DIANE'S NGN NCLEX 2026 VISUAL STUDY LIBRARY

Invasive *Oxygen Therapy* Artificial Airways & Mechanical Ventilation

Oxygen delivered through an artificial airway (endotracheal tube or tracheostomy), nearly always combined with mechanical ventilation. The nurse owns airway verification, VAP prevention, cuff management, suctioning safety, and emergency response to a dislodged tube or vent alarm.

SYSTEM: RESPIRATORY | CLUSTER: CRITICAL CARE | PRIORITY: AIRWAY / ABC | PHARM: RSI + SEDATION | HIGH-ACUITY NGN

SOURCE TRANSPARENCY

This topic is **not present in Diane's uploaded reference notes**, which cover non-invasive oxygen therapy only (nasal cannula, mask, COPD limits). Content drawn from: Saunders Comprehensive Review for the NCLEX-RN 2026, ATI RN Adult Medical-Surgical Nursing, Lippincott Manual of Nursing Practice, AACN Practice Alert on Endotracheal Tube Cuff Management, IHI Ventilator Bundle (HOB elevation, sedation interruption, PUD/DVT prophylaxis, oral care), and AHA/ACLS airway guidance.

1 Definition & Overview

WHAT IT IS · WHY IT MATTERS

Invasive oxygen therapy delivers oxygen through an artificial airway that bypasses the upper airway (mouth, nose, pharynx, larynx). It is used when the patient **cannot maintain a patent airway, cannot oxygenate or ventilate adequately, or cannot protect against aspiration**.

KEY DEVICES

- **Endotracheal tube (ETT)** — short-term, ≤ 14–21 days
- **Tracheostomy** — long-term airway access (surgical stoma)
- **Oropharyngeal airway (OPA)** — unconscious only; gag → vomiting
- **Nasopharyngeal airway (NPA)** — conscious / semi-conscious OK

WHY IT MATTERS

- Bypassing the nose **removes warming, humidification, and filtering** — humidified O_2 is mandatory.
- The cuff seals the airway → prevents aspiration **and** allows positive-pressure ventilation.
- Once intubated, the patient **cannot speak, swallow, or clear secretions** — the nurse becomes the airway.

2 Indications for Intubation

WHEN NON-INVASIVE O_2 IS NO LONGER ENOUGH

Think of the **4 Failures**: failure to **oxygenate**, failure to **ventilate**, failure to **protect** the airway, and an **anticipated** airway loss.

OBJECTIVE TRIGGERS

- **PaO_2 < 60 mmHg** on high-flow O_2 (refractory hypoxemia)
- **$PaCO_2$ > 50 mmHg** with **pH < 7.25** (acute respiratory acidosis)
- **RR > 35 or < 8** breaths/min
- **SpO_2 < 90%** on max non-invasive support
- **GCS < 8 → intubate** (cannot protect airway)

CLINICAL TRIGGERS

- Apnea or respiratory arrest
- Severe shock, cardiac arrest
- Status asthmaticus / impending exhaustion
- Severe smoke inhalation, facial burns, anaphylaxis
- Massive secretions the patient can't clear
- Anticipated airway compromise (OR, sepsis, trauma)

RED FLAG — DON'T WAIT

A **quiet chest** in an asthmatic, **rising CO_2** with falling RR, or **paradoxical breathing** = exhaustion. Tube *before* arrest, not after.

3 How It Works (Simplified)

POSITIVE PRESSURE VS. NATURAL NEGATIVE PRESSURE

Normal breathing = negative pressure. The diaphragm drops, intra-thoracic pressure falls, air is sucked in. **Mechanical ventilation = positive pressure.** The vent pushes gas *into* the lungs — which is why it can drop blood pressure (decreased venous return) and cause barotrauma.

