PASSY MUIR'S
AERODIGESTIVE HEALTH

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Volume 9, Issue 1

BUILDING BLOCKS FOR
SPEAKING VALVE USE

Putting it all together

Volume 9, Issue 1

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ARTICLES LEGEND

Decannulation & Weaning · Mechanical Ventilation · Pediatric · Pediatric Vent · PMV Placement · PMV Vent · Trach Cuff · Transtracheal Pressure

Welcome to Passy-Muir, Inc.'s *Aerodigestive Health*:

Building Blocks for Speaking Valve Use

Welcome to this issue of *Aerodigestive Health*. The focus of this publication is to provide educationally and clinically relevant information about patients with tracheostomies and for the safe and efficacious use of the Passy Muir® Tracheostomy & Ventilator Swallowing and Speaking Valve (PMV®). Each edition of *Aerodigestive Health* features articles and other resources tailored for evidence-based care of adult and pediatric patients, with a focus on tracheostomy management, both with and without mechanical ventilation. The Editor's objective is to provide readers with clinical perspectives and cutting-edge research to address specific questions raised by practitioners relating to the care of patients.

In this edition, you will find these key elements:

- Editor's commentary – An overview of the publication topic.
- Healthcare practitioners' perspectives – Articles by healthcare professionals on clinical issues and interventions.
- Clinical take-home boxes – Relevant clinical information for healthcare practitioners, including protocols and research summaries.

For this issue, the primary focus is on *Building Blocks for Passy Muir Valve Use*. This special issue addresses the fundamentals for efficacious and safe assessment of patients for Passy Muir Valve use, both on and off mechanical ventilation. Readers will find in this issue the primary considerations for assessing both pediatric and adult patients. With articles contributed by both practicing clinical professionals and Passy Muir clinical specialists in respiratory therapy and speech-language pathology, the evidence-based, practical steps for assessment, from proper cuff management to in-line placement of a Passy Muir Valve, are reviewed. With an overview of several considerations impacting use, readers will have access to key factors to consider during evaluation. The building blocks in this issue are intended to guide the clinician through assessment considerations related to airway patency, cuff management, and best practices for both pediatric and adult patients. This issue of *Aerodigestive Health* provides articles on the clinical considerations for implementing Valve use in healthcare. It is imperative for clinical professionals to have awareness of evidence-based practices and current standards of care.

The building blocks will increase success with Valve use. The first half of the publication focuses primarily on non-vent application, with the second half addressing ventilator management with Valve use. Starting with cuff management considerations, several clinical specialists discuss the impact of a cuff on patient care and tracheostomy management. King and Harrell review considerations for cuff inflation and deflation, including the impact of a multidisciplinary team (MDT). Following that article, Oakes and Ortiz discuss the differences between tolerating cuff deflation and cuff deflation trials, with an emphasis on the impact of Valve use.

After the review of cuff management, Brooks shares considerations and steps for using transtracheal pressure measurements (TTP) to ascertain if airway patency is appropriate for Valve use. She includes a discussion on the technique and considerations for implementing TTP to assist with best practices as it relates to airway patency, both on and off the ventilator.

Ortiz's article on non-vent use of the Passy Muir Valve reviews considerations for patient selection and provides an outline of the steps to Valve placement during assessment. This article seeks to provide clinicians with a guide for patient selection, airway patency considerations, and Valve placement during assessment to aid in successful trials. She also shares the role of the respiratory therapist and speech-language pathologist during the assessment process. It is followed by a Troubleshooting Guide that includes the most common problems and how to address them. After the Ortiz article, Shaw presents further discussion with an emphasis on the pediatric patient population and what indicates candidacy.

After the articles covering non-vent considerations in both pediatric and adult patients, this issue then offers building blocks related to mechanical ventilation. An article by Ortiz reviews the differences between active and passive circuits and how the type of circuit impacts ventilator management and considerations for Valve use. Questions often arise as the type of circuit may impact both assessment and intervention strategies.

Following the review of circuit types, King and Sudderth review the benefits of using a Valve in-line with mechanical ventilation and offer an overview of the basic steps to follow for use with the adult patient population. This section also includes tables with tips for successful placement. The Brooks' article addresses candidacy and early intervention for using the Valve in-line during mechanical ventilation for both infants and young children, especially in the intensive care unit setting. This issue is rounded out by an article from King, which shifts considerations for Valve use to its role in weaning and decannulation.

