Gas-powered
Positive Airway Pressure Device
Cheat Sheet

Device types: EzPAP, VersaPAP

General Physiology/Mechanism of action: The continuous positive pressure during inhalation encourages deep breaths, and the positive pressure during exhalation helps keep the airways open[1], increases functional residual capacity (FRC), and increases intrathoracic pressure distal to retained secretions using collateral ventilation channels[6].

General Indications.[2,3]:

1. The treatment and prevention of atelectasis in the hospital environment

Contraindications[9]:

1. Patients unable to tolerate the increased work of breathing (acute asthma, COPD)
2. Intracranial pressure (ICP) > 20 mm Hg
3. Hemodynamic instability
4. Recent facial, oral, or skull surgery or trauma
5. Acute sinusitis
6. Epistaxis
7. Esophageal surgery
8. Active hemoptysis
9. Nausea
10. Known or suspected tympanic membrane rupture or other middle ear pathology
11. Untreated pneumothorax

Limitations/Disadvantages:

1. Must be powered by a 15 L/min-capable flow regulator that is connected to a 50-psi air or oxygen source (hospital use only)
2. Requires that the patient actively participate
3. Lack of evidence demonstrating effectiveness[10]

Instructions for Use[2,3]:

1. Firmly connect one end of oxygen tubing to a 0-15 L/min flow regulator that is connected to a 50-psi air source
2. Set gas flow at 5 L/min, or to the flow setting at the last therapy session.
3. Check that flow can be felt coming out of the Mouthpiece.
4. Have the patient sit in a comfortable position.
5. Instruct the patient to relax while performing diaphragmatic breathing.
6. Have the patient put the mouthpiece in mouth and close lips around it to ensure an effective seal (a nose clip can be used if needed).
7. Have the patient perform breathing through the device for both inhalation and exhalation.
8. Periodically check for a suitable breathing rate and patient tolerance, adjust the flow rate if needed.

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9. Have the patient maintain breathing through the device for the entire therapy session to accomplish clinical goals.

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Mechanical-Insufflation/Exsufflation Therapy Cheat Sheet

General Physiology/Mechanism of action: Mechanical insufflation-exsufflation (also known as in-exsufflation) refers to a procedure where air is pushed into the lungs using positive pressure, followed by a controlled negative-pressure exsufflation. This process generates a strong peak flow and sustained airflow that effectively loosens and moves secretions toward the mouth, making it easier for them to be suctioned or coughed up.[2]

General Indications:

1. A patient unable to clear secretions effectively due to muscle weakness[2]
2. A cough peak flow of less than 270 L/min indicates the need for assisted cough methods, even if you are not sick[4]

Contraindications:

1. Contraindications to increased positive pressure (pneumothorax (untreated or recent), hemothorax, hemoptysis, subcutaneous emphysema, pulmonary bullae, barotrauma[1]
2. Recent surgery (pulmonary/thoracic/abdominal/neuro)[2]
3. (Severe) bronchospasm, COPD, or asthma[2]
4. Hemodynamic instability[2]
5. Active tuberculosis[2]
6. Increased intracranial pressures (> 25 mm Hg)[2]
7. Trauma (facial, cranial, rib fractures)[2]

Limitations/Disadvantages:

1. Less effective if administering to an uncooperative patient, or a patient with cognitive deficiency
2. May cause abdominal distention and nausea[4]
3. Size, weight and burden to the caregiver[7]
4. Poor evidence to guide the clinical practice[4]

Recommendations for Use[2]:

1. Inspiratory and expiratory timing and pressures should be personalized, gradually increasing pressure until the desired efficacy is achieved
2. Face masks should be used during manual hyperinflation-exsufflation (MI-E) for patients without an artificial airway
3. It is advisable to maintain higher expiratory pressures compared to inspiratory pressures.
4. Patients with amyotrophic lateral sclerosis (ALS) may benefit from lower pressures, triggered insufflation, and extended insufflation duration
5. MI-E can be performed through tracheostomy tubes, utilizing higher pressures for smaller tube diameters
6. Conclude the session with an insufflation to maintain an appropriate functional residual capacity in patients with weaker respiratory muscles.

