

NIV and COVID-19

International and national healthcare bodies have differing guidance for the use of Noninvasive ventilation (NIV) in the treatment of COVID-19 patients. Please refer to the guidance provided by the societies or governing body for your region (links to some of these can be found below).

The key recommendations from the World Health Organization (WHO) when NIV is used for COVID-19 patients are:

- NIV (generally used for hypercapnic respiratory failure) should only be used in selected patients with hypoxemic respiratory failure.
- Patients treated with NIV should be closely monitored for clinical deterioration.
- Due to uncertainty around the potential for aerosolization, NIV should be used with airborne precautions.

NIV and potential for aerosolization

With any NIV mask there are two main places where gases and potential aerosols will leak. They are between the patient and the mask (patient leak) and, when venting is required, through the venting or exhalation port (intentional leak).

- NIV therapy should be treated as an aerosol-generating therapy and appropriate PPE should be employed.
- A well-sized and fitted mask should be used to reduce patient leak.
- A non-vented mask should be used, and where venting is required an exhalation port and a filter to reduce exposure of exhaled aerosols from patients should also be used (refer to different setups below).

Filters

There are a number of considerations to take into account when selecting a filter to reduce aerosolization during NIV therapy. The use of a filter may reduce the amount of aerosol released into the environment. However, some aerosols may still be generated through patient leak and leak through connections. Subsequently, appropriate PPE should still be employed.

Filter selection considerations can include:

- Viral-filtration efficiency when used dry.
- Viral-filtration efficiency when conditioned with humidity.
- Resistance to flow of the filter when both wet and dry. Typically, HEPA filters will have a higher filtration efficiency but also higher resistance to flow.

For further information about F&P Healthcare filters, go to <https://www.fphcare.com/covid-19/filters-evaqua-circuits-covid-19/>

Off-label use

These devices are required to be prescribed by a clinician as per their intended use. If a device is used off-label, the user recognizes that it is not the approved use of the device and that the responsibility for doing so is their own.

