PFTs and Oxygen Delivery

Spirometry, DLCO, oxygen devices, COPD targets and aerosols

SPIROMETRY: OBSTRUCTION OR RESTRICTION?

LLN = lower limit of normal (z-score −1.645). Low ratio plus low TLC = mixed pattern.

FINDING	OBSTRUCTIVE	RESTRICTIVE
FEV_1/FVC	Low	Normal or high
FVC	Normal or low	Low
TLC	Normal or high	Low (confirms it)
RV	High (air trapping)	Low; high in neuromuscular weakness

- Low FVC, normal ratio: restriction, air trapping or poor effort; low TLC confirms restriction.
- Classic cutoffs: TLC ≤80% predicted = restriction, >120% = hyperinflation; RV >120% or high RV/TLC = air trapping.
- ATS/ERS 2022 severity (z-score): mild −1.65 to −2.5, moderate −2.5 to −4, severe below −4.
- Quality: 3 acceptable efforts; two largest FEV_1 and FVC within 0.150 L (over age 6).

EXAM TIP GOLD: post-bronchodilator FEV_1/FVC under 0.70 confirms COPD (ATS/ERS uses the LLN); FEV_1 % predicted grades it: 1 ≥80, 2 50–79, 3 30–49, 4 under 30.

BRONCHODILATOR RESPONSE AND DLCO

- ATS/ERS 2022: FEV_1 or FVC rises more than 10% of predicted.
- Older 2005 rule, still common: at least 12% and 200 mL above baseline.
- Withhold first: SABA 4–6 h, SAMA 12 h, LABA 24 h (once-daily 36 h), LAMA 36–48 h.

VA = alveolar volume; KCO = DLCO ÷ VA. Correct for hemoglobin.

DLCO	THINK OF
Low; low VA and KCO	Interstitial lung disease
Low; normal VA	Emphysema, pulmonary vascular disease, anemia
Low; low VA, normal or high KCO	Chest wall or neuromuscular (poor expansion)
High	Alveolar hemorrhage, polycythemia, high blood flow, some asthma

EXAM TIP Emphysema = obstruction + low DLCO; asthma = obstruction + normal or high DLCO; fibrosis = restriction + low DLCO.

OXYGEN DEVICES

Low-flow: below inspiratory demand, so FiO_2 varies. High-flow: meets demand, so FiO_2 is fixed.

Typical adult exam values; sources differ, so follow your institution's protocols. Cannula: about +4% per L/min.

DEVICE	FLOW	APPROX. FIO_2	TYPE
Nasal cannula	1–6 L/min	24–44%	Low
Simple mask	5–10 L/min	35–50%	Low
Nonrebreather	10–15 L/min	60–80%	Low, reservoir
Venturi	Minimum on jet	24–60%	High
High-flow cannula	Up to 60 L/min	21–100%	High

- Simple mask: at least 5 L/min to flush CO_2.
- Reservoir masks: never let the bag collapse (nonrebreather ≥10 L/min). Partial rebreather: no valves; the first third of each exhalation refills the bag.
- Venturi: more O_2 flow raises total flow, not FiO_2 (raise it if RR is over 30). Blocked ports raise FiO_2 and cut flow.
- HFNC: heated and humidified; meets inspiratory demand; washes out dead space; small PEEP effect.

EXAM TIP Venturi math: air:O_2 = (100 − O_2%) ÷ (O_2% − 21). Total flow = O_2 flow × total parts. 40% ≈ 3:1, so 8 L/min gives about 32 L/min.

COPD AND OXYGEN TARGETS

- Risk of hypercapnia (COPD, morbid obesity, neuromuscular or chest wall disease, CF): SpO_2 88–92%.
- Most other acutely ill adults: 94–98% (AARC, BTS).
- Start with a 24–28% Venturi or cannula at 1–2 L/min; titrate per protocol.
- CO_2 rises mainly from worse V/Q (lost hypoxic vasoconstriction); reduced drive and Haldane effect add.
- Long-term O_2: PaO_2 ≤55 mm Hg or SaO_2 ≤88%; or PaO_2 56–59 (SaO_2 89%) with edema, cor pulmonale or Hct over 56% (Medicare; GOLD: 55–60, Hct over 55%).

SAFETY Never withhold O_2 from hypoxemic COPD or stop it abruptly once CO_2 has risen: rebound hypoxemia can be severe. Step down gradually with SpO_2 monitoring.

HUMIDITY AND AEROSOLS

SITUATION	HUMIDITY
Low-flow O_2	Usually none; AARC: consider above 4 L/min
HFNC	Always heated and humidified
Ventilator, heated	33–44 mg H_2O/L, 34–41 °C at Y-piece
Ventilator, HME	≥30 mg H_2O/L; not with low tidal volumes
NIV	Active humidity; no HME

- Age 4 or under or poor coordination: nebulizer or pMDI with valved holding chamber; mask, no blow-by.
- pMDI and soft mist inhaler: slow, deep breath. DPI: fast, forceful breath; age 4 or over.
- Large-volume nebulizer: bland aerosol for thick secretions or a bypassed airway; cool mist for upper-airway edema.
- Mist should flow all through inspiration; if it vanishes, total flow is too low (likelier at high FiO_2).

SAFETY Hypercapnic COPD: use an air-driven nebulizer with O_2 by cannula during treatment. An O_2-driven nebulizer mask delivers about 60%.

OXYGEN HAZARDS

- Toxicity: dose- and time-dependent; avoid FiO_2 over 0.6 unless needed for survival.
- Absorption atelectasis behind blocked airways, even at FiO_2 0.3–0.5.
- Preterm infants: retinopathy of prematurity, chronic lung disease.
- Infection risk from humidifier and nebulizer reservoirs.

SAFETY Fire: O_2 supports combustion. No smoking, flames or heat sources nearby; secure cylinders against falls.

Sources (24) are listed with links at icubasics.com/sheets/rt-pft-oxygen.html. For education and exam preparation only. Not medical advice; follow current guidelines and your institution's protocols. ICU Basics is an independent study aid not affiliated with any certifying body.