Mechanical-Insufflation/Exsufflation Therapy Cheat Sheet

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Hand-held OPEP Device Cheat Sheet

Oscillating Positive Expiratory Pressure (OPEP) device brands: Aerobika, Acapella, Flutter, Lung Flute, Pocket PEP, Quake, Cornet, ShurClear, Vibralung, vPEP, Vibra-PEP[1]

General Physiology/Mechanism of action: The patient takes a deeper-than-normal inhalation, and as they exhale through the device, the positive pressure helps keep the airways open[2], increases functional residual capacity (FRC), and increases intrathoracic pressure distal to retained secretions using collateral ventilation channels[6]. The oscillations assist in thinning and loosening mucus that is trapped in the airway[3]. Ideally, the frequency of oscillation should match the ciliary beat frequency, which ranges from 11 to 15 Hz[4]. This combination of applied airway pressure changes and oscillations facilitates the movement of mucus plugs toward the central and upper airways, where further clearance is encouraged by subsequent huffing and coughing[5].

General Indications[7]:

1. Atelectasis
2. Retained secretions
3. Old age and immobility
4. To increase lung volume by increasing forced residual capacity and tidal volume
5. Reduce hyperinflation/air trapping in patients with emphysema, bronchitis, and asthma
6. Improve airway clearance in patients with cystic fibrosis, chronic bronchitis, bronchiectasis, and bronchiolitis obliterans
7. To maximize the delivery of bronchodilators in patients receiving bronchial hygiene therapy (for nebulizer-capable devices

Contraindications[7]:

1. Untreated pneumothorax
2. Intracranial pressure >20 mm Hg
3. Active hemoptysis
4. Recent trauma or surgery to skull, face, mouth, or esophagus
5. Patient with acute asthma attack or acute worsening of chronic obstructive pulmonary disease unable to tolerate increased work of breathing
6. Acute sinusitis or epistaxis
7. Tympanic membrane rupture or other known or suspected inner ear pathology
8. Nausea.

There are no absolute contraindications to PEP that have been noted by the literature.

Limitations/Considerations[8]:

1. Gravity dependent
2. Must be cleaned after each session
3. Designed for use by one patient only
4. Requires sufficient cognitive function, such as motivation and concentration
5. Requires adequate motor control, meaning the ability to sit in the correct position, hold the device at the proper angle, and generate sufficient expiratory pressure.

Hand-held OPEP Device Cheat Sheet

Instructions for Use[7]:

1. **Sit up tall.** Instruct the patient to sit up straight in a well-supported chair, maintaining a neutral lumbar spine. This position enhances the function of the diaphragm and pelvic floor while minimizing musculoskeletal stress.
2. **Inhale deeply and slowly.** The individual should be guided to take a slow, deep breath, inhaling to a volume slightly greater than their normal tidal volume. Breathing can occur through the nose or the mouth, using a mouthpiece
3. **Hold your breath for 2-3 seconds.** After inhaling, instruct the individual to hold their breath for 2 to 3 seconds
4. **Exhale through the device.** Following the breath hold, the individual should exhale through the device. The exhalation should have sufficient flow velocity against slight expiratory resistance, using the abdominal muscles at a slightly faster rate than normal. If needed, individuals may stabilize their cheeks (buccal muscles) with their other hand during exhalation to ensure better airflow reaches the lungs.
5. **Ensure optimal oscillation and pressure:** Some devices have a manometer. The optimal oscillation frequency and flow should result in airway resonance and vibration in the lower chest and upper abdominal region. Individuals are generally taught to recognize this tactile feedback and use it to adapt their technique.
6. **Secretion mobilization/removal.** Cycles of breaths through the device are followed by the forced expiration technique (FET) aka huff cough, then coughing to remove secretions

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Hand-held OPEP Device Cheat Sheet

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Home Non-Invasive Ventilation (NIV) Cheat Sheet