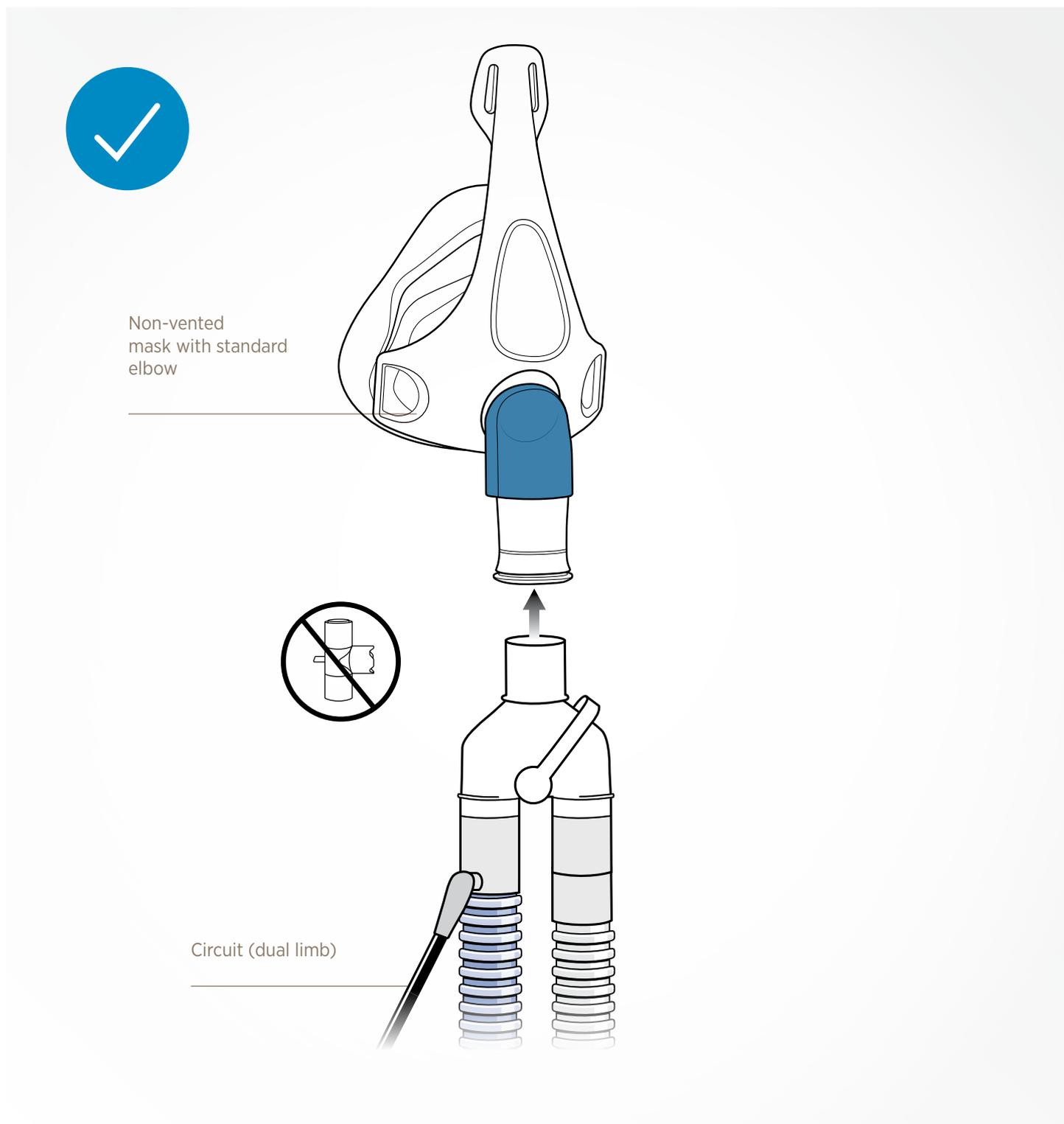
NIV setups

Dual-limb systems

These are for use with ICU ventilators that have the ability to provide NIV, and are commonly used to provide NIV in Europe.

Setup 1: Non-vented mask in a dual-limb system: **Recommended**

The majority of guidance where NIV is indicated in the treatment of COVID-19 patients recommends the use of a non-vented mask in a dual-limb system (where venting is not required) to reduce caregiver exposure to aerosolization. However, many regions will see these ventilators required for invasive ventilation, and the use of NIV on single-limb systems (dedicated NIV ventilators, Bi-level and CPAP devices) may be necessary.