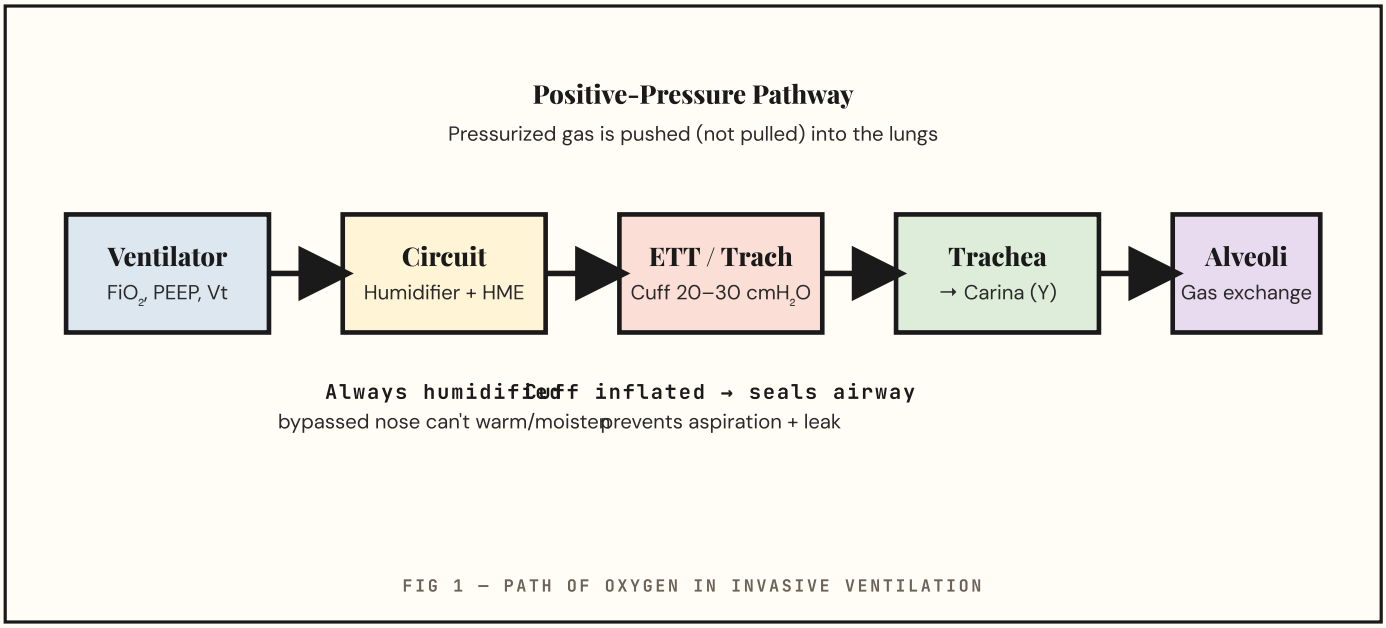

FIG 1 — PATH OF OXYGEN IN INVASIVE VENTILATION

KEY VENT SETTINGS (VOCABULARY)

- **FiO_2** — fraction of inspired O_2 (0.21 → 1.0). Goal: lowest that keeps $SpO_2 \geq 92\%$.
- **Vt (tidal volume)** — 6–8 mL/kg of **ideal body weight** (low Vt = lung-protective, ARDSnet).
- **PEEP** — positive end-expiratory pressure; keeps alveoli open (typical 5).
- **Rate / RR** — breaths/min set by vent.
- **PS (pressure support)** — boosts patient-initiated breaths.

COMMON MODES

- **AC (Assist-Control)** — every breath fully supported; resting mode.
- **SIMV** — vent gives mandatory breaths; patient can breathe between.
- **PS / CPAP** — spontaneous mode; used for **weaning**.
- **PRVC** — pressure-regulated volume control (lung-protective).