These articles provide the building blocks needed to enhance patient care and to establish best practice guidelines when working with these patient populations. Considerations related to assessment from Valve use through decannulation are presented in a systematic manner that reflects on both research and clinical protocols. These building blocks lead the clinician through the stages of assessment and intervention that are often utilized for patients with tracheostomies. However, no standard of practice is consistent across the continuum or from state to state and country to country. This issue strives to provide evidence-based considerations for the efficacious use of the Valve, including improving success rates leading to best practice. The primary takeaways from this issue are that having appropriate staff training improves overall care for the patient with a tracheostomy, appropriate assessment is key to successful interventions, and that the sooner clinicians have their Building Blocks, the better for both the patient and their recovery.

Kristin A King PhD, CCC-SLP

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About the Editor

With over 25 years of experience in medical settings, academia, and industry, Dr. King brings a unique perspective to the care of patients with medical diagnoses. Her experience includes a clinical focus on critical care and trauma, with an emphasis on TBI and tracheostomy and vent patients. As a professor, she conducted research and published in peer-reviewed journals on TBI and swallowing disorders. She continues her career by working in the industry to improve patient outcomes through the development of multi-media education and participating in product development and regulatory requirements for medical devices. She is the host of the CAM Podcast for Passy Muir, editor of *Aerodigestive Health* by Passy Muir, and contributes regularly at the state, national, and international levels for both speaking and clinical papers. She also is co-editor of the book *Tracheostomy and Ventilator Dependence in Adults and Children: Learning Through Case Studies*.

Upcoming Issues:

If you have an interest in submitting or writing for one of our upcoming issues, please contact me at ***aerodigest@passymuir.com***.

Tracheostomy Tube Cuff: Purpose and Practice Through Team Management

Michael S. Harrell, BS, RRT | Kristin A. King, PhD, CCC-SLP

Care of patients with tracheostomies has become a frequent topic of discussion in the medical industry and publications. With this focus, details related to the care plan for patients with tracheostomies are of concern and must be considered with a focus on evidence-based and best practice. One significant consideration for patient care is the safety and efficacy of proper cuff management, especially when using a bias-closed position, no-leak Valve.

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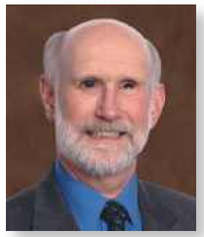

Purpose of a Cuff

The purpose of having the tracheostomy tube cuff inflated is to direct airflow through the tracheostomy tube and into the lower respiratory system or airway. Use of an inflated cuff typically occurs during mechanical ventilation, as a closed ventilator circuit allows improved control and monitoring of ventilation for the patient. Typically, the patient on a ventilator has a more seriously compromised respiratory system than patients who are not on a ventilator. The inflated cuff assists with providing focused management and support that the patient may require.

The inflated cuff also may be important in cases of gross emesis or reflux when gross aspiration is a risk; the cuff may assist in limiting aspirated material entering the lower airway. However, the definition of aspiration is any food, liquid, or other matter passing below the vocal folds. Therefore, the cuff cannot prevent aspiration as the cuff is located below the vocal folds (see Figure 1). When neither mechanical ventilation nor risk of gross aspiration is present, consideration should be given to deflating the cuff. If the patient does not need a cuffed tracheostomy tube, transitioning them to a cuffless tracheostomy tube as soon as possible may be an option.

Clinical Practice: Cuff Inflation

The inflated cuff should be avoided whenever possible because it has the potential to cause multiple complications, such as increased risk of tracheal injury, including mucosal injury, stenosis, granulomas, and more; diminished ability to use the upper airway, leading to disuse atrophy over time; and restriction of laryngeal movement (laryngeal tethering), which may negatively impact swallowing. The potential for a negative impact is also affected by the management of the tracheostomy tube cuff, with proper inflation critical to the health of the airway.

If a patient requires an inflated cuff, then the manner in which it is being inflated should be carefully evaluated. Complications that have been reported with tracheostomy tube cuffs may be avoided by proper management. Three methods that are commonly used to inflate a tracheostomy tube cuff are:

1) Cuff manometer (cuffalator) – the gold standard.
2) Minimal occlusion volume.
3) Minimal leak technique.