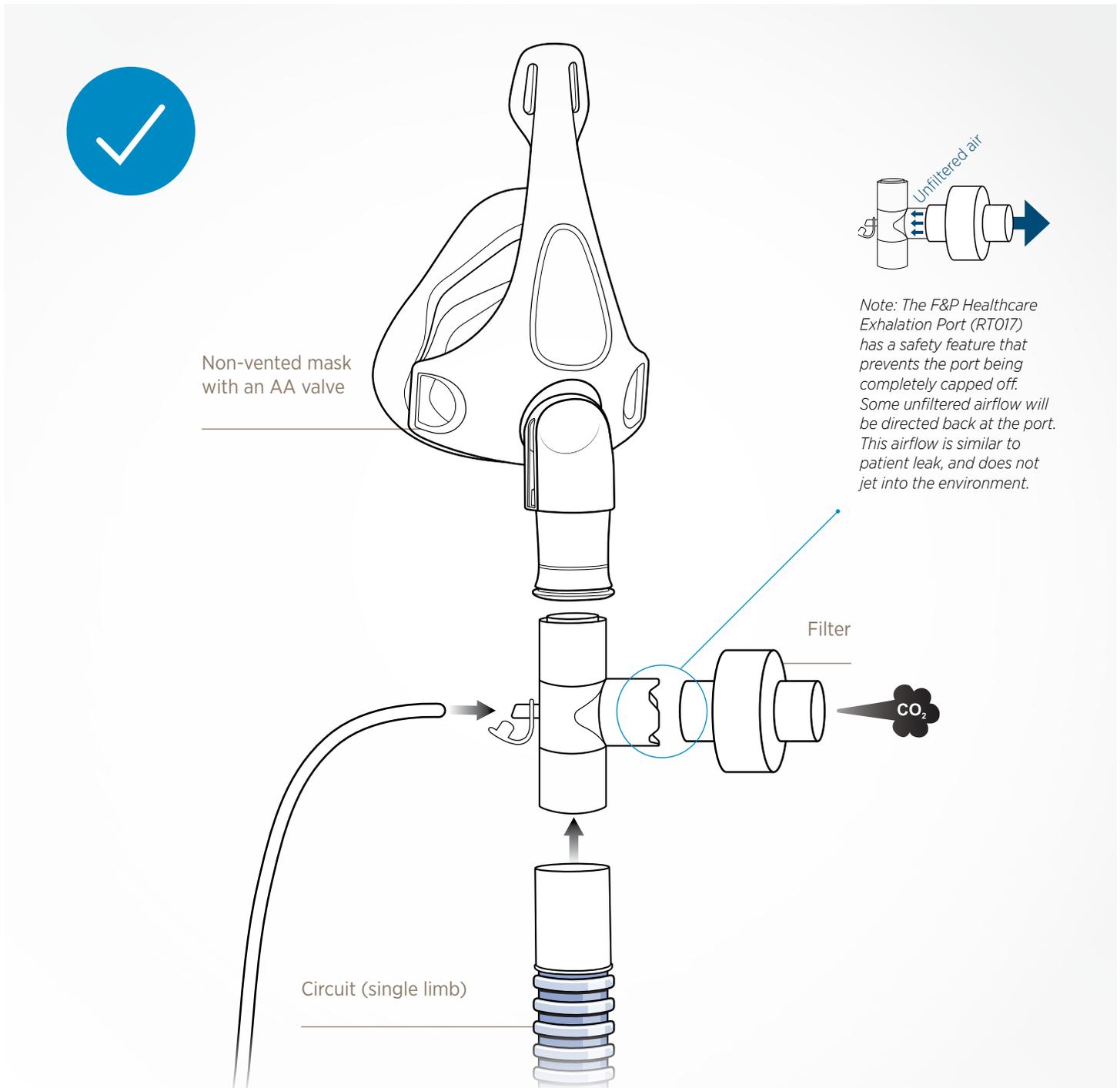
Single-limb systems

Dedicated NIV ventilators, Bi-level and CPAP devices are generally single-limb systems. These single limb systems require venting of the patients exhaled breath to prevent the buildup of CO₂.

- A non-vented mask with an exhalation port should be used rather than a vented mask.
- Vented masks could worsen contamination of the environment.
- Ensure the employed ventilator mode supports the use of non-vented masks and exhalation ports.

Setup 2: Non-vented mask in a single-limb system exhalation port filter: **Recommended**

- Ideally an exhalation port with reduced jetting should be used. Typically, this has a shroud around the exhalation holes to reduce air entrainment and an array of small holes creating a diffuse flow.
- An exhalation port with the ability for the exhaust to go through a filter should be employed to reduce aerosol dispersion.
- A low resistance to flow filter is recommended to reduce CO₂ rebreathing and maximize the percentage of gases being filtered.



Setup 3: Non-vented mask in a single-limb system in line filter: **Not Recommended**

