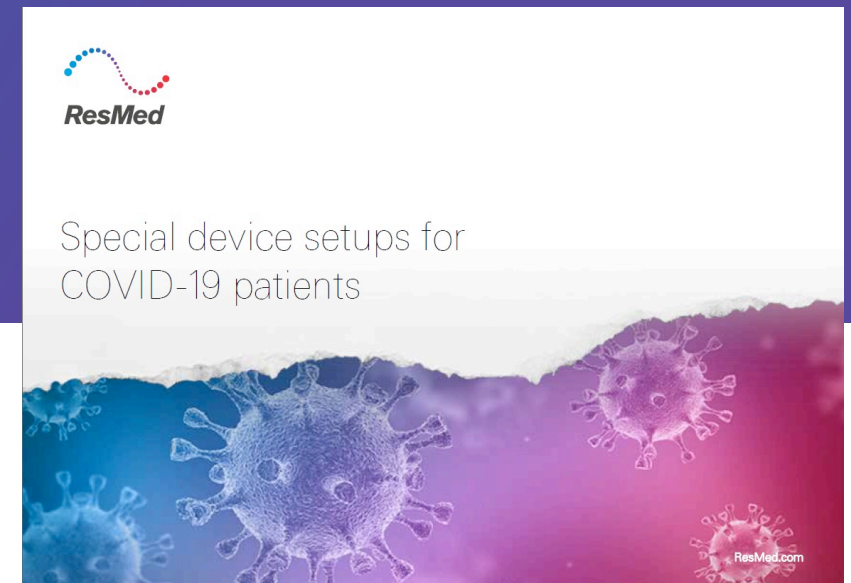
With leak valve with anti-asphyxia valve



With leak port



# Special device setups for COVID-19 patients





# Invasive ventilation



**RED**

# - ICU ventilators

## Acute phase

- Intubation
- Sedation and curarization
- ICU ventilator/blender/100% FiO<sub>2</sub>
- Protective ventilation
  - ACV mode with high PEEP
  - Plateau pressure monitoring and associated alarm
  - Prone position

## Weaning

- Sedation drop
- Switching to PS, FiO<sub>2</sub> < 40%
- Extubation/tracheotomy



## Protection of health care teams and other patients :

- Filters
- Enclosed suctioning system
- Scrubs, masks, goggles, gloves...



**RED**

# – transport or emergency ventilators

## Acute phase

- Intubation
- Sedation and curarization
- Transport or emergency ventilator/blender/100% FiO<sub>2</sub>
- Protective ventilation
  - ACV mode with high PEEP
  - Plateau pressure monitoring and associated alarm
- Prone position

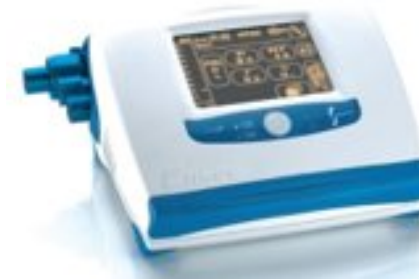
## Weaning

- Sedation drop
- Switching to PS, FiO<sub>2</sub> < 40%
- Extubation/tracheotomy



## Protection of health care teams and other patients :

- Filters
- Enclosed suctioning system
- Scrubs, masks, goggles, gloves...



**LIMITS:** screen size and advanced features limited depending on model

**RED**

# life support ventilators

## Weaning:

- Sedation drop
- Switching to AI,  $\text{FiO}_2 < 40\%$
- Extubation/tracheotomy



## Protection of health care teams and other patients :

- Filters
- Enclosed suctioning system
- Scrubs, masks, goggles, gloves...

