

## **B&B Medical Technologies**

### **B&B HOPE NEBULIZER™**

The HOPE NEBULIZER has proven to be a cost effective solution for delivery of continuous medication for the treatment of moderate to severe life threatening asthma and COPD. The HOPE is a high output nebulizer used for delivery of aerosolized medications and diagnostic formulations. It provides additional hydration for patients to loosen secretions when extended therapy is required.

The HOPE is a refillable, closed dilution, high output, large volume continuous medication nebulizer. The flow design and 200 ml reservoir allow for up to 8 hours of nebulized medication delivery at 25 ml/hr. The HOPE delivers 1 to 8 hours of continuous medication with 2.5 MMAD. The output at 25 ml/hr delivers >60% particles in the respirable range at 10 lpm flow. With the addition of supplemental Heliox, the HOPE provides a 50 ml/hr output with >75% particles in the respirable range with 15 lpm supplemental 80/20 Heliox delivered through the auxiliary port.

The HOPE has become the gold standard for the delivery of continuous nebulization and Heliox therapy. Heliox has been reported to build a therapeutic bridge in severe asthma and COPD until conventional medications have had time to take effect. It is no wonder the competition has reconfigured their products to emulate the B&B HOPE NEBULIZER. B&B first introduced the patented supplemental port for Heliox delivery in a closed dilution nebulizer, greatly enhancing the performance of the HOPE NEBULIZER. HOPE leads the market in simplicity and outstanding nebulizer performance in a Large Volume Continuous Medication Nebulizer.

#### **What is Continuous Nebulization Therapy?**

Continuous Nebulization is a therapeutic modality that provides nebulization of Beta2 bronchodilators, and other medications, over an extended period of time to reactive airways. Continuous Nebulization has been proved to decrease ER admissions by 24%, decrease length of hospital stay by as much as 3 days, dramatically reduce labor costs associated with small volume nebulizer therapy and rescue impending respiratory failure patients.

Asthmatic, pneumonia and COPD patients present to the Emergency Department 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 mucus. The response may be moderate to severe.

The chief complaint is shortness of breath. The narrowing of the airways causes bronchospasm and is an obstructive disease process. The patient has no problem getting air in, the major problem is 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 mucus plugs and increased secretions are common.

Treatment for this patient population is twofold:

1. Nebulization of Beta2 agonists to topically administer medications to the smooth muscle of the airways, and
2. Administration of steroids to reduce inflammation. Continuous Nebulization permits administration of Beta2 medications on a continual basis to relieve shortness of breath while other medications take effect.

Large Doses of Albuterol, in conjunction with the high output from the nebulizer, provides a larger amount of Beta2 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 mucus plugs and secretions by reestablishing mucokinesis.

### **Nebulizer Basics**

The effectiveness of a nebulizer is directly proportional to the percent of particles produced within the respirable range of 1 to 3.5 microns, not 1 to 5 microns as old literature states. The therapeutic respirable particle size range for patients presenting with bronchospasm is 1 to 3.5 microns. Small Volume Nebulizers (svn) have a wide range of respirable sizes. Most produce less than 20% particles within the respirable range. Literature states that most svn's have less than 10% of nebulized medications that reach reactive airways and may not provide the relief indicated for the moderate to severe patient in respiratory distress.

The ideal nebulizer for asthmatic and COPD patients therefore needs to:

1. Have a small particle size with greater than 60% of particles in the respirable range of 1 to 3.5 microns.
2. Contain High Output to have available large amounts of medication and saline on a breath by breath basis.
3. Ability to use with variable oxygen concentrations to meet patient's inspiratory demands.
4. Be Heliox compatible for rescue of impending respiratory failure.

In a recent study, it was demonstrated that the type of nebulizer used in conjunction with its primary source gas creates and determines particle size. The flow of gas and the addition of supplemental gas and flow determine nebulizer output. A nebulizer driven by oxygen produces more output than when driven by air. Nebulizers driven by Heliox produce less respirable particles than when driven with air or oxygen. The HOPE NEBULIZER uses oxygen as the primary source of driving gas and consistently produces particles in the acceptable respirable range.