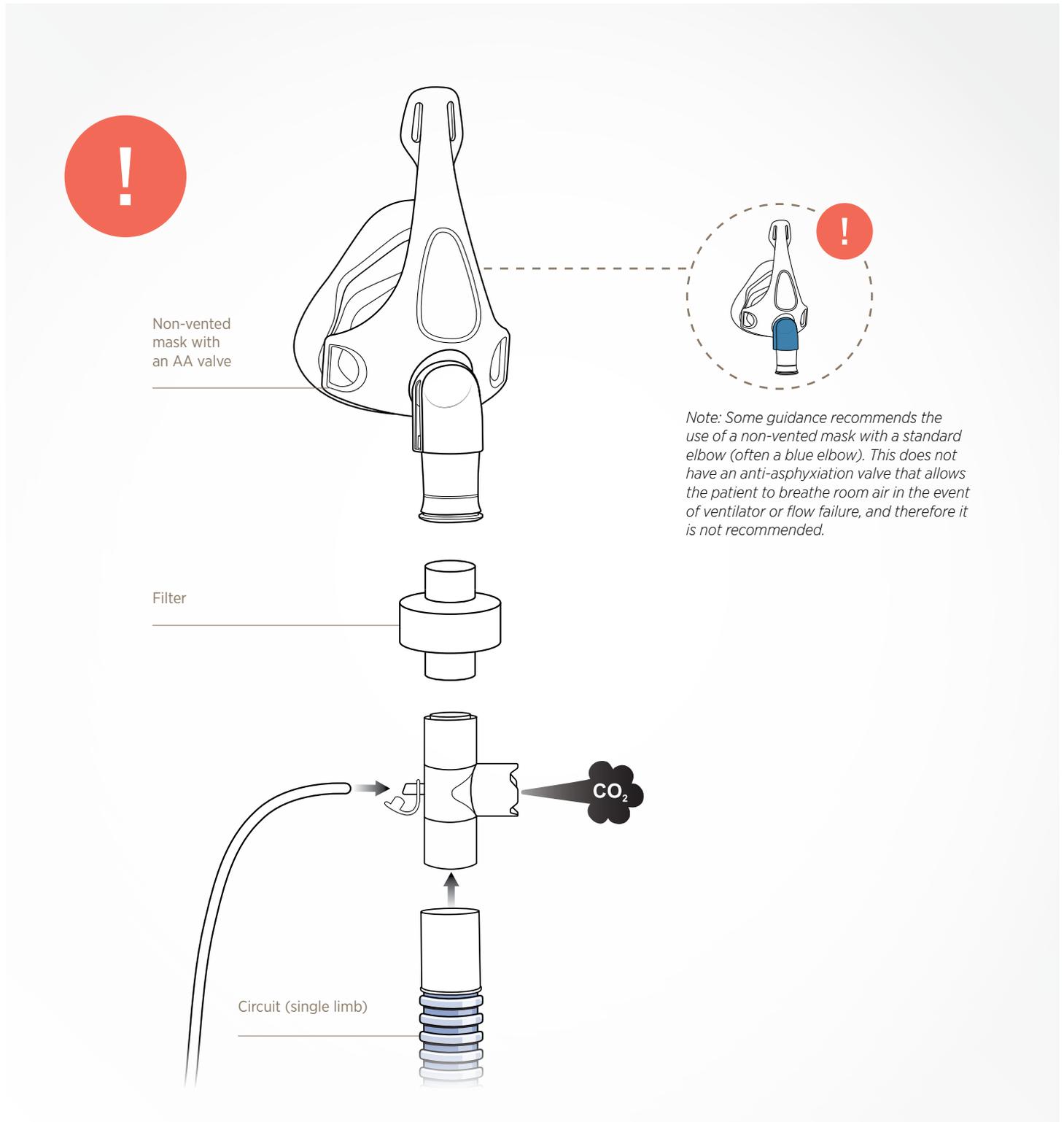
Some guidance recommends the system uses a filter between the mask and exhalation port. There are some major drawbacks of this setup.

F&P Healthcare don't recommend this setup if you already have an exhalation port which allows a filter to be attached to reduce aerosols being released into the environment.

Reasons we do not recommend this setup include:

- This will likely increase dead space, work of breathing and potentially reduce the efficacy of treatment.

- Triggering and pressure delivery may be affected due to the resistance to flow of the filter.
- Inspiratory flow may be exhausted out the port before reaching the patient due to the inline filter's resistance to flow.
- Secretion accumulation may cause filter blockage.
- Frequent replacement of the filter is required, which in this setup involves breaking the circuit, increasing the risk of infection for caregivers.