While some guidelines provide that cuff pressure should be between 20 – 25 cmH_2O, others suggest 15 – 30 cmH_2O (Credland, 2014). The disparity that exists between resources makes it imperative that healthcare professionals understand the potential impact and how to manage a cuff properly. Amathieu et al. (2012) found that at 25 cmH_2O or higher cuff pressure, swallowing begins to be negatively affected. Another consideration is that if cuff pressure exceeds tracheal perfusion pressure, adequate blood flow to the tracheal mucosa may be reduced or stopped, leading to significant injury or damage.

Using the pilot balloon or pushing air into the cuff with a syringe without a stethoscope places the patient at high risk of an improperly inflated cuff, which may cause damage or impairment. Dikeman and Kazandjian (2022) recommended that cuff inflation always occur with the use of a manometer or stethoscope.

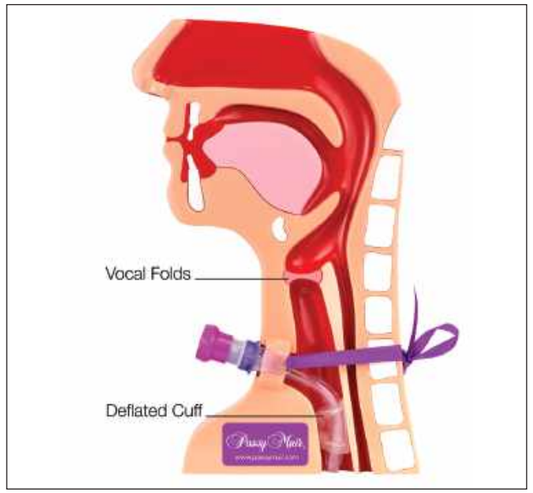

Figure 1: Cuff location in relation to the vocal folds

Practice: Cuff Deflation

Deflating the tracheostomy tube cuff, when appropriate, has been shown to provide many patient benefits, including (Harrell, 2018):

- Reduced risk of potential tracheal mucosal damage.
- Restored physiology, including closing the system by using a bias-closed position, no-leak Valve.
- Restored speech and improved communication.
- Improved swallow.
- Lowered risk of aspiration.
- Earlier rehabilitation.
- Decreased time to decannulation.

Cuff deflation is recognized as an important step in the care plan for a patient with a tracheostomy (Speed & Harding, 2013). The benefits of cuff deflation can be safely and effectively extended to a patient with mechanical ventilation, when appropriate assessment and patient selection are performed (Sutt et al., 2013). This early cuff deflation may improve the time to rehabilitation and potentially avoid the negative consequences related to an inflated cuff. The earlier a patient has their cuff deflated, the earlier the patient may be weaned or decannulated. Even when decannulation is not a goal, cuff deflation may still provide many benefits on a long-term basis.

Impact of Cuffs on Swallowing

Another reason for closely monitoring tracheostomy tube cuff status is that it may have a negative impact on swallowing. While a consensus does not exist in the research, it has been reported that an inflated cuff may impinge upon swallowing by tethering the larynx and reducing hyolaryngeal excursion during the swallow (Amathieu et al., 2012). Another reported impact is that an over-inflated cuff may impinge on the esophagus, causing reflux of ingested substances. However, research has shown that use of a Passy Muir® Valve improves swallowing and reduces aspiration more often and more significantly than cuff deflation alone (Suiter et al., 2003).

Amathieu et al. (2012) conducted a study investigating incremental increases in cuff pressure for patients with tracheostomies and measured the impact on the swallow reflex. They found that as the cuff pressure increased, the swallow reflex became increasingly more difficult in both latency and magnitude, meaning that the timing and force of the swallow were impacted. Their findings indicated that any pressure above 25 cmH_2O has a significant risk of negatively affecting swallow function. This finding becomes even more significant when considering the role that swallowing function plays in weaning a patient from both mechanical ventilation and from a tracheostomy tube.

A study by Ding and Logemann (2005) investigated swallowing in both cuff-inflated and cuff-deflated conditions. They found that the frequency of reduced laryngeal elevation and silent aspiration was significantly higher in the cuff-inflated condition as compared to the cuff-deflated condition. Swallow physiology changes also were found to be significantly different among various medical diagnostic categories. The researchers suggested that these findings indicate a need to test both conditions during a swallow study.