The use of Heliox has been advocated since the early 1930's. Helium, because of its light weight and density characteristics has a direct effect on the Reynolds Number, a theoretical number that calculates laminar flow. Gas that is run at a high flowrate causes turbulence. With the HOPE NEBULIZER, Heliox increases the number of particles within the respirable range from 64 to 78% and is added to the auxiliary port to allow for best nebulization and mixing of the Heliox gas. Heliox flushes carbon dioxide from the lung and carries medication past obstructed lung segments and allows better deposition.

Extensive research and development to produce a small particle, high output nebulizer was employed by B&B Medical Technologies. The result is the HOPE NEBULIZER that delivers optimal particle size for delivery of bronchodilators and hydration in the therapeutic respirable range.

### **Continuous Nebulization Therapy with the HOPE™ Nebulizer**

The ideal drug for this form of therapy has high efficacy with side effects which are both infrequent and benign.

The pulmonary deposition of drug is dependent upon the following:

- A. The duration of exposure.
- B. The drug concentration in the aerosol mist.
- C. The patient's minute volume and respiratory rate.
- D. Other physical factors such as the inspiratory flow rate, airway diameter and route of administration.

Initially, patients with severe bronchospasm may have reduced tidal and minute volumes, as well as decreased airway diameters. The reduced volumes in combination with high inspiratory flow rates and narrow airways can lead to a marked reduction in the amount of drug deposited in the lungs. In this situation, a stronger dose is needed to achieve bronchodilation. High doses may lead to side effects as the patient "opens up". When the patient improves, their minute volume and airway diameters may increase and their inspiratory flow rates decrease. The resulting increase in the amount of drug being deposited in the lungs may lead to side effects such as nausea, vomiting, tachycardia and a decreased electrolyte levels (K<sup>+</sup> in particular). To avoid this, the patient should be reassessed often and the dose reduced as improvement is noted.

### **Prepare Medication Protocol**

This protocol is a guide to the preparation of medication. Physician orders as to medication content and strength must be on the chart prior to start of Continuous Bronchodilator Nebulization Therapy (CBNT). It is inherent to this therapy that the patient may need to have the dosages changed several times after the initiation of this procedure. The therapist must be aware of the signs that indicate the need for dosage change and alert the physician to any change in the patient's status.

### **Guidelines based upon the dosing chart included with the HOPE Nebulizer:**

1. Initial Gas flow consideration is 10 lpm of 100% source gas driving the nebulizer
2. The medication delivery is based on physician prescription for mg/hr or ml/hr of bronchodilator.
3. Mg/hr of medication ordered x 0.2 = ml of medication used per hour.
4. Output of nebulizer - ml of medication = ml of diluent (normal saline)
5. Multiply diluent and medication times hours you want to deliver; up to 8 hours @ 10 lpm (maximum volume of nebulizer is 220 ml).

**SAMPLE MEDICATION CALCULATION: SEE Dosing Chart on back of HOPE Nebulizer Instruction Sheet.** This is a sample calculation. Ideally, when setting up CBNT, the initial fill and dosage should be for 3 hours.

MEDICATION + DILUENT = OUTPUT OF NEBULIZER (25 ml/hr. @ 10 lpm)

Albuterol 0.5% (5 mg = 1 ml, 10 mg=2 ml, 15 mg=3 ml, 20 mg=4 ml)

### Dosage Recommendations

	Adult	Pediatric
<b>Albuterol</b>	2.5 to 20.0 mg/hour	0.3 to 0.5 mg/kg/hour
<b>Atrovent</b>	0.5 to 1.0 mg/hr	

The use of other than the above bronchodilators for the CBNT for severe bronchospasm should be reviewed by the physician in regards to the following criteria. The ideal drug for this form of therapy has high efficacy with side effects which are both infrequent and benign. The drug may not have metabolites, which are bronchoconstrictors.