Indications/Conditions: Neuromuscular diseases (NMD), Restrictive Thoracic Disorders (RTD), Chronic Obstructive Pulmonary Disease (COPD) with hypercapnia, other hypoventilation disorders (also central sleep apnea or complex sleep apnea for respiratory assist devices)

- Home ventilators predominantly used for progressive NMD requiring NIV beyond nocturnal use (e.g. ALS)

Healthcare Common Procedure System Codes (HCPSC), Available Devices, and Key Differences:

- Respiratory Assist Devices (RAD):
  - E0470 (no backup rate) – ResMed AirCurve 10 and 11 VAuto, React Health Luna G3 Bilevel 25A
  - E0471 (with backup rate) – ResMed AirCurve 10 ST and ST-A, ResMed AirCurve ASV, ResMed Stellar 150, React Health Luna G3 Bilevel ST 30Vt
- Home Mechanical Ventilators (HMV):
  - E0465 (invasive interface) and E0466 (non-invasive interface) – ResMed Astral 100/150, React Health V+Pro and V*Home, Phillips Respironics Trilogy Evo, Movair/Lowenstein Luisa, Breas Vivo
  - E0467 (multi-function) – React Health/Ventec VOCSN
  - E0468 (dual-function, cough assist) – React Health/Ventec VC+Pro and V+C
- Key features of HMV vs. RAD:
  - Expanded modes of ventilation (including auto EPAP, volume modes, mouthpiece ventilation, sigh breaths), multiple modes can be programmed (and readily switched to), can be used for invasive mechanical ventilation, can provide high flow oxygen, portable (internal battery), expanded safety alarms, remote monitoring with separate modem but unable to make remote adjustments to settings (can with RAD), higher maximum pressure (50 cmH_2O vs. 30 cmH_2O), humidifier separate, ancillary respiratory therapies available (oxygen concentrator, cough therapy, suction, nebulization)

Commonly Used NIV Modes and Features:

- Spontaneous (S) – set EPAP and IPAP; all patient triggered breaths; flow cycled; ± Ti (min and max if available); variable Vt from breath to breath; no BUR; avoid if NMD or prone to central apneas
- Spontaneous/Time (S/T) – similar to S mode but with set BUR if RR ↓ or apneic; Ti used with mandatory (device triggered) breaths; variable Vt but guaranteed minimum BPM and ventilation during apneas
- Pressure (Assist) Control (PC) – similar to S/T mode but with Ti applied to every breath; ensures more consistent Vt; may be beneficial for patients not able to generate sufficient Vt (e.g., NMD)
- Volume Assured Pressure Support (VAPS) – add on feature to above modes (rather than standalone mode); fixed EPAP, min and max IPAP/PS/PC to meet target Vt or Va (alveolar ventilation); ensures minimum target ventilation
- Auto EPAP (AE) – can combine with VAPS to provide auto titratable EPAP; ensures airway patency so may be beneficial for combined OSA; NMD may not tolerate due to pressure changes inducing possible glottic closure
- Assist Control (AC) – Target achieved with every breath (spontaneous or mandatory)
  - Pressure (as above with PC) or Volume
- Synchronized Intermittent Mandatory Ventilation (SIMV) – Target achieved for prespecified number of breaths based on synchronization of spontaneous and mandatory breaths, rest of breaths pressure supported
  - Pressure or Volume
- Mouthpiece Ventilation (MPV)
  - Pressure or Volume (usually Volume at 2-3x routine Vt to allow for breath stacking)

Additional Equipment: circuit (passive or active ± O_2, leak or valve, MPV; single or double limb), tubing, HME (non-heated) or heated humidifier, filters, patient interface (non-invasive = mask ormouthpiece; invasive = tracheostomy)

- Mask options – nasal pillows, nasal cradle, nasal, oronasal/full face, hybrid/subnasal, total face
- *Caution:* use vented mask or exhalation valve connected to tubing if using passive circuit to eliminate CO_2

Initial Settings and Adjustments:

Settings	NMD and RTD	Hypercapnic COPD	OHS (as alternative to CPAP)
Pressure Mode	S/T, PC	S, S/T	S, S/T
VAPS	Optional	Optional	Optional
AE	Not recommended	Optional	Optional, esp. for OSA
EPAP or PEEP	Lower (4-6 cmH_2O)	Lower (4-6 cmH_2O) unless OSA overlap, avoid too low if iPEEP	Higher (i.e., ≥6 cmH_2O as needed to maintain upper airway patency)
IPAP, PS, or Vt	4-5 cmH_2O > EPAP, ↑ as tolerated & for gas exchange, goal Vt 6-10 ml/kg IBW (↑ for SCI)	4-5 cmH_2O > EPAP, ↑ as tolerated & for gas exchange, IPAP 20-24 cmH_2O for HI-NIV	4-5 cmH_2O > EPAP, ↑ as tolerated and for gas exchange, goal Vt 6-10 ml/kg IBW
BUR	2-3 BPM < spont RR (min 8-10 BPM)	2-3 BPM < spont RR if used, ↑ for HI-NIV (12-16 BPM)	2-3 BPM < spont RR if used (min 8-10 BPM)
Rise Time	Slow/long (≥ 300-600 msec)	Fast/short (100-400 msec)	Slow/long (≥ 300-600 msec)
Ti	Long (Ti/Ttot 40-50%, or I:E ratio 1:1.5-1:1)	Short (Ti/Ttot 25-30%, or I:E ratio 1:3-1:2)	Long (Ti/Ttot 40-50%, or I:E ratio 1:1.5-1:1)
Trigger Sensitivity	High sensitivity (low flow)	Medium sensitivity (med. flow)	Medium sensitivity (med. flow)
Cycle Sensitivity	Low sensitivity (10-15% of maximal inspiratory flow)	Medium to High (25-50% of maximal inspiratory flow)	Medium (25% of maximal inspiratory flow)

Alarms: inspiratory pressure, EPAP/PEEP, Vt, Ve, RR, apnea, leak, circuit disconnect, FiO_2, battery, etc.

Downloads: directly or from cloud-based applications (e.g., React Health Connect for VOCSN, AirView for Astral 150) using separate modem

Select Unique Features of React Health/Ventec VOCSN and ResMed Astral 150 Ventilators:

- VOCSN
    - Ventilation and Ancillary Respiratory Therapies:
        - Ventilation – 3 presets; modes, settings, alarms; unable to change settings for mode being used
        - Oxygen – 3 presets (internal O_2 concentrator up to 6 L/min, low pressure O_2, high pressure O_2); O_2 flush (max available flow or FiO_2 for preset being used for up to 3 minutes)
        - Suction – High flow (up to -450 mmHg or ~40 L/min); can use with any traditional suction adaptor, connect to standard cannister or travel suction cannister (300 ml); cannot use with O_2
        - Cough Therapy – 3 presets; insufflation and exsufflation pressure and time, pause time, cough cycles, breath sync (synchronize cough with ventilation, in-line); use humidifier bypass circuit
        - Nebulization – connect nebulizer cup to device via nebulizer filter and then to circuit; select duration from 5-60 min; ventilator compensates for nebulizer flow; cannot use with O_2
    - Vol. Targeted-PS = VAPS; Vol. Targeted-PC = PRVC; Vol. Targeted-SIMV = SIMV+PRVC; no auto EPAP
    - Other – 1 internal and 2 external batteries (up to 9 hr of use); proprietary filters and tubing; unlocked (clinical) mode with last 4 of SN; Pre-Test with every initiation of therapy or switching modes/circuits
- Astral 150
    - iVAPS – set height, set target rate (~15 BPM) with iBR (2/3 set rate during spontaneous breathing and set rate ~spontaneous rate during apneas), target Va (can base on Vt, Vt/kg, and Ve noted on device) – achieved with variable PS (min ~5 cmH_2O, max ~15 cmH_2O); Safety Vt with other modes (PS, S/T, PAC)
    - Auto EPAP available – iVAPS-AE
    - Other – internal battery lasts ~8 hr (extended to ~16 hr with 2 external batteries), 4 presets for ventilation, unlocked (clinical) mode by pressing lock icon for 3 sec; Learn Circuit during setup

