Continuous Nebulization Therapy

In-Service Education

E Z Flow Nebulizer

Introduction
What is Continuous Nebulization Therapy?

Continuous Nebulization is a therapeutic modality that provides nebulization of Beta 2 and other medications, over an extended period of time, to reactive airways. Continuous Nebulization has been proven to decrease E.R. admissions by 24%, decrease length of hospital stays by as much as 3 days, dramatically reduce labor costs associated with small volume nebulization (SVN) therapy and can ultimately rescue impending respiratory failure patients.

Asthmatic, pneumonia and C.O.P.D. patients commonly present to the E.R. with moderate to severe narrowing of the airways, an obstructive process from a number of mediating factors. These include exposure to dusts, pollens, spores and other triggering mechanisms that cause an antigen-antibody response and the release of histamine within the airways. Associated with this reaction are bronchospasm, interstitial edema, and thick mucous. The response may be moderate to severe.

The chief complaint is shortness of breath. The narrowing of the airways causes bronchospasm, an obstructive disease process. The patient has no problem getting the air in, but has major problems getting the air out. The “Air-trapping” causes increased carbon dioxide levels in the blood. These patients are often oxygen starved with decreased oxygen saturation levels. Most utilize a pursed lip-breathing pattern - a short inspiratory phase and a long expiratory phase. This causes the alveoli to become over distended - a PEEP effect. Thick mucous plugs and increased secretions are common.

Treatment for this patient population are twofold:

1. Nebulization of Beta 2 agonists to topically administer medications to the smooth muscle of the airways, and

2. Administration of steroids to reduce the inflammation. Continuous Nebulization permits administration of Beta 2 medications on a continual basis to relieve shortness of breath while the other medications take effect.

Large Dosages of Albuterol, in conjunction with the high output from the nebulizer, provides a larger amount of Beta 2 medications that are delivered to the airways on a breath-by-breath basis. The addition of large amounts of saline in the medication mixture helps to loosen the thick mucous plugs and secretions.

Nebulizer Basics:

The effectiveness of a nebulizer is directly proportional to the % of particles within the respirable range of 1-3.5 microns. The respirable particle size range for patients presenting with bronchospasm is also 1-3.5 microns.
**Small Volume Nebulizers have a wide range of particle sizes.** Most produce less than 25% within the respirable range. According to literature released from the AARC, less than 10% of medications reach reactive airways with the use of small volume nebulizers.

The ideal nebulizer for asthmatic and C.O.P.D. patients therefore needs to:

1. Have a small particle size with greater than 60% of particles in the respirable range 1-3.5 microns.
2. Have direct nebulizer to patient interface, to permit more medication delivery on a breath-by-breath basis.
3. Be used with high oxygen concentrations to meet patient demands (EZflow MAX-High Flow).
4. Be used on mechanically ventilated patients (EZflow-Low Flow).

**Benefits of Continuous Therapy vs. SVN Repetitive Therapy.**

1. **Current practice** is to give back-to-back treatments with 0.5cc Albuterol Sulfate every 10—15 minutes in conjunction with steroidal therapy. This is very labor intensive.

2. Current studies and protocols provided by the American Association for Respiratory Care have proven that the patient only receives approximately 10% of the nebulized medication. This is why repetitive back-to-back treatments are necessary to obtain relief of bronchospasm.

3. Hospitals are now advocating the use of high dosages of Albuterol (2—4 cc per hour) to deliver continuous beta 2 stimulation. By delivering high dosages of Albuterol (i.e.: more medication per breath) in conjunction with the small particle size of the nebulizer, studies have shown greater response in FEV 1 and FVC, and reduction in the length of stay of severely compromised patients by as much as 3 days. Reduction of length of stay by 3 days from the ICU saves approximately $4,500 ($1,500 per day cost of ICU bed alone, depending on geographic region).

4. Under **DRG (Diagnostic Related Group) Reimbursement Structure** The hospital only receives a certain dollar reimbursement per diagnosis. The reimbursement is the same if your department is performing one treatment on a particular patient or 20 treatments. When performing repetitive (repeated) treatments, your department and hospital are losing labor dollars costs that could be redirected in the performance of other duties.

5. **Other collateral treatments are missed** when a floor therapist that is also covering the E.R. gets repeatedly called from the floor. Depending on the condition of the floor patient, missed treatments may increase their length of stay—a cost to the hospital in the DRG structure. Look at the global picture.
6. Recent studies show that Circular is less effective than SVN’s and Mini-Hearts and Uni-Hearts are similar to MDI’s in effectiveness.