4 Tube Placement Verification

FIRST THING AFTER INTUBATION — EVERY SINGLE TIME

METHOD	WHAT IT CONFIRMS	NCLEX NOTE
End-tidal CO_2 (capnography)	Tube is in the trachea (CO_2 detected over ≥ 6 breaths)	**Gold standard at bedside**
Chest X-ray	Tube tip 2–4 cm above carina; not in right mainstem	**Definitive** confirmation
Bilateral breath sounds	Equal aeration (no R-mainstem intubation)	Auscultate **both axillae + epigastrium**
Bilateral chest rise	Symmetric expansion	Asymmetric → consider mainstem or pneumothorax
Condensation in tube + rising SpO_2	Supporting evidence only	Never sufficient alone

RED FLAG — ESOPHAGEAL INTUBATION

Gurgling over the epigastrium, no chest rise, falling SpO_2, no CO_2 on capnography = tube is in the esophagus. **Remove immediately**, bag-mask ventilate, and re-intubate.

Document the cm marking at the lip/teeth (usually 21 cm female, 23 cm male) so any later migration is detected instantly.

5 Complications & Warning Signs

EARLY VS LATE · WHAT THE NURSE WATCHES FOR

EARLY (PERI-INTUBATION)

- **Hypoxia** during intubation attempt
- **Hypotension** from positive pressure + sedatives
- **Esophageal intubation** — no CO_2, gurgling epigastrium
- **Right mainstem intubation** — unilateral breath sounds (R)
- Dental / lip trauma
- Aspiration during the attempt
- Vagal response → bradycardia (esp. peds)

LATE / ONGOING

- **VAP** — ventilator-associated pneumonia (new infiltrate + fever + ↑WBC + purulent sputum after 48 h)
- **Barotrauma / pneumothorax** — sudden ↑PIP, ↓BS, ↓SpO_2, tracheal deviation
- Volutrauma, atelectrauma
- Tube displacement / accidental extubation
- Cuff over-inflation → tracheal ischemia, stenosis, fistula
- Mucus plugging → sudden ↓SpO_2 + high-pressure alarm
- Stress ulcer, DVT, ICU delirium, muscle weakness

RED FLAG — SUDDEN DETERIORATION ON VENT → THINK D · O · P · E

Displacement of tube · **O**bstruction (mucus, kink, biting) · **P**neumothorax · **E**quipment failure. **Assess the patient first**, then disconnect from vent and bag with 100% O_2 while troubleshooting.

6 Priority Nursing Interventions

ABC FRAMEWORK · THE NURSE'S DAILY CHECKLIST

A — Airway

- Verify cm mark at lip every shift & PRN
- **Cuff pressure 20–30 cmH_2O** q4–8h
- Bilateral breath sounds q2h
- Secure tube; reposition daily to prevent pressure injury
- Communication board / writing tool

B — Breathing

- SpO_2 continuous; **$EtCO_2$ continuous**
- ABGs as ordered (after vent changes)
- Monitor vent alarms — never silence without assessing
- **Suction PRN only**, never routinely
- Hyperoxygenate 100% × 30–60 sec before suction
- Suction pass ≤ **10–15 seconds**

C — Circulation & Comfort

- BP, HR, MAP q1h
- Sedation per RASS / CPOT goals
- Daily **sedation vacation** + spontaneous breathing trial
- DVT & stress-ulcer prophylaxis
- Eye care (lubricant, gentle closure)
- Frequent repositioning, skin checks

SUCTIONING — SAFETY SPECIFICS

- Use **closed inline suction** system for vented patients (keeps PEEP, reduces VAP).
- **Do NOT instill saline** before suctioning — pushes pathogens deeper, drops SpO_2.
- Pre-oxygenate to 100% FiO_2 for 30–60 sec.
- Apply suction **only on withdrawal**; total pass ≤ 10–15 sec.
- Stop & bag with 100% O_2 if: ↓SpO_2 < 90%, dysrhythmia, bradycardia, hypotension.

7 Ventilator-Associated Pneumonia (VAP) Bundle

FIVE INTERVENTIONS THAT SAVE LIVES — IHI STANDARD

VAP develops **≥ 48 hours after intubation**. The bundle is a non-negotiable nursing checklist; partial compliance ≠ compliance.