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VOCSN Clinical Training Chapters 1-15 on YouTube (https://www.youtube.com/watch?v=XW2gxNxO3Pg&list=PLiyzC4k7t2-87ZZcxqsDQhb2AJYn7Nv8d)

HOW TO WEAR YOUR FILTERING FACEPIECE RESPIRATOR

For your filtering facepiece respirator (FFR) to work as effectively as possible, you must wear it correctly. This includes the process of putting it on (donning) and taking it off (doffing). FFRs must form a seal to the face. Fit testing is the best way to confirm that a respirator fits you.

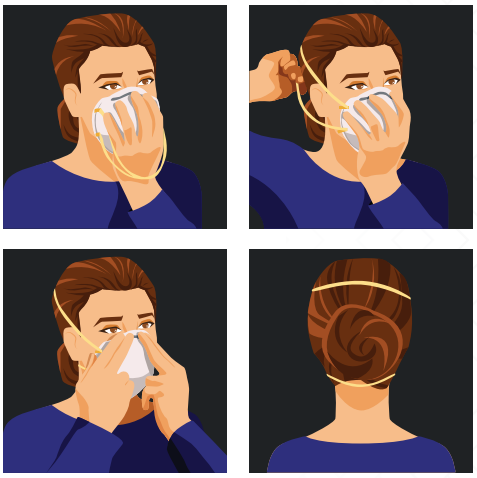
Donning Your FFR

Before Donning

- Always use a new FFR.
- Clean and thoroughly dry your hands.
- Inspect your FFR. If it appears damaged, dirty, damp, or the straps are stretched, do not use it. Replace it with a new one.

Donning Step by Step

1. Hold the FFR in your hand with the nose piece bar (or foam) at your fingertips. (If you don't see a nose piece, check that the text is right side up.)
2. Place the FFR under your chin with the nose piece bar at the top.
3. Pull the top strap over your head, placing it near the crown and just above your ears. Then, pull the bottom strap over and place it at the back of your neck, below your ears. Make sure to lay the straps flat and that they are not twisted.
4. Place your fingertips from both hands at the top of the nose piece. Press down on both sides of the nose piece bar to mold it to the shape of your nose.
5. Perform a user seal check.



User Seal Check*

Positive Check

Negative Check

For a good seal, your breath must pass through your FFR and not around its edges. Doing a user seal check every time you wear an FFR tells you if gaps exist between your FFR and your face, which would allow contaminated air in. A user seal check can be a positive or negative pressure check.

Positive User Seal Check

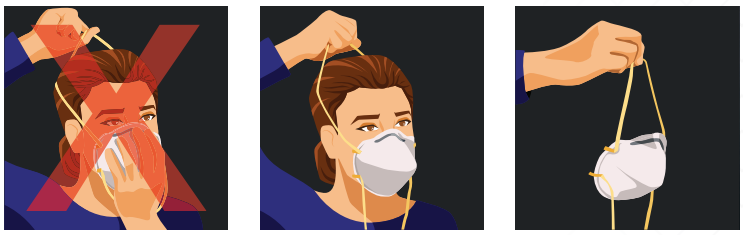
To check for gaps with a positive pressure user seal check, gently place your hands over the FFR, covering as much as possible, then **breathe out**. If you feel air leaking out from the edges, or if you are wearing glasses and they fog up, the FFR is not snug. Adjust the FFR and try again.

Negative User Seal Check

To check for gaps with a negative pressure user seal check, gently place your hands over the FFR. **Breathe in** sharply and use the bottoms of your hands to block the paths where air could enter the facepiece. If the FFR is sealed tightly, the facepiece will slightly collapse under the negative pressure. If the facepiece does not collapse, or you feel air leaking beneath, the FFR is not snug. Adjust the FFR and try again.

