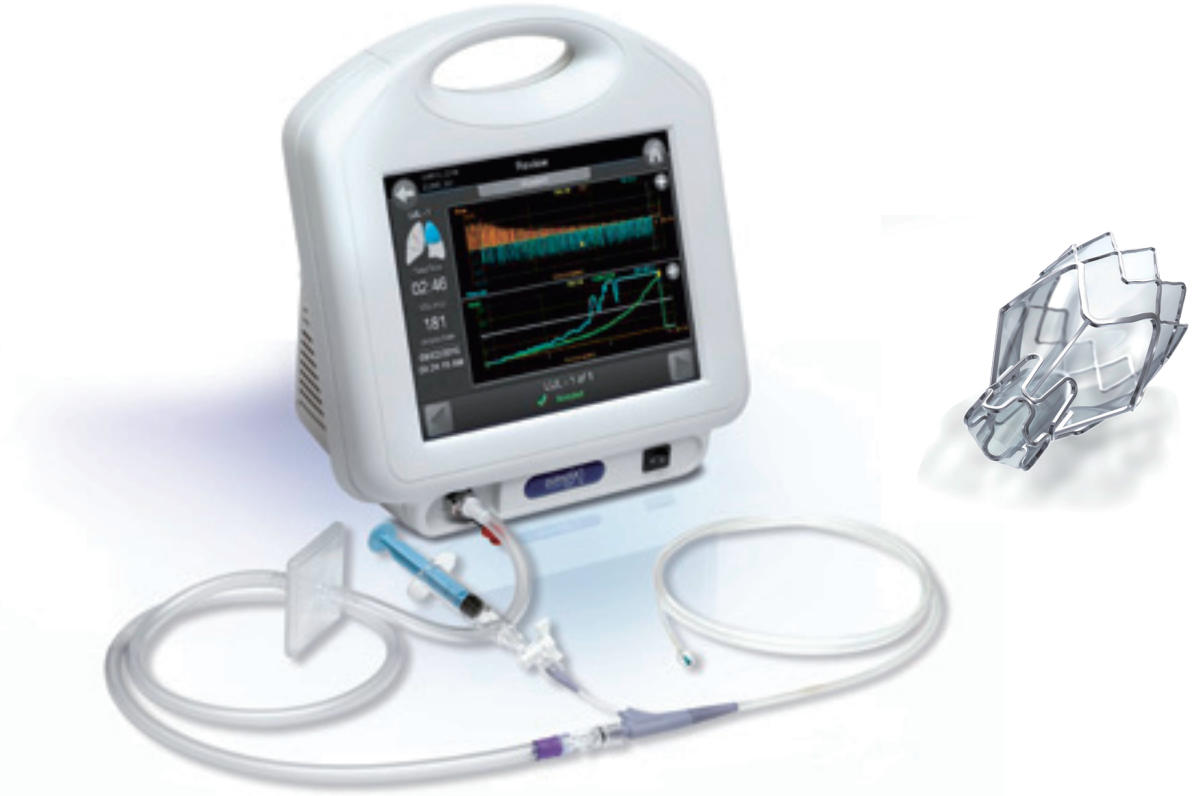
Endobronchial Lung Volume Reduction

Product information for ZEPHYR® Endobronchial Valves, Delivery Catheters and CHARTIS Assessment System