- **ASTRAL** in double limb with  $\text{FiO}_2$  monitoring if available
- Low pressure  $\text{O}_2$  supplementation max 30l/min



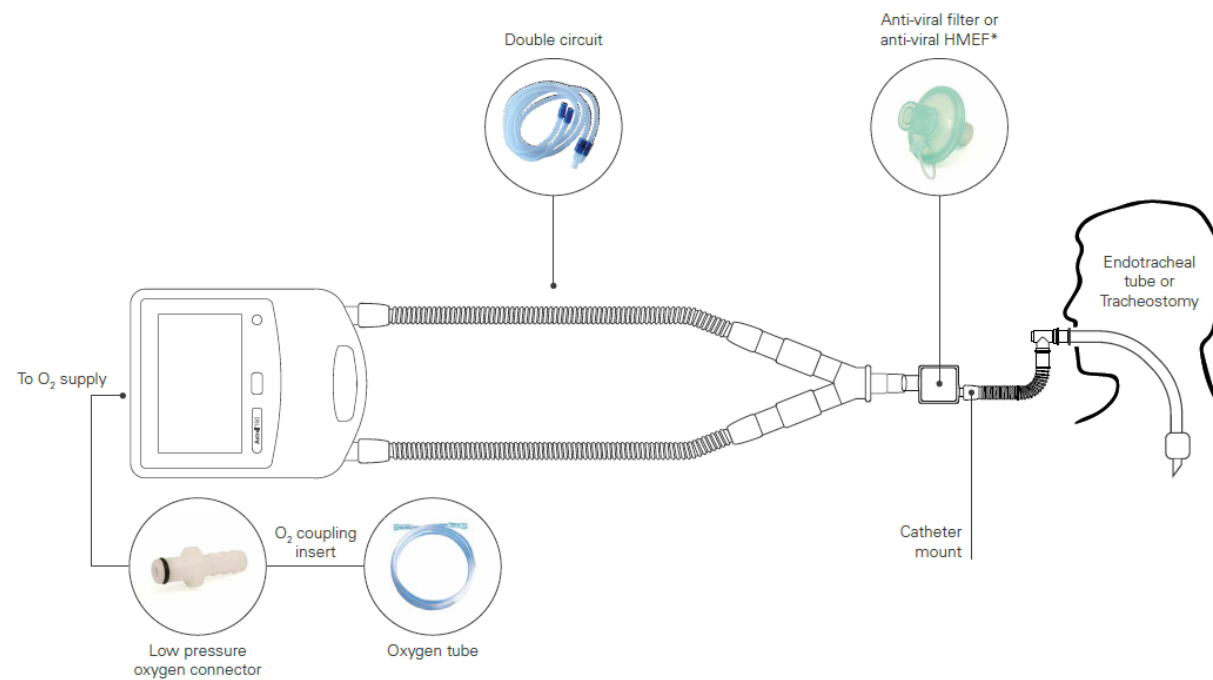
**LIMITATIONS:** screen size, limited advanced functionalities, no monitored plateau pressure or associated alarm in ACV,  $\text{FiO}_2$  may be limited depending on the patient's respiratory mechanics.

Single with valve with Astral 100

# Example of circuit configuration with Astral

## 5 IV – Double circuit

Astral™ series



▲ This low dispersion circuit is not the intended use for these devices, but emerging clinical practice in treating COVID-19 shows that it is a likely need given the ventilator shortage and the concern of infection risk to healthcare workers during the COVID-19 pandemic. For further information, please refer to national guidelines.

\* HMEF = Heat Moisture Exchange Filter. The shape and colour of filter might vary. **Note:** FIO<sub>2</sub> monitoring possible. | SpO<sub>2</sub> monitoring possible with separate module

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## Weaning:

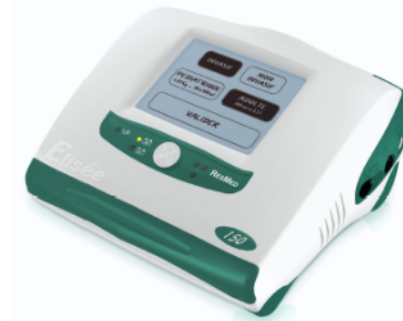
- Sedation drop
- Switching to AI, FiO<sub>2</sub><40%
- Extubation/tracheotomy



## Protection of health care teams and other patients :

- Filters
- Enclosed suctioning system
- Scrubs, masks, goggles, gloves...

- **ELISÉE 150** in double limb with FiO<sub>2</sub> monitoring if available
- Low pressure O<sub>2</sub> supplementation max 15l/min



**LIMITATIONS:** screen size, limited advanced functionality, no monitored plateau pressure or associated alarm in ACV, FiO<sub>2</sub> may be limited depending on the patient's respiratory mechanics

RED

# life support ventilators

## Weaning:

- Sedation drop
- Switching to AI,  $\text{FiO}_2 < 40\%$
- Extubation/tracheotomy



## Protection of health care teams and other patients :

- Filters
- Enclosed suctioning system
- Scrubs, masks, goggles, gloves...