The pulmonary deposition of drug is dependent upon the following:

- A. The duration of exposure.
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Initially, patients with severe bronchospasm may have reduced tidal and minute volumes, as well as decreased airway diameters. The reduced volumes in combination with high inspiratory flow rates and narrow airways can lead to a marked reduction in the amount of drug deposited in the lungs. In this situation, a stronger dose is needed to achieve bronchodilation. High doses may lead to side effects as the patient "opens up". When the patient improves, their minute volume and airway diameters may increase and their inspiratory flow rates decrease. The resulting increase in the amount of drug being deposited in the lungs may lead to side effects such as nausea, vomiting, tachycardia and a decreased electrolyte levels (K+ in particular). To avoid this, the patient should be reassessed often and the dose reduced as improvement is noted.

## EQUIPMENT

**B&B HOPE™ Nebulizer** (P/N 11310), Oxygen and/or medical grade air at 50 psi, Blender, Oxygen Analyzer with Alarm, Aerosol Tubing, Mask or other delivery device, Cardiac monitor (if indicated) and Pulse Oximeter (if indicated). The B&B Heliox regulator (P/N 11370) can be used for the delivery of 80/20 Helium-Oxygen Gas Mixture.

## PROCEDURE – HOPE NEBULIZER PN:11310

### A: Application/Preparation Steps

1. Therapy should be initiated in the ER, Critical Care Unit, and Pediatric Critical Unit or in an area in which the patient's EKG may be monitored continuously.
2. The treatment must be reordered every 24 hours by a physician. After an order has been received, the therapist is to verify the order in the patient's chart.
3. After checking the patient's ID, the therapist is to explain the procedure to the patient and answer any questions the patient may have.
4. Wash hands and assess patient's heart rate, breath sounds, respiratory rate, peak flow, color, use of accessory muscles, patient's oxygen needs (current ABG) or SaO<sub>2</sub>.
5. Set up a continuous pulse oximeter to establish baseline saturation and monitor the patient.
6. Attach flowmeter to 50 psi gas source.
7. Attach the HOPE Nebulizer to the flowmeter or blender (Figure 2).
8. Attach the corrugated tubing to the HOPE nebulizer output and to the aerosol mask or other delivery device (Figure 1).

### B: Application/Action Steps

1. PREPARE MEDICATION per protocol of this policy (Section E).
2. Pour medication into the HOPE nebulizer reservoir using aseptic technique.
3. Set flow meter to 10 liters per minute and adjust FiO<sub>2</sub> per chart or Blender to meet patient needs after attaching appropriate size mask to the patient.
4. Monitor the patient for adverse reactions and check the HOPE nebulizer every 30 minutes x 2 hours
5. To determine approximate use of medication, look at the marks on the side of the nebulizer (marks on nebulizer are in 25 ml increments). Adjust the flowmeter by small increments to achieve desired output of 25 ml/hour, without auxiliary flow
6. When using auxiliary flow output increases. Mix one more hour of medication to accommodate increased output.

### C: Application/ Patient Assessment

1. Monitor the patient's Pulse before, during treatment, every 30 minutes x 2 hours, then every 2 hours, and post treatment.
2. Assess Breath sounds before, during and post treatment.
3. Assess patient with Pulse oximeter before, during and post treatment.
4. In pediatrics, a TCM may be used to monitor patient pre, during and post treatment to monitor
5. PaCO<sub>2</sub>.
6. Measure Peak Flow rates before treatment, during treatment every hour x2, then every 2
7. hours and post treatment
8. Measure and quantify Sputum production.

9. Document Subjective statements by patient.
10. Monitor and document patient position, color and level of cooperation.
11. Monitor and document complications or problems noted during therapy.
12. Measure and monitor Electrolyte levels at physician discretion, if patient is receiving agonist therapy greater than 4 hours
13. Reevaluate the patient after initial 2 hours of therapy for possible decrease in drug dosage level

**D: Documentation/Charting**

8. Check the patient and document the following information every 30 minutes for the first 2 hours, then every 2 hours on the Patient Flow Sheet
  - A. Date and time
  - B.  $FiO_2$
  - C. Heart rate
  - D. Respiratory rate
  - E. Breath sounds
  - F. Oxygen saturation/TCM reading or  $ETCO_2$
  - G. Peak expiratory flow
  - H. Side effects and remarks
  - I. ABG information
  - J. Mental status
  - K. Respiratory Care Practitioner signature