BUNDLE ELEMENT	NURSING ACTION	WHY
1. HOB elevation	Head of bed **30–45°** at all times (unless contraindicated)	Reduces aspiration of gastric contents
2. Oral care	**Chlorhexidine 0.12%** q2–4h + brush q12h; suction oropharynx	Decreases oropharyngeal bacterial load
3. Sedation interruption	Daily "sedation vacation" + SBT (spontaneous breathing trial)	Reduces ventilator days → fewer infections
4. PUD prophylaxis	PPI or H_2 blocker as ordered (e.g., pantoprazole, famotidine)	Prevents stress ulcer bleeding
5. DVT prophylaxis	SCDs + LMWH (e.g., enoxaparin) unless contraindicated	Prevents PE in an immobile patient

ADD-ONS (STRONGLY RECOMMENDED)

- **Subglottic suctioning** tube if available — drains pooled secretions above the cuff.
- **Cuff pressure 20–30 cmH_2O** — below 20 = micro-aspiration; above 30 = ischemia.
- **No routine** ventilator circuit changes — only when soiled.

8 Pharmacology

RSI · MAINTENANCE SEDATION · PARALYTICS

Rapid Sequence Intubation (RSI)

ROLE	DRUG	KEY NURSING NOTE
Induction (hemodynamically stable)	**Etomidate**	BP-neutral; transient adrenal suppression
Induction (shock / bronchospasm)	**Ketamine**	Maintains BP; bronchodilates; ↑secretions
Induction (normotensive)	Propofol	Causes hypotension; rapid onset/offset
Paralytic — depolarizing	**Succinylcholine**	**Avoid** in hyperkalemia, burns > 24 h, crush, MH risk
Paralytic — non-depolarizing	**Rocuronium**	Longer duration; reverse with sugammadex

Maintenance Sedation & Analgesia

DRUG	CLASS / ACTION	WATCH FOR
Propofol (Diprivan)	Sedative-hypnotic; rapid on/off	↓BP, **↑triglycerides, ↑lipase**, propofol infusion syndrome; lipid emulsion — change tubing q12h
Midazolam (Versed)	Benzodiazepine	Respiratory depression; reverse: **flumazenil**
Dexmedetomidine (Precedex)	α-2 agonist	**Does NOT suppress respiratory drive** → ideal for weaning; bradycardia, hypotension
Fentanyl	Opioid analgesic	Respiratory depression; reverse: **naloxone**; chest-wall rigidity at high doses
Cisatracurium / Vecuronium	Non-depolarizing paralytic	**MUST be combined with adequate sedation** — patient is awake but paralyzed; train-of-four monitoring

RED FLAG — PARALYTIC WITHOUT SEDATION = AWARENESS UNDER PARALYSIS

A patient on cisatracurium / vecuronium / rocuronium is **awake, in pain, and unable to move or signal** if not sedated. **Always pair a paralytic with continuous sedation + analgesia.**

9 Emergency: Tube Dislodgement

ETT EXTUBATION VS. TRACH DECANNULATION

ETT – ACCIDENTAL EXTUBATION

- **Call for help** immediately
- **Bag-mask ventilate** with 100% O_2
- Suction oropharynx
- Prepare for **re-intubation** at bedside
- Do NOT attempt to push tube back in

TRACHEOSTOMY – DECANNULATION

- **Stoma < 7 days old (fresh trach) → surgical emergency**. Cover stoma, bag-mask ventilate **over the mouth/nose** while occluding stoma. Call provider/RRT NOW.
- **Stoma > 7 days (mature stoma)** → nurse may reinsert the trach using the **obturator**; if unable, insert smaller size or temporarily ventilate over stoma.
- Keep **two trach tubes** at bedside (same size + one smaller) and **obturator** taped to the wall.