- **VS III** in double limb with  $\text{FiO}_2$  monitoring if available
- Low pressure  $\text{O}_2$  supplementation max 8l/min or 14l/min



### LIMITATIONS:

screen size, limited advanced functionality, no monitored plateau pressure or associated alarm in ACV.  
 $\text{FiO}_2$  may be limited depending on the patient's respiratory mechanics.



RED

# non life support ventilators

## Weaning

- Sedation drop
- Switching to AI,  $\text{FiO}_2 < 40\%$
- Extubation/tracheotomy
- Ventilation with non life support ventilator with low pressure oxygen supplementation limited to 30l/min



### Protection of health care teams and other patients :

- Filters
- Enclosed suctioning system
- Scrubs, masks, goggles, gloves...


- **STELLAR** in leak circuit & barometric modes with  $\text{FiO}_2$  monitoring if available
- Low pressure O2 supplementation max 30l/min

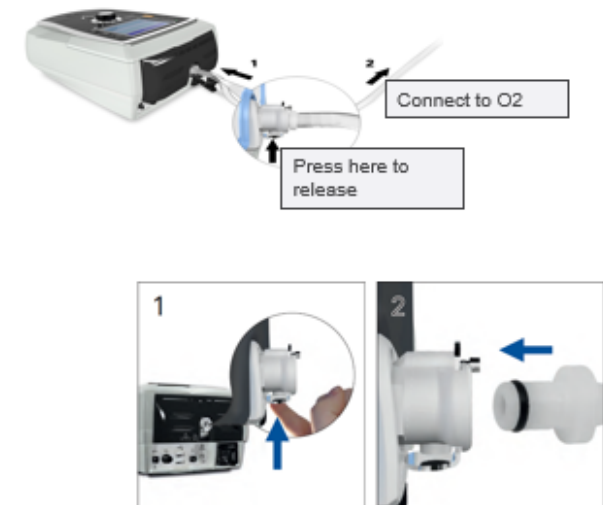


**LIMITATIONS:** screen size, barometric modes only, single leak circuit,  $\text{FiO}_2$  may be limited and may fluctuate depending on patient respiratory mechanics, unintentional leaks, etc.



# Example of invasive setting with $\text{FiO}_2$ measurement

Adding $\text{O}_2$	STELLAR 150 / 100
Flow $\text{O}_2$	<b>30L/min maximum</b> at the rear of the device $\text{O}_2$ low pressure connector (Product code 24971) 
$\text{FiO}_2$ setting	<b>No</b>
$\text{FiO}_2$ Monitoring	<b>Optional</b> Control kit without $\text{O}_2$ cell (Product code 24955) $\text{O}_2$ Cell (Product code CAP008617)



When the addition of oxygen is delivered at a fixed rate, the concentration of inhaled oxygen varies depending on

- Ventilation mode and settings
- Type of circuit used
- Patient breath pattern
- Mask chosen
- Unintentional leak value

# Non Invasive Ventilation CPAP/NIV



RED

OR

ORANGE

CPAP/NIV

- Home ventilator with low pressure oxygen supply, flow rate limited to 30l/min.
- Barometric modes



#### Protection of health care teams and other patients :

- Filters
  - Enclosed suctioning system
  - Scrubs, masks, goggles, gloves...
- 
- **ASTRAL** in double limb circuit and FiO<sub>2</sub> monitoring if available
  - Low pressure O<sub>2</sub> supply max 30l/min



**LIMITATIONS:** screen size, FiO<sub>2</sub> may be limited and fluctuate depending on the patient's respiratory mechanics and unintentional leaks.