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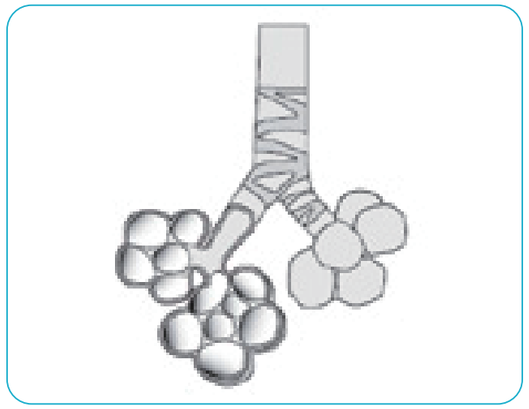
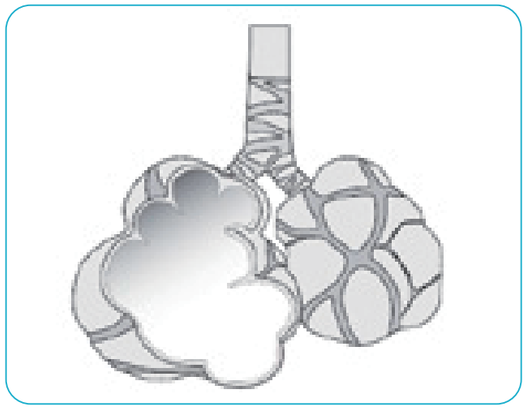
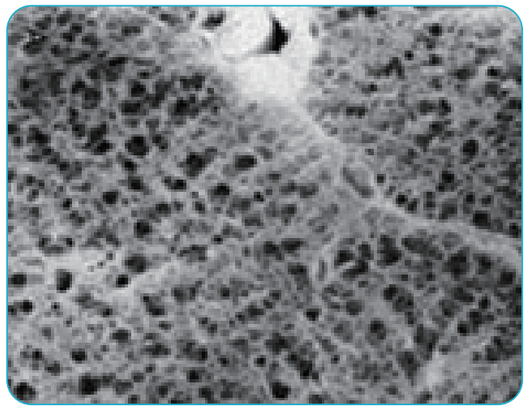
Emphysema is included in a group of diseases called Chronic Obstructive Pulmonary Disease, COPD. Emphysema accelerates the destruction of the walls of the air sacs (alveoli) of the affected lung, reducing the elasticity of the lung tissue, meaning air is trapped in the lung. This trapped air can cause the lung to enlarge (hyperinflate), taking up more space in your chest and making breathing more difficult. This can result in dyspnea (shortness of breath) and lack of stamina.



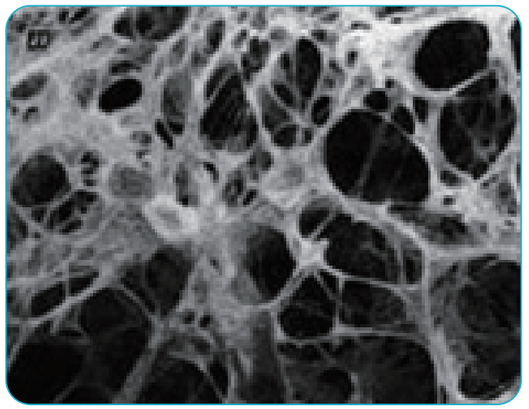
Healthy alveoli (with large surface area)



Diseased alveoli (enlarged with small surface area)