**E: Contraindications:**

1. Absence of the above indications.
2. Increased heart rate of >25 beats or as defined by the physician.

**F: Treatment Complications:**

A complete reassessment is indicated any time the patient vomits. Failure may include, but is not limited to the following:

1. Failure to significantly respond in 4 hours.
2. Decreasing aeration over time or increased wheezing without a simultaneous increase in aeration
3. Worsening blood gases.
4. Decreasing pulse oximeter readings or an increasing need for higher  $FiO_2$ 's to maintain the same saturation.
5. Increased work of breathing.
6. Anything that leads you to believe, through your patient assessment, that the patient is getting worse.
7. When treatment failure is suspected, re-evaluate the patient and contact the physician immediately.

**G: Precautions and Adverse Events**

1. Exhaled aerosol or patient coughing may spread active pulmonary infections.
2. The HOPE Nebulizer is intended for single patient use.

**PROCEDURE**

**A. FiO<sub>2</sub> CHART**

**IMPORTANT: Use oxygen analyzer to verify FiO<sub>2</sub>**

**IMPORTANT: Auxiliary flow increases nebulizer output, mix one more hour of medication.**

Primary Gas	Oxygen at 10 Lpm
Secondary Gas	Air
	FiO <sub>2</sub>
12 Lpm	56%
8 Lpm	64%
4 Lpm	77%
2 Lpm	87%

Primary Gas	Air at 10 Lpm
Secondary Gas	Oxygen
	FiO <sub>2</sub>
12 Lpm	28%
8 Lpm	34%
4 Lpm	40%
2 Lpm	50%

**PROCEDURE**

**A. Heliox Therapy**

**Using 80/20 Heliox: 50% FiO<sub>2</sub> 50% Helium**

1. Set the Primary gas delivery at 10 lpm oxygen. Auxiliary gas 80/20 Heliox at 17 lpm or 15 lpm on the B&B Medical preset Heliox regulator
2. For every hour of medication delivery, mix 2 hours of solution.
3. Use alarmed oxygen analyzer to titrate nebulizer output to 50% FiO<sub>2</sub>.

**IMPORTANT: Use oxygen analyzer to verify FiO<sub>2</sub>**

**IMPORTANT: Auxiliary flow increases nebulizer output, mix one more hour of medication.**

**B. Guidelines for Auxiliary Flow and Nebulizer Output**

With the addition of auxiliary flow (lpm), the output of the nebulizer increases. The Hope Output Chart provides guidelines with average output in ml per liter of gas delivered to the patient. This chart provides the approximation of change in time for delivery of the medication along with average output of the medication delivered to the patient.

Source Gas Oxygen (100%)	Auxiliary Flow Air or Heliox	Total Flow	Average Output	Average Output in ml per liter of gas	25 ml of solution will nebulize in approx time
10 lpm	0	10 lpm	25 ml/hr	0.042	1 hour
10 lpm	1 lpm (21%)	11 lpm	26.9 ml/hr	0.041	55 minutes
10 lpm	15 lpm (80/20 Heliox)	25 lpm	50 ml/hr	0.031	30 minutes

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#### **Synopsis: Continuous Medication Delivery vs Intermittent Aerosol Therapy**

##### **Rudnitsky GS, Eberlein RS, et al. Comparison of Intermittent and Continuous Nebulized Albuterol for Treatment of Asthma in an Urban Emergency Department.**

Annals of Emergency Medicine 1993;22(12)

*“Patients with a PEFR equal to or less than 200 l/min did show an increase in PEFR when treated with continuous nebulization. In these patients, there was a statistically significant decrease in admission rate.” (24.4% less admissions)*

*“Physicians who manage adult asthmatic patients in an ED may consider the use of continuously nebulized Albuterol as an alternative to intermittent nebulization, especially in the context of labor efficiency and perhaps in patients with severe asthma.”*