Doffing Your FFR

1. **Do not touch** the front of your FFR. It may be contaminated.
2. Remove by first pulling the bottom strap over the back of your head, followed by the top strap—all **without touching the respirator**.
3. Discard the used respirator in a waste basket.
4. Thoroughly wash your hands.



Tips for a Good Fit

- Fit testing provides the best way to ensure proper respirator fit. Find out more from the person in charge of your workplace respiratory protection program.
- Jewelry, glasses, and facial hair can cause gaps between your face and the edge of an FFR. Your FFR will fit better if you are clean shaven. Gaps can also exist if the FFR is too big or too small.
- Your FFR may look different than shown. If your FFR has two head straps, basic donning instructions apply.
- You can find manufacturer's instructions for your respirator model on the manufacturer's website.

*Not every respirator can be checked using positive or negative pressure. Refer to the manufacturer's instructions for conducting a user seal check on any specific respirator.

Need more information? Email us at *PPEConcerns@cdc.gov*

Resources

NIOSH [2010]. How to properly put on and take off your disposable respirator. Pittsburgh, PA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2010-133, *https://doi.org/10.26616/NIOSHPUB2010133*.

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Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

WILDFIRE SMOKE FACTSHEET

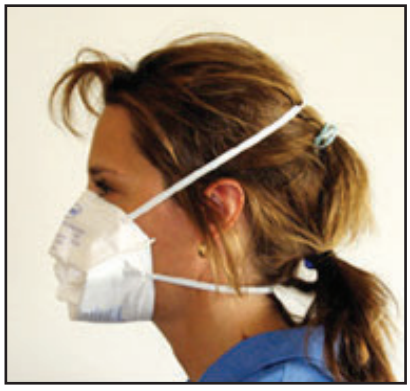
Protect Your Lungs from Wildfire Smoke or Ash

Wildfire smoke and ash can irritate your eyes, nose, throat, and lungs. They can make you cough or wheeze, and can make it hard to breathe. A respirator is a device (mask) that covers your nose and mouth, fits tightly to your face, and can filter out smoke or ash particles before you breathe them in. Respirators are not sized for children.

Protecting Your Health

The most effective way to protect yourself during wildfire emergencies is to stay indoors or limit your time outdoors when there is smoke in the air. This is especially important if you have heart or lung disease and are at higher risk for adverse health effects. Reducing physical activity and using HEPA-filtered air cleaners indoors are other ways to reduce your smoke exposure. Consider temporary relocation out of the smoky area if possible. By limiting your exposure one of these ways, you may not need to wear a respirator.

Respirators Can Help Protect Your Lungs



N95 or P100 respirators can help protect your lungs from smoke or ash. Straps must go above and below the ears.

How Do I Know if I Need to Wear a Respirator?

- People who stay indoors or limit their time outdoors during wildfire emergencies are doing the most effective thing to avoid exposure and may not need to wear a respirator.
- People who must be outside for extended periods of time in smoky air or an ash-covered area may benefit from using a tight-fitting N95 or P100 respirator to reduce their exposure.
- People experiencing health effects from a smoky environment, even if indoors, may also benefit from using a tight-fitting respirator to reduce their exposure.
- For people who want to wear a respirator, learning how to select and correctly use the respirator is important for achieving the most protection possible.

Choose the Correct Respirator

- Respirators are sold at many hardware and home repair stores and pharmacies.
- Choose a "particulate respirator" that has been tested and approved by the National Institute of Occupational Safety and Health (NIOSH). It will have the words **"NIOSH" and either "N95" or "P100"** printed on it.
- Choose a respirator that has two (2) straps to go around your head.
- Choose a size that will fit over your nose and under your chin and seal tightly to your face. Any leakage around the edge of the mask causes unfiltered air to enter and be inhaled.
- Do NOT choose a mask with only one strap or two straps that go around your ears. They are not designed to seal tightly to the face and will not protect your lungs.