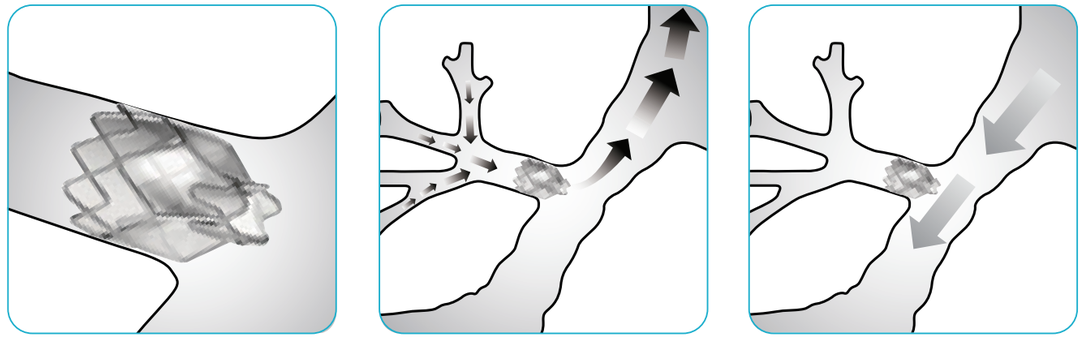


Normal lung tissue



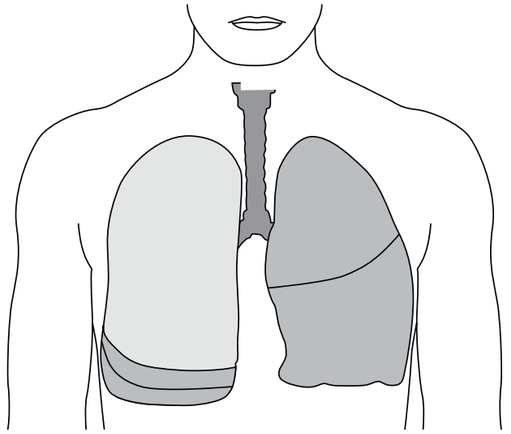
Lung tissue with emphysema

Lung volume reduction with valves

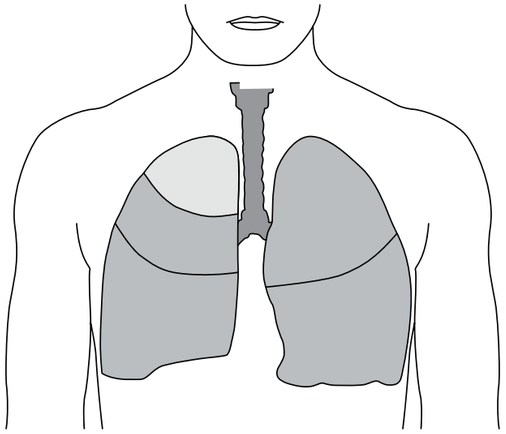


The lung is divided into compartments(lobes) and the valves are placed in the airways of one of the lobes of the lung. The valves allow air and secretions to pass out through the valve but not back in. This may result in the lobe shrinking in volume and may allow more healthy parts of the lung to expand and takepart in the exchange of oxygen and carbon dioxide.

Lung volume reduction with valves aims to reduce the volume in an enlarged part of the lung.



Before volume reduction. The diseased part is enlarged and compresses healthy part of the lung.

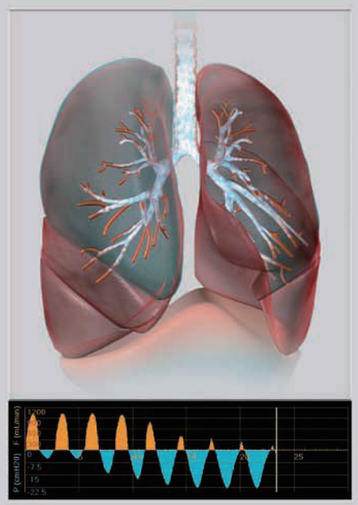


After lung volume reduction. The diseased part is reduced in volume allowing healthy part of the lung to expand and function better.

Collateral Ventilation

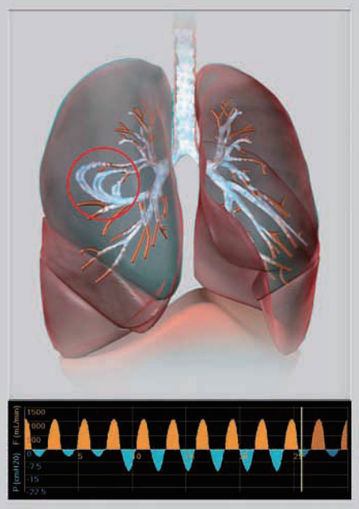
Recent research suggests that Collateral Ventilation (CV), or inter-lobar airflow in the lungs, can limit the effectiveness of lung-volume reduction therapy for severe emphysema.[3,4] Collateral channels can circumvent airway occlusion devices, allowing backfill into the target lobe. Prospective identification of collateral flow may be essential before targeting a lobe for endobronchial valve (EBV) implantation.

CV- | No Collateral Ventilation

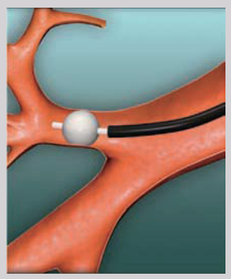


The Chartis System detects a low level of collateral ventilation. The lung compartment is completely emptied of air over several breathing cycles, indicating little to no collateral airflow from adjacent lung compartment(s).

CV+ | Collateral Ventilation



The Chartis System detects a high level of collateral ventilation. Expiratory airflow persists over time, indicating the presence of collateral airflow from adjacent lung compartment(s).



The Chartis balloon catheter enables real-time measurements on the Chartis Console display.

The Chartis Pulmonary Assessment System enables the physician to directly detect the presence of CV in the targeted lobes of the lungs.[5] In comparison, high-resolution computed tomography (HRCT) can only estimate CV through a visual analysis of inter-lobar fissure integrity. The Chartis System puts greater control into the hands of the treating physician. By prospectively and accurately determining which patients have little to no CV and are likely to achieve lung volume reduction from Zephyr valve therapy, physicians and their patients can make data-driven care decisions.

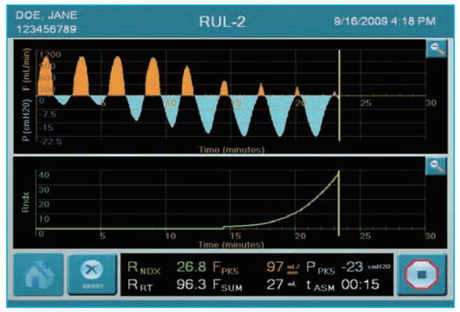
How It Works:

Chartis System & Zephyr ELVR

Real-Time Assessment of Lung Function

The Chartis System detects the presence of CV in the target lobe by calculating the level of resistance to airflow. High resistance signifies low levels of CV.[3,4]

Using a flexible bronchoscope, the Chartis balloon catherter is positioned and inflated to occlude the target lobe bronchus. The procedure enables the precise measurement of expiratory flow and inspiratory pressure by the Chartis Console, while preventing the direct flow of inspired air. Performed under conscious sedation, the procedure typically takes 3 – 5 minutes to record a result for each lobe tested.