##### **Lin RY, Sauter D et al. Continuous Versus Intermittent Albuterol Nebulization in the Treatment of Acute Asthma.**

Annals of Emergency Medicine 22:12, December 1993

*“None of the patients treated continuously were admitted compared with 3 of the intermittent group.” (Of 19 patients in both study groups)*

##### **Papo MC, Frank J, Thompson AE. A Prospective, Randomized Study of Continuous versus Intermittent Nebulized Albuterol for Severe Status Asthmatics in Children.**

Critical Care Medicine 1993;21(10)

*“Patients in the continuous group improved more rapidly and were out of impending respiratory distress sooner than patients in the intermittent group.” (Median range 18 hours Intermittent, 12 hours Continuous)*

*“When examining total length of hospital stay, it was evident that patients in the intermittent group stayed in the hospital almost 3 days longer than patients in the continuous nebulization group.”*

*“Continuous nebulization of Albuterol is safe and results in more rapid clinical improvement than intermittent nebulization.”*

*“In addition, respiratory therapy time and hospital stay were found to be significantly shorter for patients who received continuous nebulization, indicating that it is not only less labor intensive, but potentially more cost effective than intermittent nebulization of Albuterol in the treatment of severe asthmatics.”*

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**Inhaled Helium-Oxygen Revisited: Effect of Inhaled Helium-Oxygen during the Treatment of Status Asthmaticus in Children**

Kudukis TM, Manthous CA, Schmidt GA, et al.

J Pediatr, February 1997; 130: 217-224.

**Abstract**

**Background:** An 80:20 mixture of helium and oxygen has a density of one-third that of air. Since resistance to flow through a tube is directly related to fluid density, administering heliox to patients with status asthmaticus has the potential to decrease both airway resistance and the work of breathing.

**Methods:** This prospective study, from the University of Chicago, measured pulsus paradoxus (PP) as a surrogate marker for work of breathing in children being treated for status asthmaticus. Pediatric patients who failed to respond to initial inhaled albuterol and steroids were randomly assigned to receive heliox (80/20 helium:oxygen) or compressed air through a non-rebreathing face mask. Supplemental oxygen up to 2.0 L/min was supplied to keep oxygen saturation >88%. Outcomes measured at baseline and during and after treatment included PP, respiratory rate, pulse rate, dyspnea index and oxygen saturation.

**Results:** 18 children were enrolled; 10 received heliox and 8 were controls. Ages ranged from 16 months to 16 years. Both PP and dyspnea index significantly decreased during inhalation of heliox but not compressed air. In 3 children with incipient respiratory failure being prepared for intubation and mechanical ventilation, early administration of heliox seemed to improve respiratory status insufficiency to avoid the need for that intervention. There were no adverse from Heliox.

**Conclusion:** Heliox reduces work of breathing and may prevent respiratory failure in children with status asthma.

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**Laboratory Evaluation of the B&B Medical B-130 Hope™ Nebulizer**

**James Fink, MS, RRT**

**Hines VA Hospital, Hines, IL**

**May 1998**

**Supported by a Grant from B&B Medical**

**Introduction**

The following experiments were performed to evaluate the performance of the Hope Nebulizer.

**Methods**

In vitro model used to test aerosol generating device.

To determine the best characteristics of the nebulizer, a standing cloud technique was utilized. A cascade impactor was used to characterize the mass mean aerodynamic diameter and geometric standard deviation. An in-vitro experimental model was used to study the delivery of aerosol to the mouthpiece distal to 6 foot aerosol tubing.

To collect aerosol from the gas stream for subsequent assay, the mouthpiece was attached to a standard USP induction port attached to an Anderson Mark II Cascade Impactor.

Each experiment was repeated with fresh nebulizers from the same lot, using a standard 500 ml pour bottle. On completion of each experiment, the filters were labeled, capped and filled with 5 ml 0.9% NaCl, and the albuterol was eluted by gentle shaking for 24 hr. The albuterol deposited on the filter was measured by spectrophotometry (see below).