In a more recent systematic review, Goff and Patterson (2018) analyzed multiple studies and concluded that patients should be evaluated for possible swallowing impairment regardless of cuff condition. They also suggested that patients should be seen and evaluated on a case-by-case basis to determine the safety of swallowing for return to oral nutrition. These recommendations were suggested because the research to date has not reached a consensus to establish a standard of care for tracheostomy and cuff management as they relate to swallowing.

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Impact of Team Management

The complexity of this patient population lends itself to being managed by a multidisciplinary team (MDT). It has been demonstrated that a team of appropriately trained professionals armed with evidence-based guidelines significantly improves care and reduces negative outcomes for the patient with a tracheostomy. A team approach assists with continuous monitoring, proper cuff management, and the patient care plan (Speed & Harding, 2014; deMestral, 2011).

Working with patients following tracheostomy and with mechanical ventilation takes an MDT approach to ascertain that the needs of the patient are well met. Because of the complex nature of working with these patients, having the involvement of different disciplines provides a perspective on various aspects of care. Typically, these patients are followed by both the respiratory therapist (RT) and the speech-language pathologist (SLP). However, many other healthcare professionals are trained and involved with the tracheostomy and use of the PassyMuir Valve. To initiate an MDT approach, it takes multiple healthcare professionals, including the physician, nursing, dieticians, physical therapists, and occupational therapists, with the patient at the center of it all.

In a study conducted by Fröhlich et al. (2017), the authors investigated best practices for early intervention with the use of the Passy Muir Valve as a standard of care in the ICU following tracheostomy and mechanical ventilation. Their findings demonstrated that patients improved with voicing and swallowing more quickly than those without MDT intervention. However, since the authors were able to follow the patients over time, which included up to 51 trials with the PMV®, they also reported how the implementation of a team approach had a positive impact on potential adverse events, with none occurring. The researchers attributed this to the multidisciplinary team approach and suggested their findings support the idea that two professionals should be at the bedside to provide assessment and intervention with the PMV in-line with mechanical ventilation.

Santos et al. (2018) also investigated the impact of team management on the post-tracheostomy care of patients. Their findings concur with Frohlich et al. (2017) and suggest that having the involvement of an MDT allows the patient to progress faster in multiple areas. The parameters addressed in their study were time in the ICU, total hospital days, days to Valve use, days to verbal communication, oral intake, and decannulation. The group receiving team management was found to have improved care in all areas measured. Patients who received the Valve with the MDT did so earlier in their care and had voicing, communication, and the ability to participate in their care restored. The positive impact of an MDT on the care of patients and the ability to achieve earlier voicing cannot be understated in its clinical significance. As with any medical procedure or device, thorough education is important in achieving the desired outcomes.

Summary

It is the responsibility of healthcare professionals to provide the best possible care to their patients. Proper cuff management, including cuff deflation, contributes significantly to the best practice plan of care for the patient with a tracheostomy. Proper cuff management also leads to earlier intervention for communication and swallowing. The safety and efficacy of the plan depend largely on the education and competency of the team caring for these individuals, as well as a commitment from the healthcare facility to a multidisciplinary tracheostomy team approach for patient care.

References

Amathieu, R., Sauvat, S., Reynaud, P., Slavov, V., Luis, D., Dinca, A., Tual, L., Bloc, S., & Dhonneur, G. (2012). Influence of the cuff pressure on the swallowing reflex in tracheostomized intensive care unit patients. *British Journal of Anaesthesia, 109*(4), 578-583. https://doi.org/10.1093/bja/aes210

Credland, N. (2014). How to measure tracheostomy tube cuff pressure. *Nursing Standard, 30*(5), 36-38. https://doi.org/10.7748/ns.30.5.36.e9495

de Mestral, C. (2011). Impact of a specialized multidisciplinary tracheostomy team on tracheostomy care in critically ill patients. *Canadian Journal of Surgery, 54*(3), 167-172. https://doi.org/10.1503/cjs.043209

Dikeman, K., & Kazandjian, M. (2022). *Communication and Swallowing Management of Tracheostomized and Ventilator-Dependent Individuals*. 3rd ed. Eat-Speak-Breathe: United States.

