Nutritional Assessment of Patients with Respiratory Disease
Nutritional Status

- Major factor influencing acute and long term outcomes
- Quantity and quality of food affects the efficiency of the metabolic process
- Nutrients can enhance or harm immune functions
- Important to understand the interdependence of nutrition and respiratory care
Integration of Organ Systems

Muscles
  respiratory pump

Lungs
  gas exchange

Cardiovascular
  circulation and pump

Neurologic
  drive and control

O₂, CO₂
### Components of the Respiratory System

<table>
<thead>
<tr>
<th>Neurologic</th>
<th>Cardiovascular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drives and controls ventilation</td>
<td>Carries both nutrients and oxygen to the tissues</td>
</tr>
<tr>
<td>Requires glucose, protein</td>
<td>Protein, carbohydrates, fat, water, vitamins</td>
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<tr>
<td>Respiratory Muscles</td>
<td>Gas Exchange</td>
</tr>
<tr>
<td>Pump that drives the lungs</td>
<td>V/Q matching</td>
</tr>
<tr>
<td>Energy from glucose, fatty</td>
<td>Surfactant synthesis, humidity and mucociliary performance</td>
</tr>
<tr>
<td>acids, muscle glycogen</td>
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</tbody>
</table>
Metabolism

- Produces body heat
- Requires fuel = food
- Combustion requires oxygen to produce ATP

- Catabolism
- Anabolism

- 4 major phases
  - Digestion
  - Production of acetyl CoA
  - Krebs/citric acid cycle
  - ATP production
Metabolism

- Metabolic rates of the tissues dictate the amount of oxygen needing to be picked up in the lungs
- BMR/BEE
- REE

- Sufficient food maintains an equilibrium – energy production and demands of environment
- Too little food ingested – use of stored energy
- Too much food ingested – convert and store as fat
- Too much or too little cause the functional capability to decrease
Energy Use

- Determined by:
  - Direct calorimetry
  - Indirect calorimetry
    - Respiratory measurements
Metabolic Cart

- **Bedside monitors**
  - O₂ CO₂ analyzers; flow transducers
  - Nose clips/Mouthpiece
  - Hood/Tent
  - Through the ventilator circuit

- **Weir Equation**
  - Determines energy expenditure

- **Procedure:**
  - Collect expired gas
  - Analyze for carbon dioxide and oxygen
  - Measure the volume of gas collected
  - Calculate VCO₂ and VO₂ and convert to kilocalories
In order to provide an accurate breath-by-breath measurement of respiratory gas exchange the module must algorithmically integrate side stream gas concentrations (CO2 and O2) as well as the flows and volumes generated by each breath. This is done with the D-Lite + flow sensor in conjunction with the fast paramagnetic oxygen sensor and the infrared gas bench for CO2 measurement. Thus, the measurement can be thought of as a three stage technique whereby flows and concentrations are synchronized and gas volumes calculated.
Variations in oxygen consumption and carbon dioxide production (expressed as percent change) associated with diagnostic and therapeutic interactions in an ICU patient.
Clinical Usefulness of Metabolic Monitoring

- Determines the REE
- Guides appropriate nutritional support
- Tailor support to meet the patient’s needs
- Continued evaluation of adequacy and appropriateness of nutritional support

- Provides relationship between $\text{DO}_2$ (oxygen delivery) and $\text{VO}_2$ (oxygen consumption)
- Guide for ventilator mode and setting selection, assess weaning strategies; predictor of patient outcomes
Limitations

- No contraindications other than caution when assembling equipment (brief interruption of mechanical ventilation while connecting measurement lines – hypoxemia, bradycardia)
- Leaks in the system prevent accurate measurements
- Patient condition or activities may prevent measurements from occurring
- Costly equipment with few comprehensive studies demonstrating improved outcomes, decreased ventilator times, or shorter ICU/hospital stays
## Routes of Nutritional Administration

<table>
<thead>
<tr>
<th>Enteral</th>
<th>Parenteral</th>
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</thead>
<tbody>
<tr>
<td>• Preferred route</td>
<td>• Use peripheral or central vein</td>
</tr>
<tr>
<td>• Sites</td>
<td>• TPN</td>
</tr>
<tr>
<td>○ Nasogastric, nasoduodenal</td>
<td>• Risk of infection</td>
</tr>
<tr>
<td>○ nasojejunal</td>
<td></td>
</tr>
<tr>
<td>○ Gastrostomy</td>
<td></td>
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<tr>
<td>○ Jejunostomy</td>
<td></td>
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<tr>
<td>○ Esophagotomy</td>
<td></td>
</tr>
<tr>
<td>○ PEG/PEJ</td>
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<tr>
<td>• Given by bolus, intermittent,</td>
<td></td>
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<tr>
<td>or continuous drip</td>
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<tr>
<td>• Risk of Aspiration</td>
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</table>
Nutritional Depletion

- Blood sugar levels; gluconeogenesis
- Protein depletion
- Decrease in respiratory muscle strength
- Weight loss
- Malnutrition
- PEM
Nutritional Repletion

- Hindered in Respiratory patients
- Respiratory response is usually regulated by $\text{VCO}_2$
- Critical care patients require continuous assistance with nutrition and breathing
Respiratory Quotient

- Metabolic pathways use O2 produce CO2
- RQ = ratio of VCO2 to VO2
- Determined by the amount of fat, carbohydrate, or protein eaten

- PROTEIN RQ = 0.85
- FAT RQ = 0.7
- CARB RQ = 1.0
- Mixture = 0.8

- Minimum nutrient levels to avoid deficiency symptoms and low enough to prevent toxicity
Nutritional Elements

- **Carbohydrate**
  - Largest amount of intake
  - Complex vs simple
  - Evaluate response – CO2 load and production

- **Protein**
  - 12-15% intake
  - Quantity and quality
  - Extremes are detrimental
  - Nitrogen balance

- **Fat**
  - Best storage form for energy
  - Efficient way to provide calories
  - Quality – saturated, polyunsaturated, monounsaturated

- **Vitamin, Mineral, Other**
  - Variety of foods
  - Supplementation

- **Fluids, Electrolytes**
  - Monitor intake/output
The role of the RT in nutrition

- NOT responsible for the nutritional assessment
- Familiar with the process and contribute to the data gathering
  - History
  - Physical exam
  - Clinical lab values
Respiratory Assessment

- **Inspection**
  - BMI
    - Cachectic
    - Kwashiorkor/Marasmus
    - Obesity
    - Muscle condition
    - JVP, acites, edema – fluid balance
    - Sputum viscosity
  - **Auscultation**
    - Course or fine crackles
    - Wheezing

- **Laboratory Findings**
  - PFT measurements
  - PEP, PIP
  - Lung compliance
  - ABG values
COPD

Difficulty consuming food
Increased metabolic rate

Worsening
Chronic inadequate intake
Increased caloric needs

Worsening

Decreased muscle strength
Impaired aerobic capacity

Malnutrition