**Experiment 2.1 – Determination of Mass Mean Aerodynamic Diameter**

Aerosol was characterized using a 8-stage impactor (Anderson Mk2, New Smyrna, GA). The aerosol produced by the Hope Nebulizer, operated at 13 L/min, was sampled at a standard flow rate of 28.3 L/minute. Prior to each measurement, the impactor was cleaned and assembled, and tested with a Thorpe tube flow meter to assure that calibration flow of 28.3 L was achieved. Measurements were made with three solutions, (albuterol sulfate with normal saline, ipratropium bromide with normal saline, and albuterol sulfate with hypertonic saline) each with a fill volume of 5.0 ml. With each run the nebulizer was filled with the freshly mixed solution, and the Hope was operated for 2 minutes while attached to the induction port (throat) of the impactor. After the sampling, the throat and each stage of the impactor were washed with 0.9% NaCl and collected for spectrophotometric analysis to determine the mass of albuterol deposited. The nebulizer was discarded and the impactor was thoroughly cleaned and dried, prior to performing the next run.

The mass of albuterol at each cut-off of particle was plotted on a log normal graph, from which the mass mean aerodynamic diameter (MMAD) and geometric standard deviation (GSD) were determined. The total mass of aerosol depositing in the impactor was also measured.

**Assay Technique:** The volume of fluid recovered from throat or impactor plate was recorded and the concentration was determined at a wavelength of 276 nm (albuterol), 203 nm (Atrovent) and 265 nm (dexamethasone) using normal saline as the reference (Beckman Instruments, Fullerton, CA). Individual experiments were repeated three times on different days with single blind analysis.

Data Analysis: All results were expressed as the absolute amount of (mean +/- SD). The particle size distribution of the emitted dose from the USN was expressed as MMAD +/- GSD. Differences among the delivered amounts of drug and MMAD were analyzed by one way analysis of variance (ANOVA) with the Newman-Keuls test;  $p < 0.05$  was considered significant.

## Results

### Experiment 2.1 – Characterizing Aerosol Output

Calculations of MMAD and GSD for each nebulizer (unit) were based on three impactor runs, each with a fresh nebulizer from the same lot, with each medication solution tested. Results indicate a similar MMAD (2.2 – 2.9 $\mu$ m) and GSD (2.6 – 3.1) across nebulizers and solutions nebulized. While respirable range is commonly defined as a MMAD of 1 - 5  $\mu$ m, some researchers argue that a range of 1 - 3.5 $\mu$ m is more appropriate for deposition to the lung. The Hope nebulizer meets both criteria with between 64 – 78% of particles in the respirable range.

Albuterol (30 mg in 50 ml, with 0.9% NaCl)  
Units 1, 2, 3 MMAD 2.202  $\mu$ m GSD 2.906

Atrovent (iprotropium bromide) 2.0 mg in 24 ml with 0.9% NaCl  
Units 4, 5, 6 MMAD 2.88  $\mu$ m GSD 3.065

Dexamethasone (50 mg in 50 ml with 0.9% NaCl)  
Units 7, 8, 9 MMAD 2.41  $\mu$ m GSD 2.61

## Discussion

The Hope Nebulizer provides a consistent output with an MMAD well within the respirable range with a consistent GSD, with all three solutions tested. Residual volume was less than 20% per cent of the total fill volume. It would appear that the Hope B-130 is comparable to performance described by other investigators delivering aerosol with pneumatic nebulizers during continuous operation.

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**Clinical Corner for Managers: A New Tool for Continuous Bronchodilator and Heliox Therapy**

**Mark Goldstein, RRT**

**Focus on Respiratory Care 1999**

As clinicians and “tinkerers”, we have searched for ways to save patients from the dreaded ET-Tube. In the 70’s, patients received hours of labor intensive IPPB treatments with repeated dilator doses and at times pioneering mixtures of Heliox were even tried to stave off intubation. Someone at that time, started filling the Bird 500cc Nebulizer with Bronkosol and giving it continuously. Not such a radical idea, as pediatric physicians had for years been dumping 50cc bottles of Isuprel into the 3 liter fill of the Ohio mist tents to help alleviate asthma and croup. Hey, kids could take a high heart rate & it sure beat a tracheotomy on a two-year-old, didn’t it?