The Chartis Console measures & displays:

- Expiratory airflow (orange)
- Inspiratory pressure (blue)
- Collateral resistance (green)

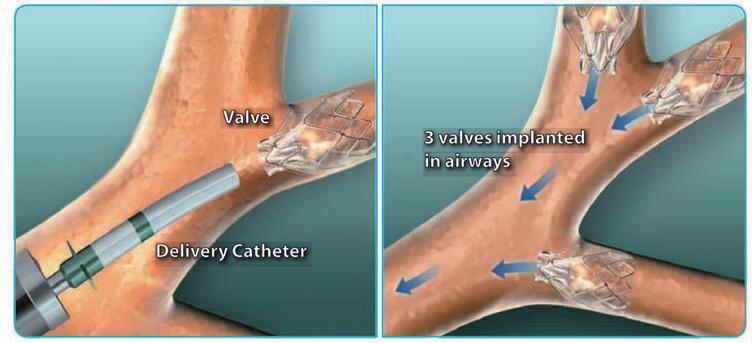
Procedures that Fit Your Practice:

- **Chartis assessment and Zephyr valve placement can be performed in a standard bronchoscopy suite or operating theatre.**
- **Chartis Catheter fits standard 2.8 mm working channel video bronchoscopes** (max. length: 600 mm Olympus, 550 mm Pentax).
- **Chartis assessment is performed under conscious sedation, without patient intubation or ventilation.**
- **Zephyr valve placement can be performed under deep sedation or conscious sedation.**

Non-Surgical Lung Volume Reduction

Zephyr valve therapy involves transcopic placement of self-expanding, one-way endobronchial valves in the patient's lungs to prevent inspiratory airflow, while allowing trapped air and fluid to escape.

The Zephyr valve delivery catheter is passed through the working channel of the bronchoscope, enabling the physician to directly visualize each valve placement. A measurement gauge is attached to the end of the catheter to assist in proper valve sizing. Once the target lobe is isolated, its volume is reduced, allowing healthier regions of the lung to function more normally. A typical lobar occlusion procedure requires three valves and takes 30 minutes to complete.



*** NOTES:**

1. International Bronchial Valve for Emphysema Palliation Trial (International VENT). Referenced study available on request.
2. Sciurba FC, Ernst A, Herth FJF, et al. A Randomized Study of Endobronchial Valves for Advanced Emphysema. N Engl J Med 2010;363:1233-44; doi: 10.1056/NEJMoa0900928.
3. Alijuri N, Freitag L, Validation and pilot clinical study of a new bronchoscopic method to measure collateral ventilation prior to endobronchial lung volume reduction. J Appl Physiol. 2009; 106: 774 – 783.
4. Fessler HE. Collateral damage assessment for endobronchial lung volume reduction. J Appl Physiol. 2009; 106: 755 – 756.
5. Gompelmann D, Eberhardt R, Ernst A, et al. Predicting Atelectasis Using Collateral Ventilation Assessment prior to Endobronchial Lung Volume Reduction – A Feasibility Study. Respiration 2010;80:419-425; doi: 10.1159/000319441.

Patient Selection Guidance

Patient screening requirements[1]

- **COPD/Emphysema**
- **FEV_1 < 50%**
- **TLC > 100%**
- **RV > 175%**
- **6MWT > 100m**

Patient testing requirements[2]

- Pulmonary Function Testing
  (Spirometry, gas diffusion & body plethysmography)
- Thin slice (0.5 to 1.5 mm) HRCT scan at full inspiration
- Quantitative Ventilation/Perfusion (V/Q) scan
- 6MWT
- Clinical history related to COPD
- Cardiac assessment

Recommended inclusion criteria[1]

- COPD/Emphysema
- FEV_1 15-50%
- TLC > 100%
- RV > 175%
- $paCO_2$ < 60mmHg
- paO_2 > 45mmHg
- > 100m on preliminary 6MWT
- No evidence of significant co-existent pulmonary pathology on HRCT
- Clinically stable prior to the procedure
- No collateral ventilation
- Cessation of smoking

Recommended exclusion criteria[1]

- Clinical instability
  - 3 or more exacerbations resulting in hospitalizations during previous 12 months
  - Unstable cardiovascular disease including severe heart failure (LVEF < 35%), unstable cardiac arrhythmia, myocardial infarction or stroke within the past 6 months
- Significant symptomatic bronchiectasis
- Severe hypercapnia ($paCO_2$ > 60mmHg)
- Severe Hypoxemia (paO_2 < 45mmHg)

1 Endobroncial Valves for Endoscopic Lung Volume Reduction – Best Practices. PulmonX, data on file 2016
2 Dr Nick Wilsmore MBBS (hons) FRACP, Respiratory and Sleep Physician. Pers. Comm. Oct 2016. Pulmonx, data on file.

