# Humidity and Aerosol Therapy

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## What is humidity?

- Water in gaseous form or vapor
- Cannot be seen
- Used to add water vapor to anhydrous gas
- Used to raise *relative humidity*
- Prevents retained secretions
- Loosens thick secretions

## Humidity

- Importance to the pulmonary system
  - Maintains fluidity of muco-ciliary escalator
  - Maintains moisture and compliance of lung parenchyma
- Amount of humidity lost per day is 500 ml/24hr
  - 250 ml recaptured by nasal pharyngeal mucosa

## Inhalation of dry gases could result in:

- Impaired ciliary ability
- Slowed mucus movements
- Inflammation and necrosis of pulmonary epithelium
- Retention of thick secretions and incrustations
- Bacterial infiltrations of mucosa
- Atelectasis
- Pneumonia

## What is aerosol?

- Aerosol is the suspension of particulate water in a gas
- Aerosols are generated by "aerosol generators" such as nebulizers.
- Two types of aerosols:
  - Bland
  - Medication

## Factors that affect the area of deposition

- Size (smaller ones travel faster)
- Gravity (larger particles "rain out")
- Viscosity
- Kinetic energy
- Particle inertia
- Composition of particles
  - Hypertonic
  - Hypotonic
  - isotonic

## Purposes (goals) of humidity and aerosol therapy

- To aid in bronchial hygiene
  - Hydrate dried secretions
  - Promote cough
  - Restore mucous blanket (membrane)
- Humidify dry gases
- Deliver medications
- Induce sputum for lab studies

## Clinical Applications

- Need to always humidify a dry gas to prevent adverse reactions
- Impaired ability to cough and move secretions
- Presence of thick, abundant amounts of secretions
- Delivering medications such as bronchodilators, mucolytics, etc…
- Evaluation of effectiveness of therapy
  - Listen to breath sounds
  - Clearing on chest xray

## *Humidifiers* and Nebulizers

- Purpose is to deliver a gas with maximum amount of water vapor content
- May be heated or unheated
- Most can deliver 80-100% relative humidity

- Relative humidity = $\frac{\text{actual}}{\text{absolute}} \times 100$

## Factors affecting efficiency of the device

- *Temperature* – as temperature rises, more water molecules escape into gas, adding humidty
- *Time of exposure* between gas and water, the longer exposure, the better the chance for evaporation
- *Surface area involved* – the greater the surface area, the more water exposed to evaporation
- *Gas flow* – high gas flow decreases exposure of gas to water

## Types of Humidifiers

- Pass over humidifier

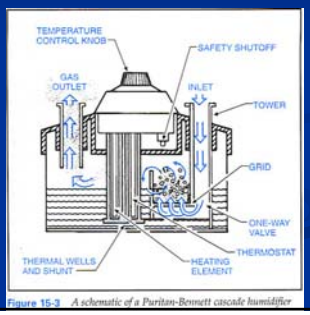


Figure 15-3 A schematic of a Puritan-Bennett cascade humidifier

## Types of Humidifiers

- Bubble humidifier

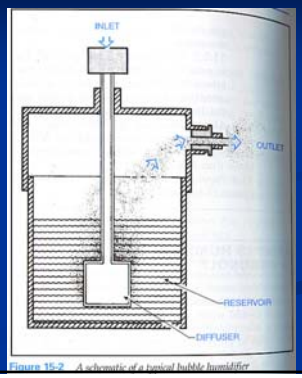
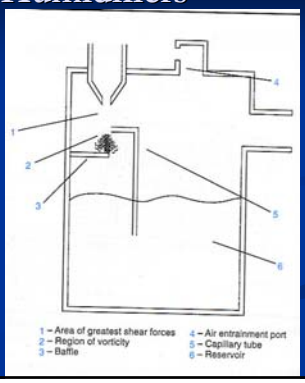


Figure 15-2 A schematic of a typical bubble humidifier

## Types of Humidifiers

- Jet-type




## Types of Humidifiers

- Wick

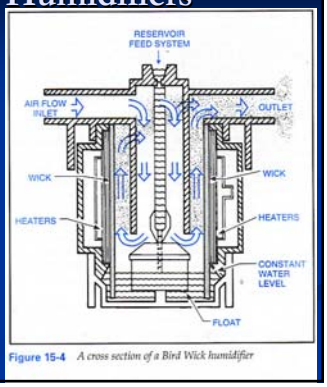



Figure 15-4 *A cross section of a Bird Wick humidifier*

## Nebulizers

- Purpose to produce an aerosol
- Use the Bernoulli principle – velocity increases and lateral wall pressure decreases
- Operation – capillary tube immersed in fluid
  - Decreased pressure draws fluid up the tube
  - Gas passes over the jet nebulizer (baffle) particles

## Nebulizers

- Pneumatic

TABLE 15-3: Concentration of Oxygen As Primary Gas and Total Flow for MistyOx GIN Nebulizer

| PRIMARY GAS: OXYGEN (L/min) | SECONDARY GAS: AIR (L/min) | TOTAL FLOW | CONCEN TRATIO |
|---|---|---|---|
| 40 | 0 | 40 | 100% |
| 40 | 10 | 50 | 84.2% |
| 40 | 20 | 60 | 73.6% |
| 40 | 30 | 70 | 66.1% |
| 40 | 40 | 80 | 60.5% |
| 40 | 50 | 90 | 56.1% |
| 40 | 60 | 100 | 52.6% |
| 40 | 70 | 110 | 49.7% |

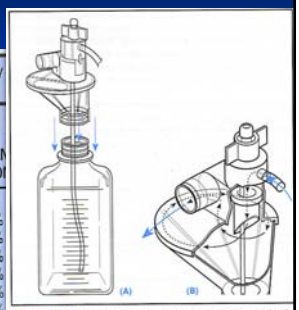


Figure 15-7 An assembly guide (A) and a detailed diagram (B) of the MistyOx Gas Injection Nebulizer (GIN)

## Nebulizer

- Centrifugal

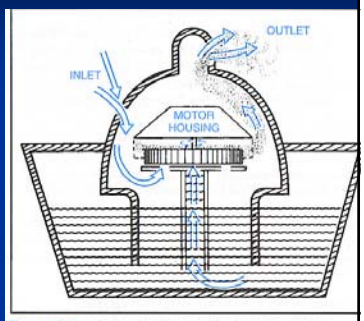
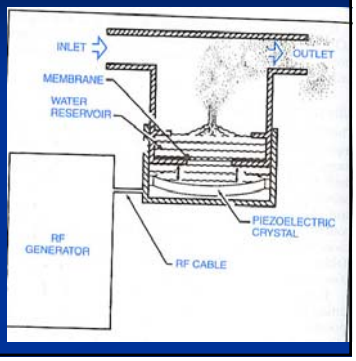


Figure 15-1 A schematic of a centrifugal room humidifier

## Nebulizer

- Ultrasonic
  - Amplitude (output)
  - Frequency (size of particles)



## Small-Volume Nebulizers

- Mainstream or Sidestream nebulizers
- Commonly administered drugs
- Monitoring for effectiveness
- Hazards and complications

## HME

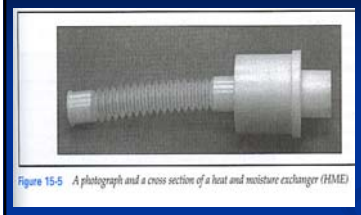


Figure 15-5 A photograph and a cross section of a heat and moisture exchanger (HME)