Then the Northwestern University study of the mid 70’s broke ground & supported the use of high dose continuous epinephrine nebulizer therapy as a means of decreasing the number of tracheotomies done on children suffering from croup. Often, after an all night stint of IPPB Q15 minutes, the patient’s ABD improved and by morning the respirations of the patient (and therapist) were back in the normal range.

The Bird 500cc nebulizer, the PB venture nebulizer and others of the time were not effective in delivering CNBT or in using Heliox to drive their large particle generating jets. Towards the 80’s, Heliox was used primarily with a non-rebreather mask via an O2 source that drove the nebulizer into a Y setup that fed the non-rebreather mask, something whipped up by the department equipment guru.

On occasion, despite our best attempts, patient still ended up struggling on a ventilator. I remember patients deteriorating with high peak pressures, bad gases, xylocaine lavages, and continuous dilators. The Ohio 560 ventilator of the day had an ultrasonic nebulizer that enabled a decent particle size, but even that sometimes wouldn’t do. Finally as an act of desperation, the feeding of helium with oxygen through a blender intake system on the ventilator worked to keep PIP’s and the WOB low enough to prevent a pneumothorax.

The 80’s brought the Babbington Nebulizer and the SPAG Nebulizer generator. The Babbington, had a spherical glass jet that provided almost unrestricted liter flow. The SPAG Generator, with it’s beautiful glassware drying chamber, allowed the controlled shrinking of the drug’s particle size to allow deeper penetration and deposition into the lungs. Some other improvements brought about, included improved ET Tubes and new generations of ventilators with 50-PSI Air Supply Valves to supplement the O2 inlet valves and eventually replace the built-in air compressors. It was this feature that allowed a more controlled use of Helium in the ventilator environment. The era also brought about DRGs as an economic reality and a change in airway management practice that resulted in the patient being quickly intubated to reduce cost.

New drugs like Albuterol made it to the market in the early 90’s, after years of European trials. With proper monitoring, effective high continuous doses of Albuterol could be given without fear and worry of side effects. It was this drug that finally allowed a fuller

utilization of CNBT. The industry also shifted towards capitation and the ER quick fix became more palatable than another ventilator patient for most physicians and families.

The HEART™ Nebulizer revolutionized CNBT treatment and rapidly became the standard of care in many institutions throughout the country. Numerous articles were written about CNBT and both patients and RCPs were happy that a new tool was available. At the same time, MDI drug delivery studies versus nebulizer drug delivery were completed. These studies showed that MDI therapy was just as effective in drug delivery and penetration, if you were just looking at the drug, not mucokinetic potential of the therapy. The Achilles Heel of each regimen was either constantly monitoring the patient's MDI technique or the particle size of the nebulizer.<sup>1</sup> Most nebulizer manufacturers then started targeting the 19<sup>th</sup> generation of the pulmonary tree as standard for aerosol drug delivery, as defined by Dr. Ziment in his classic text, *The Pharmacology of Respiratory Care*.

By 1998, the effects of different breathing patterns on drug delivery still hadn't been extensively studied in current literature, while years of experience existed of therapists matching the patients inspiratory cycle time with the appropriate flow in a maneuver to improve oxygenation. This maneuver also applies to drug delivery and particle deposition. Recently, the HOPE™ Nebulizer, (B&B Medical Technologies), became an important adjunct to the RCP's toolbox. The HOPE's particle size is 2.2um with 64-78% of the particles in the respirable range. It can be powered conventionally with a flowmeter at 13 lpm with a source gas or a blender.

This nebulizer's secondary gas port allows a wide range of FiO2 settings, which can easily be monitored with an O2 analyzer. With one Air and one O2 Flowmeter, flow rates that can meet the challenging peak inspiratory flows of distressed patients can be delivered. Consider also the time lost in trying to achieve stable FiO2's for exacerbation of COPD patients with compressed air propelling the nebulizer, (while the patient receives O2 via a cannula). Not having to run back to the department for a blender or for miscellaneous masks, adapters and parts, allows for quicker patient stabilization.