# With NV mask and filters

---



The use of  
two filters is  
based on  
availability  
and national  
guidelines



RED

OR

ORANGE

CPAP/NIV

- Home ventilator with low pressure oxygen supply, flow rate limited to 30l/min.
- Barometric modes



#### Protection of health care teams and other patients :

- Filters
  - Enclosed suctioning system
  - Scrubs, masks, goggles, gloves...
- 
- **ASTRAL** with single leak circuit and FiO<sub>2</sub> monitoring if available
  - Low pressure O<sub>2</sub> supply max 30l/min



**LIMITATIONS:** screen size, FiO<sub>2</sub> may be limited and fluctuate depending on the patient's respiratory mechanics and intentional & unintentional leaks

With NV mask,  
leak valve, oxygen  
port and filters

With NV mask, leak  
port, O2 added at the  
rear of the device



With NV mask, leak  
valve, O2 added at the  
rear of the device

The use of two filters is based on  
availability and national guidelines

• The use of two filters is based on availability and national guidelines.



RED

OR

ORANGE

CPAP/NIV

- Home ventilator with low pressure oxygen supply, limited to 30l/min.
- Barometric modes



#### Protection of health care teams and other patients :

- Filters
  - Enclosed suctioning system
  - Scrubs, masks, goggles, gloves...
- 
- **STELLAR** with single leak circuit and FiO<sub>2</sub> monitoring if available
  - Low pressure O<sub>2</sub> supply max 30l/min



**LIMITATIONS:** screen size, FiO<sub>2</sub> may be limited and fluctuate depending on the patient's respiratory mechanics and intentional & unintentional leaks

## With NV mask, leak valve, oxygen port and filters

With NV mask, leak valve  
with AA valve, O<sub>2</sub> connection  
at the rear of the machine  
and filters



With NV mask, leak port, O<sub>2</sub>  
connection at the rear of the  
machine and filters



The use of two filters is based on  
availability and national guidelines

- *This low dispersion circuit is not the intended use for these devices, but emerging clinical practice in treating COVID-19 shows that it is a likely need given the ventilator shortage and the concern of infection risk to healthcare workers during the COVID-19 pandemic. For further information, please refer to the related product "warning & caution" section and the national guidelines. CB#013*
- *The use of two filters is based on availability and national guidelines.*

- Home bilevel ventilator with low pressure oxygen supply.
- Barometric modes



#### Protection of health care teams and other patients :

- Filters
  - Enclosed suctioning system
  - Scrubs, masks, goggles, gloves...
- 
- **LUMIS** with single leak circuit and SpO<sub>2</sub> monitoring if available
  - Low pressure O<sub>2</sub> supply max 15 l/min
  - S & ST modes only, IVAPS not recommended (and 4l/min O<sub>2</sub> max)
  - Use of more than 15 l/min O<sub>2</sub> please refer to the risk and caution section from the Clinical Bulletin CB#010



**LIMITATIONS:** screen size, FiO<sub>2</sub> may be limited and fluctuate depending on the patient's respiratory mechanics and intentional & unintentional leaks

## With NV mask, leak valve, oxygen port and filters

With NV mask with O<sub>2</sub> connection , leak valve with AA valve and filters



With NV mask O<sub>2</sub> connection, leak port and filters



The use of two filters is based on availability and national guidelines

- *This low dispersion circuit is not the intended use for these devices, but emerging clinical practice in treating COVID-19 shows that it is a likely need given the ventilator shortage and the concern of infection risk to healthcare workers during the COVID-19 pandemic. For further information, please refer to the related product "warning & caution" section and the national guidelines. CB#010*
- *The use of two filters is based on availability and national guidelines.*

- "Ventilation" with home pressure generator with low flow oxygen supply limited to 15l/min
- Continuous positive airway pressure



#### Protection of health care teams and other patients :

- Filters
- Enclosed suctioning system
- Scrubs, masks, goggles, gloves...

#### AIRSENSE 10 (AutoSet ou Elite) with single leak circuit

- Low pressure O2 supply max 15l/min in CPAP mode

#### AIRCURVE 10 VAuto with single leak circuit

- Low pressure O2 supply max 15l/min
- Use of more than 15 l/min O2 please refer to the risk and caution section from the Clinical Bulletin CB#010