Pulmonx Product Overview

Zephyr® Endobronchial Valves

Valves are available in three different sizes.

Description	Catalog number
Zephyr® 4.0 Endobronchial Valve	EBV-TS-4.0
Zephyr® 4.0-LP Short Endobronchial Valve	EBV-TS-4.0-LP
Zephyr® 5.5 Endobronchial Valve	EBV-TS-5.5

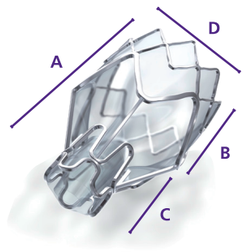
Zephyr® Delivery Catheters

Description	Catalog number
Zephyr® 4.0* Delivery Catheter	EDC-TS-4.0
Zephyr® 4.0-J* Delivery Catheter	EDC-TS-4.0-J
Zephyr® 5.5 Delivery Catheter	EDC-TS-5.5

* Note: This catheter can be used for all valves with a diameter of 4.0 mm.

Measures Fact Sheet for Zephyr® Endobronchial Valve

	A Overall length	B Length of large diameter	C Length of taper + small diameter	D Treatment diameter
EBV 4.0-LP	9.9	5.2	4.7	4.0 - 7.0
EBV 4.0	11.6	6.9	4.7	4.0 - 7.0
EBV 5.5	13.2	8.0	5.2	5.5 - 8.5



Chartis Assessment System

Description	Catalog number
Chartis Pulmonary Assessment System - Console	CHR-CO-100
Chartis Pulmonary Assessment System - Catheter	CHR-CA-12.0
Chartis Pulmonary Assessment System - Catheter XL**	CHR-CA-12.0-XL

**Note : the Chartis Catheter XL is identical to the Chartis Catheter with the exception that the strain relief is removed. This allows the catheter to be inserted approximately two inches further into the bronchoscope biopsy valve. The physician should use extra caution while manipulating the catheter in the biopsy valve area due to the lack of a strain relief.

Consistent Outcomes Across EBV RCTs in Patients without Collateral Ventilation

RCT	Design	Sample size & Follow-up period	Difference EBV vs Control Groups		
			Lung Function (FEV1%) MCID = 10%-15%	Exercise Capacity (6MWD) MCID = 26 m	Quality of Life (SGRQ) MCID = - 4 pts
TRANSFORM[4] NEW	2:1 Randomization **Heterogeneous only** Multi-Center	n=97 6 months	**29.3%***	**79 m***	**-6.5 pts***
IMPACT[3] NEW	1:1 Randomization **Homogeneous only** Multi-Center	n=93 6 months	**16.3%***	**28 m***	**-7.5 pts***
STELVIO[2]	1:1 Randomization **Heterogeneous & Homogeneous** Single Center	n=68 6 months	17.8%*	74 m*	-14.7 pts
VENT[1] (post-hoc subset, US + OUS)	2:1 Randomization **Heterogeneous only** Multi-Center	n=122 (post hoc subset) 6 months	24.8%	28 m	-8.4 pts

Complications of endobronchial valve treatment can include but are not limited to pneumothorax, worsening of COPD symptoms, pneumonia, dyspnea and, in rare cases, death.

* Intent-to-Treat population

[1] Scuirba F.C. et al. N Engl J Med. 2010; 363(13): 1233-44/ Herth F. J. et al. Eur. Respir. J. 2012; 39(6): 1334-42/ Ad hoc analysis on file at Pulmonx. [2] Klooster K. et al. N Engl J Med. 2015; 373: 2325-2336 + Supplementary Appendix [3] Press release "New Data from Two Multi-Center Randomized Clinical Trials Demonstrate That Zephyr Endobronchial Valves Deliver Benefit to Both Heterogeneous and Homogenous Emphysema Patients without Collateral Ventilation" - May 23, 2017 [4] Kemp S et al. Am J Resp Crit Care Med 2017; (196)12: 1535-1543

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