Another feature of the nebulizer is its capability to administer Heliox. By using oxygen as one's driving gas source for the nebulizer, high concentrations of Heliox can be achieved in a very rapid manner simply through the secondary gas port.

The HOPE™ is available in two configurations. One is a small-gradated 1-8 hour medication reservoir useful since these patients improve rapidly, and the CNBT dosage of medication can (and must) be changed. The acute patient generally requires at least one change during a four hour session. The second configuration is without the medication bottle and allows long term treatment since it fits standard hospital normal saline 250 & 500 ml bottles. Pour the saline out of the bottle down to either the 200 or 400 ml level and then add your drug (s) of choice. One quick mix and you have 4-16+ hours of therapy for that patient.

Recent literature is full of success stories regarding the various methods of use for Heliox and CNBT. The literature reflects on methods of turning patients in severe distress around quickly,<sup>4,5,6</sup> even saving patients from admission. In this day of capitated contracts, a patient with a short LOS is the only profit center existing for many institutions and in this era of malpractice suits, the legal exposure of creating our own devices to help patients can be professionally costly. Now it is no longer necessary.

With this simple device, you as a manager can easily start offering Heliox therapy in your hospital. Get a supply of Heliox and a supply of continuous nebulizers that can deliver it into your Emergency Department today.

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**Heliox and the Treatment of Asthma**  
**Long-abandoned treatment revived for severe asthma attacks**

Breathing a mixture of 80 percent and 20 percent oxygen (Heliox), in combination with standard therapy, can ease the work of breathing in children with severe asthma attacks and may prevent the need for mechanical ventilation, according to a study by researchers at the University of Chicago Medical Center, published in the February 1997 issue of the Journal of Pediatrics.

“This is a life-saving, risk-free therapy that could save thousands of patients each year,” said Mark Wylam, M.D., assistant professor of pediatrics and medicine, at the University of Chicago and director of this study.

Although the beneficial effects of Heliox were studied more than 60 years ago, this is the first report of its use in treating children with asthma. Even today, medical textbooks fail to mention the use of Heliox for treating severe and prolonged asthma attacks.

The therapeutic use of helium was first described by Alvan L. Barach, M.D., in the October 17, 1936 issue of the Journal of American Medical Association. Dr. Barach reported immediate relief in severe asthmatic patients near death but the therapy was abandoned for nearly 40 years.

In the past 20 years several studies have revived interest in the beneficial effects of Heliox. In the last five years, researchers at the University of Chicago Hospitals have refined the technology for administering the gas to patients with asthma and other respiratory problems.

In a double-blinded, randomized, controlled trial at the University of Chicago Children’s Hospitals, researchers studied 18 patients, ages 16 months to 16 years, suffering from severe asthma attacks. All patients were treated with common bronchodilator drugs and steroids. Then patients received either Heliox or room air.

The ten patients who received Heliox experienced a significant increase in air flow and less difficult breathing. Three patients avoided intubation and mechanical ventilation after receiving Heliox. None of the eight control group patients experienced a significant difference in air flow or work of breathing during the study period.

Because Heliox is about one-third as dense as air, it is thought to reduce the effort required to breathe through a narrowed airway. By making it easier for the asthmatic patient to breathe, Heliox may prevent respiratory muscle fatigue that leads to the need for mechanical ventilator support.

“Fatigue of the breathing muscles during a severe asthma attack is generally what kills people,” said Wylam. “Heliox is an effective and little-known therapy to buy these patients enough time for the conventional drugs to take effect.

Heliox has been standard therapy for severe asthmatics in the pediatric and adult emergency rooms at University of Chicago Medical Center for nearly five years. Respiratory Therapists and Physicians at the University of Chicago have successfully modified and calibrated respiratory therapy equipment to dispense Heliox and currently disseminate their methods to hospitals across the country. The University of Chicago is also pioneering the use of Heliox in the management of mechanically ventilated asthma patients.

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