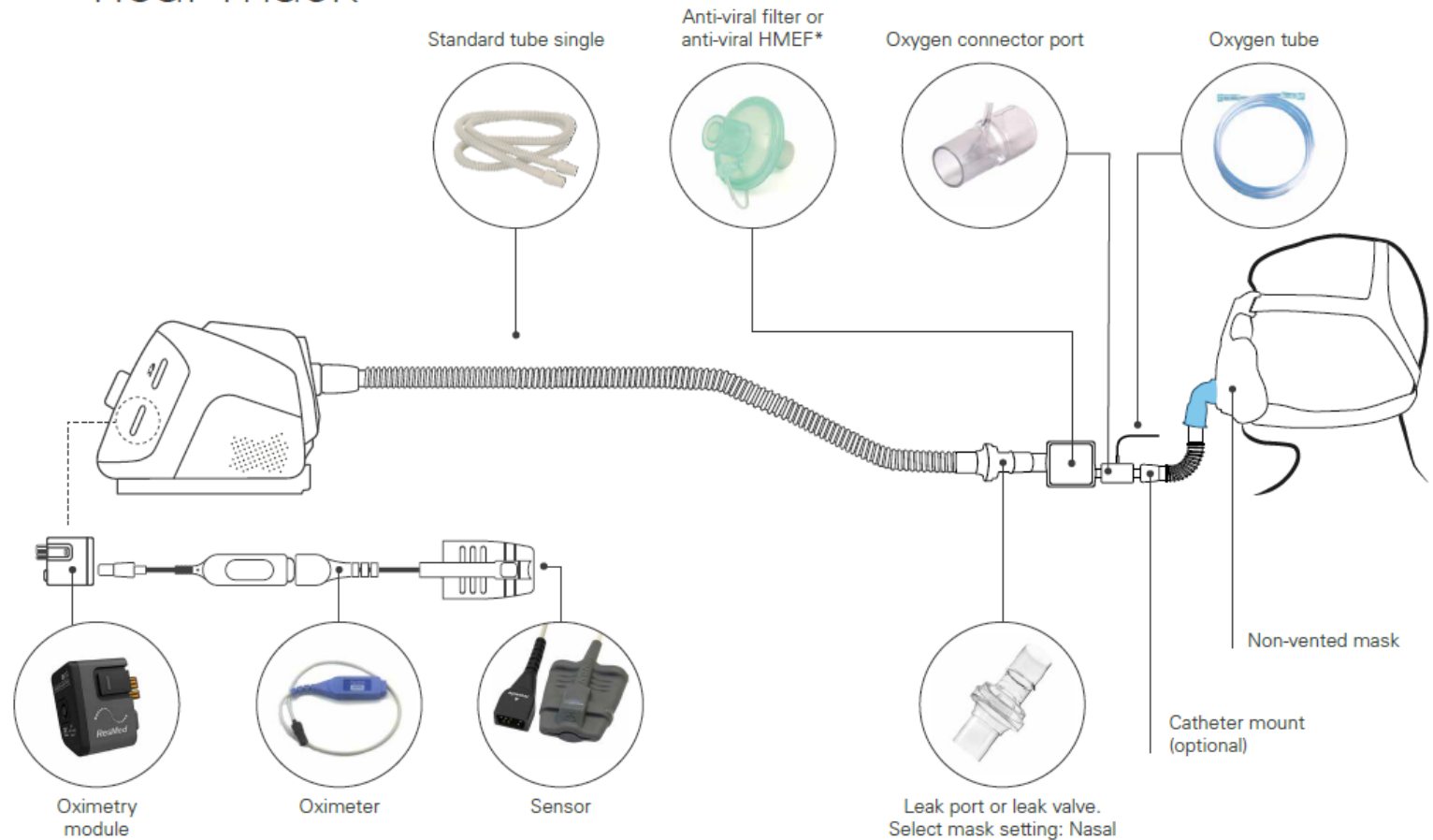
**LIMITATIONS:** screen size, FiO2 may be limited and fluctuate depending on the patient's respiratory mechanics and intentional & unintentional leaks

## Exemple of circuit configuration with intentionnel leak

### NV mask : non intentional leak

# 1 NIV with oxygen through oxygen port near mask

Lumis™ 150



▲ This low dispersion circuit is not the intended use for these devices, but emerging clinical practice in treating COVID-19 shows that it is a likely need given the ventilator shortage and the concern of infection risk to healthcare workers during the COVID-19 pandemic. For further information, please refer to national guidelines.

\* HMEF = Heat Moisture Exchange Filter. The shape and colour of filter might vary. **Note:** FIO<sub>2</sub> monitoring not possible. | SpO<sub>2</sub>

# Reference: Ventilation Accessories Catalogue