RED FLAG – VENT ALARM PRIORITIES

HIGH-PRESSURE alarm → kink, biting, secretions, coughing, bronchospasm, pneumothorax. **LOW-PRESSURE alarm** → disconnection, cuff leak, extubation. **Assess the patient first**; if in doubt, **disconnect & bag with 100% O_2**.

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NCLEX Test Traps ⚠

WRONG VS RIGHT · THE EXACT DISTINCTIONS TESTED

TRAP	RIGHT
"Suction the patient every 2 hours on a schedule."	**Suction PRN only** — based on assessment (audible secretions, ↑PIP, ↓SpO_2, visible secretions). Routine suctioning damages mucosa and ↑VAP risk.
"Instill 5 mL normal saline before suctioning to loosen secretions."	**Do NOT instill saline.** Evidence shows it drives organisms deeper, drops SpO_2, and worsens VAP. Use humidification instead.
"Keep cuff pressure as high as possible to prevent any leak."	Cuff pressure **20–30 cmH_2O**. Above 30 → tracheal ischemia, necrosis, fistula. Below 20 → aspiration + VAP.
"Lay the patient flat to prevent the tube from migrating."	**HOB 30–45°** is the VAP-bundle standard. Flat positioning ↑aspiration risk dramatically.
"The vent is alarming — silence the alarm and look up the cause."	**Assess the patient first** (chest rise, SpO_2, color, secretions). If unable to resolve quickly, **disconnect and bag with 100% O_2**, then troubleshoot. Never silence without assessing.
"Patient is on cisatracurium — sedation is not required because they can't move."	**Paralytics ALWAYS require sedation + analgesia.** The patient is fully awake and aware unless sedated.
"Auscultation of bilateral breath sounds confirms ETT placement."	Breath sounds are **supportive**. The **gold standard at bedside is end-tidal CO_2 (capnography)**; **chest X-ray is definitive**.
"The fresh tracheostomy (post-op day 2) decannulated — push the trach back in immediately."	**Fresh stoma (< 7 days) = surgical emergency.** Cover stoma, bag over mouth/nose, call provider. Do

	NOT blindly reinsert — false tract creation can kill the patient.

11 Patient & Family Education

DURING THE VENT · WEANING · LONG-TERM TRACH

WHILE INTUBATED

- The tube prevents speech — provide a **communication board, picture chart, or writing pad**.
- Explain every procedure before doing it; sedated patients still hear.
- Reassure family: alarms beep frequently; staff respond.
- Encourage family touch, voice, music — proven to reduce delirium.
- Position changes, eye drops, and mouth care are **not** optional — they are comfort.

WEANING & EXTUBATION

- Daily SBT (spontaneous breathing trial) when stable.
- Sit upright, encourage deep breaths, cough.
- Expect **hoarseness** and a sore throat after extubation — typically resolves in 24–48 h.
- Report **stridor, drooling, severe hoarseness, or worsening respiratory effort** immediately (laryngeal edema).

HOME TRACHEOSTOMY CARE

- **Clean technique** at home (sterile in hospital); wash hands before/after.
- Suction **PRN only**; pre-oxygenate; ≤ 10 sec per pass.
- Clean inner cannula q8h (or per facility); change ties when soiled — **2-finger snugness**.
- Keep **spare trach (same size + one smaller) + obturator** with the patient at all times.
- **No swimming.** Cover stoma in the shower; humidify air; avoid powders/aerosols.
- Wear a medical-alert bracelet; family learns CPR with stoma technique.

