Objectives

- **Breathing and Ventilation**
  - What is adequate versus inadequate?

- **Assessing the Patient**
  - Inspection
  - Auscultation
  - Palpation
  - Non-Invasive Monitoring
Patient History

May be the most important part of the assessment.

- Chronic or acute problem?
- Past history?
- Medications?
- Time of onset?
- Time of day?
Terms

- **Paroxysmal nocturnal dyspnea (PND)**—dyspnea that occurs at night within 1–2 hours of going to bed.
- **Orthopnea**—also related to lying supine, although typically not awakened from sleep.
- **Platypnea**—dyspnea while the patient is in the upright position.
- **Treopnea**—dyspnea while the patient is in the lateral recumbent position.
- **Dyspnea on exertion (DOE)**—dyspnea with physical activity.
Adequate Breathing

**Normal Rates**

- **Adults** 12 – 20 / min.
- **Children** 18 – 30 / min.
- **Infants** 40 – 60 / min.
The Rhythm of Breathing

- Usually regular
- May be slightly irregular and influenced by talking, laughing, crying, etc.
- Infants may normally have irregular breathing patterns
The Quality of Breathing

- **Breath Sounds**
  - Are they present? Equal? Clear?

- **Chest Expansion**
  - Symmetrical? Equal? Adequate?

- **Work of Breathing**
  - Adequate? Increased? Decreased?
  - Accessory Muscle Use?
Depth of Breathing

- **Tidal Volume**
  - Is it adequate? Increased? Decreased?
  - 500 ml with quiet respirations while at rest, 5 – 7 ml/kg.
  - Expect tidal volumes of 10 – 15 ml/kg with activity, anxiety, distress.
  - When ventilating an adult with a BVM. You should be providing approximately 800 ml.
Signs of Inadequate Breathing

- **Rate**
  - Too fast or too slow

- **Rhythm**
  - May be irregular, chaotic, or changing respiratory pattern

- **Depth**
  - Inadequate tidal volume or exaggerated depth (air hunger)
Signs of Inadequate Breathing

- **Breath Sounds**
  - Diminished, Noisy, or Absent

- **Chest Expansion**
  - Asymmetrical, Unequal, or Inadequate
Signs of Inadequate Breathing

- The Work of Breathing
  - Use of accessory muscles
  - Retractions, sternal, intercostal, etc.
  - See-Saw breathing in infants
Watch for Subtle Signs

Nasal Flaring

Retractions

See-Saw Breathing

Diaphragmatic Breathing
Signs of Inadequate Breathing

- Nasal flaring
- Cyanosis
- Chest Tightness
- Excessive use of accessory muscles
- Numbness, tingling in hands & feet
- Pursed lips on exhalation
- Coughing, crowing, high-pitched bark
- Respiratory noise
  - wheezing
  - rattling
- Impaired mentation
  - unconsciousness
  - dizziness
  - restlessness
  - anxiety
  - confusion
  - combativeness
Other Signs of Inadequate Breathing

- Pale or cyanotic skin
- Cool, clammy skin
- Restlessness and anxiety
- Decreased level of consciousness
- Agonal respirations
- Diminished speech, or the inability to answer questions except with short or one word answers.
Clubbing of the Nails or Fingers

- Chronic condition associated with underlying pulmonary or cardiovascular disease.
- May be caused by trauma, gastrointestinal disease, skin disease, or malignancies.
Abnormal Respiratory Patterns

- Kussmaul’s respirations:
  - Deep, slow or rapid, gasping; common in diabetic ketoacidosis.
Abnormal Respiratory Patterns

- **Cheyne-Stokes respirations:**
  - Progressively deeper, faster breathing alternating gradually with shallow, slower breathing, indicating a brain stem injury.
Abnormal Respiratory Patterns

- **Biot’s respirations:**
  - Irregular pattern of rate and depth with sudden, periodic episodes of apnea, indicating increased intracranial pressure.
Abnormal Respiratory Patterns

- **Central neurogenic hyperventilation:**
  - Deep, rapid respirations, indicating increased intracranial pressure.
Abnormal Respiratory Patterns

- Apneustic respirations:
  - Prolonged inspiratory and/or expiratory pauses of 2 - 3 seconds.
  - Usually seen with lesions of the mid to lower pons.
  - Deep-gasping inspiration with a pause at full inspiration followed by a brief, insufficient release.
Abnormal Respiratory Patterns

Agonal respirations:

- Shallow, slow (3 - 4/min), irregular breathing followed by irregular pauses.
- Indicates brain anoxia.
- May be characterized as gasping, labored breathing that may be accompanied by strange vocalizations and myoclonus.
Evaluation of Respiratory Status

- **Lung Sounds.** Are they clear, or are wheezes, crackles, ronchi, or friction rubs present?
- **Rate,** both respiratory rate and heart rate. Pulse oximetry can be helpful, but it’s only a tool.
- **Rhythm and depth.**
- **Onset,** gradual or abrupt? How long?
- **Positional? Pain? Past history? Medications?**
The Art of Auscultation
Auscultating breath sounds.
Normal Lung Sounds