Setup 4: Use of altered vented masks for NIV: **Not recommended**

The COVID-19 pandemic has led to an increase in demand for medical products such as NIV masks, and has also highlighted the potential for shortages. Customers and healthcare professionals have asked for guidance on using vented masks such as (OSA CPAP masks and vented hospital masks) to deliver NIV in hospital in case non-vented NIV masks are unavailable.

While the intended use allows for vented CPAP masks to be used in the hospital, there is an increased risk of aerosols jetting into the environment because of the vented configuration.

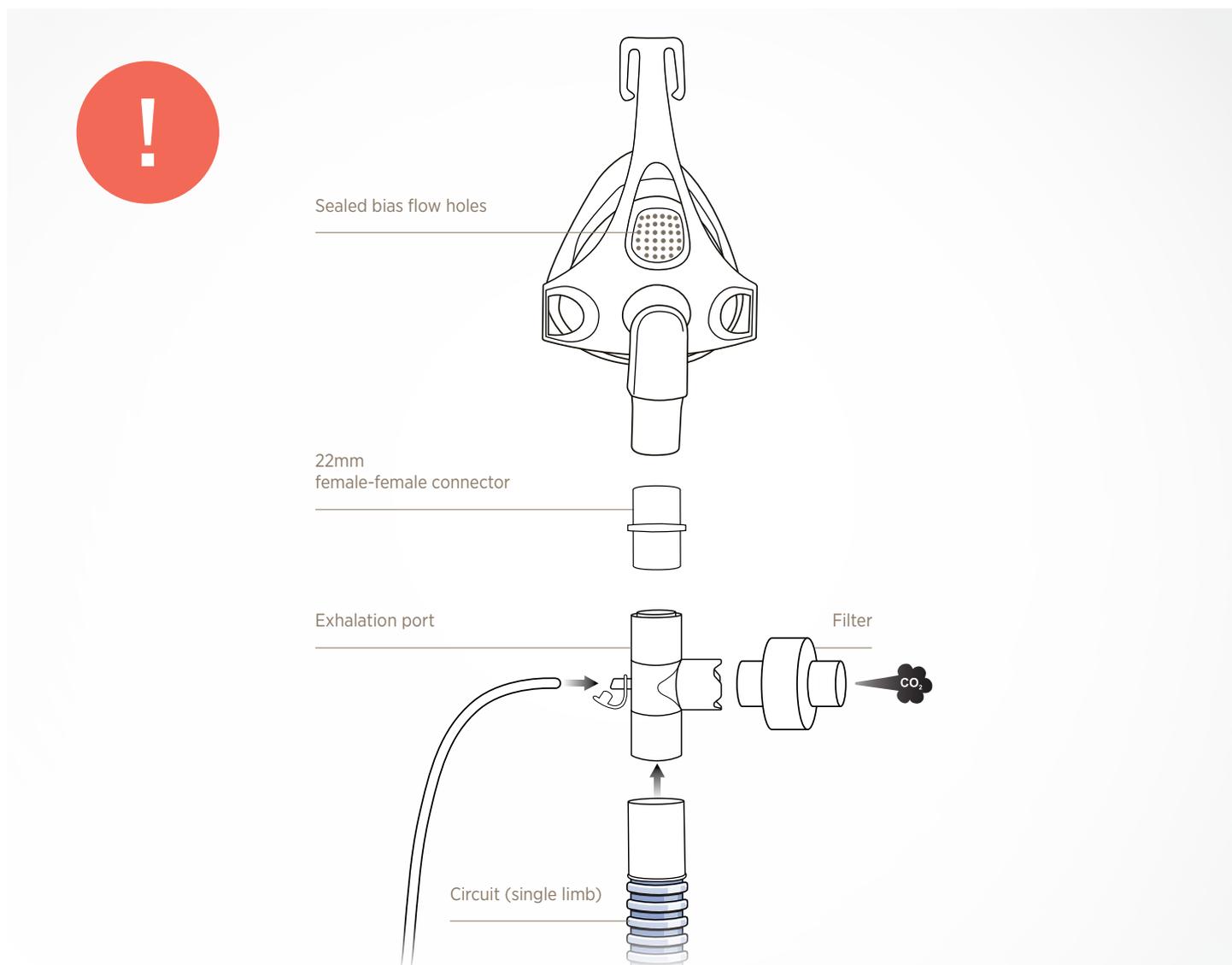
And as above vented NIV masks are not recommended for the same reason.