<table>
<thead>
<tr>
<th>Hospital Costs of 100 Respiratory Compromised Patients:</th>
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<tbody>
<tr>
<td><strong>Intermittent Therapy</strong></td>
</tr>
<tr>
<td>45 discharges</td>
</tr>
<tr>
<td>55 admissions</td>
</tr>
<tr>
<td>4 day LOS ~ $900/day</td>
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<tr>
<td>=$ 198,000.00</td>
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</tbody>
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**Basic Dosing Calculations**

0.5cc Albuterol - 2.5mg

1cc Albuterol - 5 mg  2cc Albuterol 10 mg
3cc Albuterol - 15 mg 4cc Albuterol =20 mg

Physicians order the medication depending on the severity of exacerbation. Mild to Moderate-1-2cc Medication. Moderate-2-3cc. Severe 4+ cc.

The EZflow Nebulizer comes in two basic configurations. High flow (MAX) operates at a flow of 6 or 10 liters per minute, and the low flow of 3 liters per minute.

The high flow system is for MODERATE TO SEVERE attacks. The EZflow MAX Nebulizer provides high oxygen concentrations to oxygen-starved patients that exhibit low saturation levels.

_Special Note:_ The low flow system may also be used for conventional (standard 0.5 cc Albuterol) nebulization, and is ideal for use on mechanically ventilated patients. **This is particularly useful in the neonatal and pediatric arenas.** A regular small volume nebulizer is operated at a flow rate of 6-8 liters per minute. A low flow nebulization system is necessary as many facilities utilize graphic flow packages on their ventilators. A nebulizer operating at a flow of 3 liters per minute will not interfere with the function of the ventilator and/or distort the graphic waveforms.
**Formula:**  Medication + Diluent = Output

EZflow-low flow (6 ml output per hour @ 3 Lpm)

EZflow high flow (12 ml output per hour @ 6 Lpm)

EZflow high flow (16 ml output per hour @ 10 Lpm)

**Example:**  Low flow system operating at 3 Lpm

15 mg (3cc of Medication) ordered per hour + 3cc Diluent per hour = 6cc Total output per hour

**Special Considerations:**
Actual flow from a wall outlet flowmeter may vary thereby increasing and/or decreasing actual nebulization time. For accuracy, it is recommended that a Clinician check the rate of nebulization after the first ½ of therapy and make adjustments to flow, if necessary.

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**Potential Complications:**

1. **Shaking and Tremor.** *Medication is obtaining too much systemic penetration.* Decrease the medication in 1cc per hour increments.

2. **Low Potassium.** *High dosages of Albuterol Sulfate can reduce serum potassium, magnesium, and manganese levels.* Obtain an electrolyte panel

**Competition:**

**High Flow**

1. **HEART Nebulizer.** This is a high flow, high output system that operates at a liter flow of 10 to 15 liters per minute. It contains a large reservoir (240 ml) and can nebulize up to 8 hours. It requires large bore corrugated tubing that causes rainout (medication deposition) into the circuit, a waste. Remember, the patient can only breath in so much medication on a breath-by-breath basis. When the patient is exhaling, which is prolonged in asthma and C.O.P.D., medication is “blowing by” the patient into the environment.
Hope Nebulizer

2. HOPE Nebulizer - This is another high flow, high output device. It operates at 10 liters per minute and has an output of 25 cc per hour. It also requires large bore corrugated tubing that causes rainout. It has basically the same features as the HEART nebulizer, the only real advantage is a secondary entrainment port for the use of additional gases such as Heliox that reduces turbulence in the system.

Low Flow

1. Mini-HEART Nebulizer - This system operates at 2 liters per minute, and has an output of 8 ml per hour. Since this has been the only low flow system on the market for about 6 years, it enjoys market share. It is very expensive, around the $13 to $15 dollar range, but the price has been dropping due to increased sales of the EZflow-low flow nebulizer.

2. Uni-HEART Nebulizer - This system operates at a liter flow of 2—4 liters per minute and has an output of 6—9 ml per hour. This nebulizer is essentially a glorified standard hand-held nebulizer, and to date enjoys only a very small percentage of sales.

Special Considerations: A low flow nebulizer actually delivers to the patient more medication per liter of gas. Asthmatic and C.O.P.D. (Chronic Obstructive Lung Disease) patients typically have a long expiratory phase. When the patient is exhaling, the medication is essentially being “blown by” the patient, a waste. Therefore, it stands to reason that delivery equates to deposition into the lungs.

There are also other nebulizers on the market such as breath actuated, but for those hospitals that utilize continuous nebulization, these are the real players.

Conclusion
The basic factors pertaining to nebulization therapy include nebulizer effectiveness, particle size, and nebulizer output. Secondary considerations include the price paid for the nebulizer, the labor time associated with the performance of therapy, and third party (insurance) charge/billing.
EZflow™ and EZflow MAX™ Nebulizers
“Features and Benefits”

1. Direct nebulizer to patient interface. Does not require large bore corrugated tubing which causes “rain-out” and medication—a waste.