How to Use this Type of Respirator

- To get a secure fit, place the respirator over your nose and under your chin, with one strap placed below the ears and one strap above the ears (see photo on page 1).
- Pinch the metal part of the respirator (if there is one) over the top of your nose so it fits securely.
- Follow instructions on the package about how to check for a tight face seal.
- Make sure the skin is clean shaven where the respirator touches the face. A good seal is not possible with facial hair.
- Throw away your respirator when it gets harder to breathe through, or if it gets dirty.

Possible Risks

- Wearing a respirator can make it harder to breathe. If you have heart or lung problems, ask your doctor before using a respirator.
- If you have difficulty breathing, get dizzy, or have other symptoms while wearing a respirator, go to a place with cleaner air and remove it.
- Wearing a respirator, especially if it's hot or you are physically active, can increase the risk of heat-related illness. Take breaks often and drink water.
- Respirators do not come in sizes suitable for children. Since they would not fit well enough to provide a tight face seal, they would not be effective at reducing exposure.

For more information:

- To learn more about protecting yourself from wildfire smoke, contact your local or state health department or go to www.airnow.gov
- To learn more about respirators, visit: https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/default.html
- Infographic about respirators: https://airnow.gov/static/topics/images/epa-infographic-respirator.jpg
- How to put on and remove your respirator: https://www.cdc.gov/niosh/docs/2010-133/pdfs/2010-133.pdf

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FENO

Fractional Exhaled Nitric Oxide (NO), measured in parts per billion (PPB)

Low FeNO (< 25 ppb)	Suggests low airway inflammation; consider alternative diagnoses if asthma is suspected.
Moderate FeNO (25-50 ppb)	May indicate mild inflammation; further assessment may be necessary.
High FeNO (> 50 ppb)	Suggests significant airway inflammation often associated with uncontrolled asthma.

Definition: FeNO is a non-invasive tool to measure the concentration of nitric oxide in exhaled breath, which serves as a biomarker for airway inflammation.

Common reasons for measuring FENO

1. To assist in assessing the etiology of respiratory symptoms.
2. To help identify the eosinophilic asthma phenotype.
3. To assess potential response or failure to respond to anti-inflammatory agents, notably inhaled corticosteroids (ICS).
4. To establish a baseline FENO during clinical stability for subsequent monitoring of chronic persistent asthma.
5. To guide changes in doses of anti-inflammatory medications: step down dosing, step-up dosing, or discontinuation of anti-inflammatory medications.
6. Monitoring airway Inflammation in asthma or to assist in the evaluation of adherence to anti-inflammatory medications.
7. To assess whether airway inflammation is contributing to poor asthma control particularly in the presence of other contributors (e.g., rhinosinusitis, anxiety, gastro-esophageal reflux, obesity, or continued allergen exposure).

Preparation

1. Avoid eating, drinking, and smoking for at least an hour before the test.
2. Avoid nitrate-rich foods like leafy greens, beetroot, celery, spinach, and lettuce for at least three hours before the test.
3. Avoid significant exertion or exercise for at least an hour before the test.
4. Generally, certain medications like ICS or other respiratory meds may affect the results of the test. Always check with your healthcare provider regarding medication

Contraindications: recent respiratory infections, current smoking, severe airflow obstruction (like advanced COPD), unstable heart conditions, recent thoracic or abdominal surgery, history of coughing up blood (hemoptysis), and situations where the patient may not be able to cooperate with the test instructions properly due to age or cognitive impairment.

Steps to Perform Test

1. Empty your lungs by breathing out completely.
2. Hold the breathing wand and place the mouthpiece into your mouth.
3. Depending on device, begin inhaling or exhaling (like blowing on a cup of hot tea), maintaining a steady flow to measure the concentration of NO in exhaled air. Device will confirm your blowing is adequate, repeat as needed.
4. Test should only take a few minutes. Results in PPB are ready in seconds to minutes depending on which device you use.

Follow-Up Testing: In cases of ambiguous results, repeat testing or additional assessments may be warranted to clarify the patient's inflammatory status.

Other Situations in which FENO May Be Useful

The use of FENO in COPD and pulmonary hypertension and the use of nasal NO in diagnosis and monitoring of other respiratory disorders (e.g., allergic rhinitis, sinusitis, nasal polyposis, CF) are potentially of interest, but more research is needed before we know how clinically useful these tests can be for these disorders.