The following guidance can be used to highlight the main considerations in the case that a vented hospital or CPAP mask is the only option for delivering NIV in the hospital. It is not a recommended setup.

Considerations include:

- Covering of the exhaust flow/venting holes can pose a risk to the patient. If the holes are sealed, there **MUST BE** another source of leak in order to flush out CO₂. This may increase the dead space of the mask.

- There are typically two types of vented mask:
 - Vented hospital masks commonly used in the delivery of NIV. When aerosol generation is not a concern, these masks are normally single-patient use
 - Vented CPAP masks that are typically used by patients with OSA in a home setting, but often also used in respiratory wards and sleep labs.
- The exhaust flow holes in CPAP masks are similar to a vented NIV mask and it is difficult to filter the air from them.
- The same precautions as above regarding aerosolization from NIV masks, such as wearing appropriate PPE, should be taken when using CPAP masks.
- The source of leak could be in the form of an exhalation port such as the F&P RT017.
- A filter can be placed over the exhaust port of the RT017 exhalation port (see setup diagram below).
- Most exhalation ports will not directly connect to a vented mask and will require a 22mm Female - 22mm Female connector.

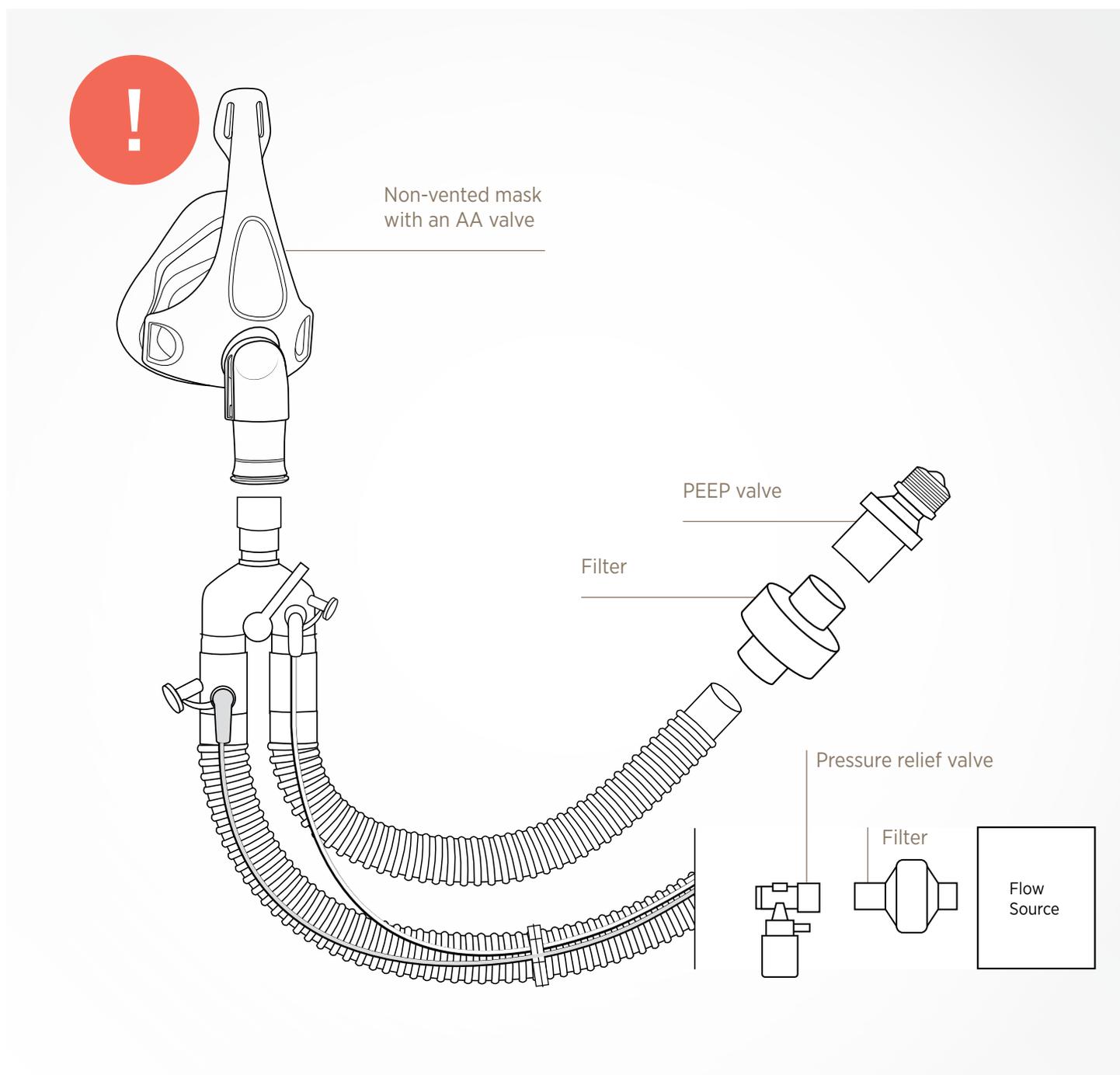


Setup 5: PEEP Valve Setup: **Not Recommended**

A low-cost method of delivering CPAP to patients in hospitals is to use a non-vented NIV mask and a Peak End Expiratory Pressure (PEEP) valve with a flow source or pressurized source of air. The exhaust in this setup exits when the PEEP valve is activated and may require a filter to reduce aerosols being released into the environment.

The following should be taken into consideration when a filter is added to the PEEP valve setup:

- The considerations regarding aerosolization and NIV therapy as set out above.
- The considerations regarding filter selection as set out above.