- Tracheal-loud sounds are heard over the trachea.
- Bronchial-high pitched-hollow sounds with slightly prolonged expiratory phase heard over the manubrium.
- Bronchovesicular-soft, lower pitched sounds heard between the scapulæ and the 2nd and 3rd intercostal space lateral to the sternalum.
- Vesicular-soft, swishy, lowest pitch sounds heard in the lung periphery with prolonged inspiratory phase.
Adventitious Lung Sounds

- Crackles—fine, moist sounds indicative of fluid in the smaller airways.
- Ronchi—coarse, rattling noises indicative of partial obstruction of the larger airways (usually by mucus).
- Wheezing—whistling sound heard with inspiration, expiration, or both. Caused by bronchoconstriction, edema, or foreign body obstruction of the airway.
Stridor—a harsh, high-pitched sound heard with inspiration characteristic of swelling of the larynx or upper airway as in Croup.

Crowing—a harsh, cawing sound that occurs when the muscles around the larynx spasm.
Adventitious Lung Sounds continued

- **Gurgling**—a bubbly, gargling sound indicative of fluid in the airway from pulmonary edema or aspiration.
- **Snoring**—the partial obstruction of the airway by the tongue.
- **Pleural friction rubs**—the squeaking or grating sounds heard when inflamed pleural linings have lost lubrication.
Tactile or Vocal Fremitus

- Bronchophony—the abnormal clarity of the patient’s transmitted voice sounds.
- Whispered pectoriloquy—the abnormal clarity of the patient’s transmitted whispers.
- Egophony—the abnormal change in the tone of the patient’s transmitted voice sounds. “E to A egophony”
Palpation

- Palpate chest wall for tenderness, symmetry, abnormal motion, crepitus, and subcutaneous emphysema.
- Assess compliance of lungs.
Non-Invasive Respiratory Monitoring
Pulse Oximeter
Pulse Oximetry

- A light source originates from the finger probe at 2 wavelengths (650 nm and 805 nm).
- The light is absorbed by hemoglobin in different amounts depending on if the hemoglobin is saturated or desaturated.
- Dependent on pulsatile flow.
Inaccurate Readings with Pulse Oximetry

- Reduction in peripheral pulsatile blood flow, i.e. hypovolemia, hypotension, hypothermia, or peripheral vascular disease.
- Venous congestion due to tricuspid regurgitation, DVT, or CHF.
- Bright lights or shivering.
- Pulse oximetry cannot differentiate between different forms of hemoglobin, carboxyhemoglobin or methemoglobin.
- Fingernail polish.
Colorimetric End-Tidal CO$_2$ Detector
Colorimetric End-Tidal CO$_2$ Detector

- Easy to use
- Safe
- Fairly reliable, except in cardiac arrest
- Disposable
End-Tidal CO$_2$ Detector
etCO$_2$ Capnography

- etCO$_2$ is the partial pressure or maximal concentration of CO$_2$ at the end of an exhaled breath expressed as a percentage or mmHg (5-6% = 35-45 mmHg).

- CO$_2$ reflects the cardiac output and pulmonary blood flow.
ETCO$_2$ Capnography

- Provides confirmation of correct tube placement. (Can be used with ETT, Combitube, or King airway.)
- Provides continuous monitoring of CO$_2$ production, perfusion, and metabolism.
- Indicator of non-survivable cardiac arrest when etCO$_2$ is 10 mmHg or less with CPR.
- Confirmation of physiologic obstruction or disease.
- Verification of appropriate ventilation of the head-injured patient.
Main Stream vs. Side Stream

- Mainstream attached directly to a tube.
- Sidestream monitors CO$_2$ production with supplemental oxygen administration.
Capnography Waveform

- **Respiratory Baseline**, usually flat. Elevation indicates the rebreathing of CO$_2$.

- **Expiratory Upstroke**, usually steep. Less steep or rounded waveforms indicate obstruction of the upper airway as in bronchospasm.

- **Expiratory Plateau**, should be nearly horizontal. Upward slanting of the plateau indicates uneven emptying of the alveoli as in asthma, COPD.

- **Inspiratory Downstroke**, nearly a vertical drop
Capnography Waveform

Capnogram in patient with severe chronic obstructive pulmonary disease
Capnography Waveform

Normal

Bronchospasm

“Shark-fin” appearance
Changes in etCO$_2$

- **Increased etCO$_2$**
  - Decreased alveolar ventilation
    - Reduced respiratory rate
    - Reduced tidal volume
    - Increased equipment dead space
  - Increased CO$_2$ production
    - Fever
    - Hypercatabolic state
  - Increased inspired pCO$_2$
    - Rebreathing
    - External source of CO$_2$
    - CO$_2$ absorber exhausted
Changes in etCO2

- **Decreased etCO₂**
  - Increased alveolar ventilation
    - Increased respiratory rate
    - Increased tidal volume
  - Reduced CO₂ production
    - Hypothermia
    - Hypocatabolic state
  - Increased alveolar dead space
    - Reduced cardiac output
    - Pulmonary embolism
    - High positive end-expiratory pressure during intermittent positive-pressure ventilation

- **Sampling error**
  - Inadequate tidal volume
  - Condensation blocking sampling line
  - Air entrainment into sampling line
Questions?