There are various manufacturers offering FENO tests: , Bosch Vivatmo Pro, Fenom Pro by MGC, Niox Vero, NObreath by Bedfont Scientific

References

1. American Thoracic Society Documents. (n.d.). https://www.thoracic.org/statements/resources/allergy-asthma/feno-document.pdf
2. Dweik, R.A., et al. (2011). American Journal of Respiratory and Critical Care Medicine*, 184(5), 602-615. DOI: 10.1164/rccm.9120-10ST.
3. Global Initiative for Asthma (GINA). (2021). "Global Strategy for Asthma Management and Prevention." GINA (https://ginasthma.org/)
4. Petsky, H.L., et al. (2016). "FeNO for Guided Treatment of Asthma: A Systematic Review and Meta-Analysis." *Chest*, 150(2), 286-295. DOI: 10.1016/j.chest.2016.02.017.

Remote Spirometry

Remote Spirometry enables patients to obtain care from the comfort of their own homes when traveling is a hardship. It allows for continuous monitoring and timely interventions, making it a valuable tool for managing respiratory health. It measures the volume of air inhaled and exhaled by the lungs, helping to diagnose conditions like asthma, COPD, and other respiratory diseases. Additionally used to evaluate lung function, monitor disease progression, and guide treatment decisions which play vital roles in managing respiratory health.

Patient Populations: Can vary widely across diverse populations and generally include the following types of patients.

1. *Chronic patients*: Individuals with long term respiratory conditions who require regular monitoring to manage their symptoms and treatment plans.
2. *Post-Acute Care Patients*: Those recovering from respiratory infections or illnesses who need ongoing assessment of their lung function.
3. *Elderly Individuals*: Older adults who may be more susceptible to respiratory issues and benefit from convenient remote monitoring.
4. *Patients in Rural Areas:* Individuals living in remote locations who may have limited access to healthcare facilities and can benefit from remote monitoring to maintain regular check-ups.
5. *Individuals with Mobility Issues:* Patients who have difficulty traveling to healthcare providers due to physical limitations or chronic illness.

Preparation

1. Ensure there aren't any contraindications before performing the test, such as myocardial infarctions within 1 week, hemoptysis (within the last 24 hours), or any recent eye surgeries (i.e., cataract surgery). See complete list of relative contraindications per ATS criteria.
2. Avoid heavy meals, smoking, and certain medications (as advised by a healthcare provider) before the test.

Testing

1. Ensure the spirometer is functioning properly and that the patient has all tools necessary including nose clip and software application.
2. Instruct patient to sit comfortably.
3. The patient inhales deeply and then exhales forcefully into a spirometer.
4. Multiple attempts may be required to ensure accuracy.

Interpretation

1. Qualified healthcare professionals such as Pulmonologists will interpret spirometry tests.
2. Key Measurements: Forced Vital Capacity (FVC): Total amount of air exhaled forcefully after taking a deep breath. Forced Expiratory Volume in 1 second (FEV1): Volume of air exhaled in the first second of the FVC maneuver. FEV1/FVC Ratio: Percentage of the FVC that can be exhaled in the first second; used to differentiate between obstructive and restrictive lung diseases. Peak Expiratory Flow (PEF): Maximum speed of expiration during the FVC maneuver.
3. Results are compared to predicted values based on demographic factors. Note, not all remote spirometry software applications include Z score interpretations.

Limitations

1. Can be influenced by patient effort and technique.
2. Not suitable for patients who are unable to follow instructions or cooperate.

Follow-Up

1. Abnormal results may require further testing, such as a formal pulmonary function test in house following the at-home tests, bronchodilator response test, and/or imaging studies.

There are various manufacturers offering remote spirometry: Aluna, Clario iSpiro MGC GoSpiro, and more

References:

American Journal of Respiratory and Critical Care Medicine, 2019. (https://www.atsjournals.org/doi/full/10.1164/rccm.201908-1590ST?role=tab)