2. More medication delivery per liter of gas with the low flow (light blue) nebulizer.

3. Small (2.2 micron) particle size for optimal deposition into the targeted airways.

4. High flow and output (dark blue EZflow MAX) for severe patients that have low oxygen saturation levels.

5. Less expensive than other competitive products, depending on bundling arrangement.

6. Can be packaged complete with nebulizer, mask and oxygen supply tubing. No need to have to locate necessary tubing, mask, etc.

7. Low flow system is ideal for use on ventilators—low flow characteristics will not interfere with graphic flow packages that are on many ventilators and the patient will not have to overcome excess flow in the ventilator circuit for the ventilator demand valve to open to deliver a breath.
Continuous Nebulization Therapy
Breathing new life into proven therapy.

Faster Improvement
Continuous nebulization of albuterol is a relatively new administration technique for treating patients with unresponsive asthma. This method may offer the advantages of greater penetration of drug into the lung, reduced bronchospasm and a more rapid and sustained response. In clinical trials, continuous nebulization has been shown to be as effective as intermittent nebulization and may be associated with a reduction in the need for hospital admission, length of hospital stay and the use of mechanical ventilation.¹

¹AACN Clin Issues, 1995 May. 6:2,279-86. Buck ML.

Fewer Admissions
Continuous nebulization of beta 2 agonists is now recognized as a useful treatment for severe exacerbations of asthma. This mode of administration has been described both for adults and children in the emergency room and in the intensive care unit. It has been suggested that early use of continuous inhalation therapy may reduce or prevent the need for intensive care unit admissions and potentially toxic treatments such as intravenous beta agonists and mechanical ventilation.²

²Annals of Allergy, 1992 Jul. 69:1, 71-9

In Peak Expiratory Flow Rates (PEFR) of 200 or less, continuous nebulization may decrease admission rate and improve PEFR’s when compared with standard therapy.³

³Annals of Emergency Medicine, 1993 Dec. 22:12, 1842-6

Shorter Hospital Stays
In children with impending respiratory failure due to status asthmaticus, continuous nebulization of albuterol is safe and results in more rapid clinical improvement than intermittent nebulization. Respiratory therapy required at the bedside and duration of hospital stay were substantially less for patients receiving continuous nebulization of albuterol, which suggests that continuous nebulization of albuterol is more cost-effective than intermittent nebulization.⁴

⁴Critical Care Medicine, 1993 Oct. 21:10, 1479-86;

Greatest Patient Improvement
When the FEW improvements for the different groups at 2 h were compared, the groups treated with continuous nebulization had the greatest improvement. The standard-dose continuous treatment regimen had the greatest improvement in FEVI with the least number of side effects.~

~Chest 1996 Jul. 1 10:1, 42-7
Continuous Nebulization Therapy
Breathing new life into proven therapy.

**Decreased Admission Rate**
Conclusion: In peak expiratory flow rates (PEFR) of 200 or less, continuous nebulization may decrease admission rate and improve PEFRs when compared with standard therapy.\(^6\)

\(^6\)Annals of Emergency Medicine, 1993 IX-, 22 12, 1842-6

**Safe for Children**
We feel that continuous albuterol nebulization (CAN) is safe for use in children diagnosed with status asthmaticus.\(^7\)

- Pediatrics Emergency Care, 1996 Feb, 12:1, 15

We conclude that continuous nebulization therapy (CNT) with low-dose beta agonists should be considered in the initial approach to therapy in children with acute severe asthma.\(^8\)

\(^8\)Asthma, 1994, 31:3;201-7

This preliminary study suggests that continuous nebulized terbutaline (CNT) is an effective therapy for severe asthma in children.\(^9\)


**Significant Time Savings**
There was no difference in efficacy or safety between continuous nebulization (CN) and intermittent nebulization (IN) therapy in the ED management of moderate to severe asthma exacerbations in children. Moreover, CN therapy provided a significant time savings in the delivery of asthma therapy to patients in a busy ED.\(^10\)


**Safe and Effective**
High-dose continuous nebulization of albuterol is as safe and as efficacious as intermittent nebulization of albuterol in the early treatment of asthma in an emergency department. To our knowledge, this is the first study showing continued significant improvement beyond the initial two hours of therapy using high dose nebulized beta agonists.\(^11\)

\(^11\)Annals Allergy Asthma Immunol, 1995 Jul 75:1, 41-7

We conclude that a continuous nebulized albuterol protocol is both extremely efficacious and safe for the treatment of acute adult asthma attacks.\(^12\)

\(^12\)American Journal Emergency Medicine, 1993 MAR, 11.2,1313