- The filter must be monitored for blockages and replaced as required.
- The replacement of the filter in this setup will interrupt the therapy delivery.
- The delivered pressure will be higher than the PEEP valve setting due to the pressure drop across the filter, particularly when higher flow rates are used. A higher resistance to flow filter will result in the patient experiencing higher pressures.
- A safety pressure relief valve must be used in this setup, particularly if the flow source is wall air, as the occlusion of the filter may cause high pressures to build up.
- There may also be additional back pressure experienced by the patient upon exhalation due to the resistance in flow of the filter. This may negatively affect work of breathing.



Useful links

WHO

[https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-\(ncov\)-infection-is-suspected](https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-(ncov)-infection-is-suspected)

Chinese Medical Association (expert consensus)

<http://rs.yiigle.com/yufabiao/1182334.htm>

American Thoracic Society

<https://www.thoracic.org/professionals/clinical-resources/disease-related-resources/novel-coronavirus.php>

JAMA Clinical Guideline Synopsis (Poston et al, 2020)

https://jamanetwork.com/journals/jama/fullarticle/2763879?guestAccessKey=e4e60cc5-cf61-4ff9-8d11-685e1e70e884&utm_source=silverchair&utm_medium=email&utm_campaign=article_alert-jama&utm_content=olf&utm_term=032620

The European Society of Intensive Care Medicine and the Medicine Society of Critical Care Medicine's joint Surviving Sepsis Campaign

<https://www.esicm.org/ssc-covid19-guidelines/>

European Respiratory Society

<https://erj.ersjournals.com/content/55/3/2000352?cct=2283>

Australia & New Zealand Intensive Care Society

<https://www.anzics.com.au/coronavirus-guidelines/>

British Thoracic Society/NHS

<https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/specialty-guide-itu-and-coronavirus-v1-16-march-2020.pdf>