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Memory Boosters & Mnemonics

PATTERN RECOGNITION FOR THE EXAM

D O P E

SUDDEN DETERIORATION ON THE VENT

- **D**isplacement (tube migrated/extubated)
- **O**bstruction (mucus, kink, biting)
- **P**neumothorax
- **E**quipment failure / disconnect

V A P

BUNDLE TO PREVENT PNEUMONIA

- **V**ertical HOB 30–45°
- **A**ntiseptic oral care (chlorhexidine)
- **P**auses on sedation + SBT + PUD + DVT prophylaxis

20 – 30

CUFF PRESSURE (CMH_2O)

- **< 20** → aspiration, micro-leak, VAP
- **20–30** → safe zone
- **> 30** → tracheal ischemia, necrosis, fistula

10 – 15

MAX SUCTION PASS (SECONDS)

- Hyperoxygenate to **100% FiO_2** × 30–60 sec first
- Suction **only on withdrawal**
- Stop if SpO_2 < 90%, dysrhythmia, ↓BP

G C S < 8

"GCS LESS THAN 8, INTUBATE"

- Patient cannot protect their own airway
- Aspiration risk is now imminent
- Even if oxygenating well — protect the airway

P U L L

SUCTIONING STEPS

- **P**re-oxygenate 100% O_2
- **U**nclamp / insert without suction
- **L**imit pass to 10–15 sec
- **L**isten / reassess after

13 Six-Step NCJMM Clinical Judgment Scenario

NGN 2026 FORMAT · APPLY IT

SCENARIO STEM

A 64-year-old client (Day 3 post-intubation for COPD exacerbation) is on AC mode: FiO_2 0.50, PEEP 5, Vt 450, RR 14. HOB 30°. RN enters at 0800 and finds: SpO_2 86% (was 96%), HR 128, BP 92/56, **high-pressure alarm** sounding. Bilateral breath sounds diminished on the right; tube depth marked at 23 cm at the lip but now reads 19 cm at the lip. Patient is restless, eyes wide, mouthing words. Last suction 2 hours ago for thick yellow secretions.

1 RECOGNIZE CUES

What is abnormal?

- SpO_2 **↓ from 96 → 86%**; HR **128**; BP **92/56**
- **High-pressure alarm** + diminished right breath sounds
- Tube depth **changed from 23 → 19 cm** at the lip (migrated **out** 4 cm)
- Restless, agitated → early hypoxia
- Thick yellow secretions 2 h ago → possible mucus plug

2 ANALYZE CUES

What patterns?

- Pattern fits **DOPE**: **D**isplacement (tube moved 4 cm), **O**bstruction possible (thick secretions), or **P**neumothorax (diminished BS one side)
- Hypoxia + tachycardia + hypotension = imminent decompensation
- Most likely combined displacement + secretions

3 PRIORITIZE HYPOTHESES

What is most urgent?

- **Hypothesis #1 (highest):** Tube displacement → ineffective ventilation
- **Hypothesis #2:** Mucus plug / obstruction
- **Hypothesis #3:** Pneumothorax (rule out with assessment + CXR)
- Airway is the priority — must be resolved **now**

4 GENERATE SOLUTIONS

What actions are possible?

- Call for help / activate Rapid Response

- **Disconnect from vent** and **bag with 100% O_2** while assessing
- Suction for the secretions
- Auscultate, check tube depth, check capnography waveform
- Prepare for re-intubation / repositioning by provider
- Notify provider + respiratory therapist

5

TAKE ACTION

Sequenced response:

- **(1)** Stay with patient, call for help — RRT + RT + provider
- **(2)** Disconnect from vent, **bag-mask ventilate with 100% O_2**
- **(3)** Assess chest rise, breath sounds, capnography
- **(4)** Suction with closed inline if obstruction suspected
- **(5)** Do NOT push the tube further in alone — provider repositions or re-intubates; obtain stat CXR
- **(6)** Ensure sedation/analgesia adequate — patient is agitated and aware

6

EVALUATE OUTCOMES

Did it work?

- **SpO_2 ≥ 92%, HR < 110, BP returns to baseline**
- Bilateral breath sounds restored; tube re-secured at 23 cm; CXR confirms placement
- Capnography waveform present and normal
- Patient calm, RASS at goal
- Document event, intervention, response; update care plan to prevent recurrence (re-tape, reinforce restraints, RASS recheck)