Ding, R., & Logemann, J. A. (2005). Swallow physiology in patients with trach cuff inflated or deflated: A retrospective study. *Head & Neck, 27*(9), 809-813. https://doi.org/10.1002/hed.20248

Fröhlich, M. R., Boksberger, H., Barfuss-Schneider, C., Liem, E., & Petry, H. (2017). Safe swallowing and communicating for ventilated intensive care patients with tracheostoma: Implementation of the Passy Muir speaking valve. *Pflege, 30*(6), 87-394. https://doi.org/10.1024/1012-5302/a000589

Goff, D. & Patterson, J. (2019). Eating and drinking with an inflated tracheostomy cuff: A systematic review of the aspiration risk. *International Journal of Communication and Language Disorders, 54*(1), 30-40. https://doi.org/10.1111/1460-6984.12430

Harrell, M. (2018). Tracheostomy tube cuff: Purpose and practice through team management. *Aerodigestive Health, 2*(1). Retrieved from https://www.passy-muir.com/journal-2-1-trach-tube-cuff/

Santos, A., Harper, D., Gandy, S., & Buchanan, B. (2018). The positive impact of multidisciplinary tracheostomy team in the care of post-tracheostomy patients. *Critical Care Medicine, 46*(1) (Supplement), 1214.

Speed, L., & Harding, K. E. (2013). Tracheostomy teams reduce total tracheostomy time and increase speaking valve use: A systematic review and meta-analysis. *Journal of Critical Care, 28*(2), 216.e1-10. https://doi.org/10.1016/j.jcrc.2012.05.005

Suiter, D., McCullough, G. H., & Powell, P. W. (2003). Effects of cuff deflation and one way speaking valve placement on swallow physiology. *Dysphagia, 18*(4), 284-292. https://doi.org/10.1007/s00455-003-0022-x

Sutt, A., Caruana, L. R., Dunster, K. R., Cornwell, P. L., Anstey, C. M., & Fraser, J. F. (2016). Speaking valves in tracheostomised ICU patients weaning off mechanical – do they facilitate lung recruitment? *Critical Care, 20*(1), 91. https://doi.org/10.1186/s13054-016-1249-x

Tolerance vs Trials: Patient Safety and Progression With Cuff Deflation

Tiffany Oakes, MS, CCC-SLP | Gabriela Ortiz, BSRT, RCP

With the number of patients receiving tracheostomies increasing over the last several years and with the increased rate of these patients being discharged to long-term care facilities prior to weaning and decannulation, more clinicians in a variety of settings are participating in the care of patients with tracheostomies (Mehta, 2015). An important part of that care is management of the tracheostomy cuff, and cuff deflation is an important step in the treatment plan for a patient with a tracheostomy (Speed & Harding, 2013). Often, questions arise about what it means to deflate the cuff and what a successful deflation trial looks like.

Before clinicians start deflating the cuff, it is important to understand why the patient required an artificial airway and the purpose of the cuff. An artificial airway is placed for three reasons: to administer positive-pressure ventilation, to provide a patent airway, or to provide access to the lower airway for secretion clearance. The primary purpose of the tracheostomy cuff is for use with mechanical ventilation as it seals the airway to direct the airflow and allow the closed ventilator circuit to control and monitor ventilation for the patient (Harrell, 2018). While an inflated cuff does not assist in eliminating aspiration, especially aspiration related to an oral diet, a patient may require cuff inflation to decrease the risk of aspiration of gross emesis or reflux (Suiter, 2003). If neither the requirement of mechanical ventilation nor the risk of gross aspiration is present, cuff deflation, or changing to a cuffless tracheostomy tube, is recommended (Harrell, 2018).

Cuff Deflation Criteria

Despite the frequency of tracheostomy tube placement in intensive care settings, little research has been conducted to determine the criteria for progressing a patient with a tracheostomy towards decannulation. What research that does exist focuses more on indicators for decannulation, rather than the progression towards decannulation, such as tolerance of cuff deflation (Mitchell, 2013).

Before clinicians start deflating the cuff, it is important to understand why the patient required an artificial airway and the purpose of the cuff.

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A study by Pryor et al. (2016) examined clinical indicators that could be associated with successful tracheostomy cuff deflation. Patient characteristics that were considered prior to cuff deflation were:

1. Medical status (stable or improving)
2. Respiratory status (stable or improving)
3. Oxygenation ($FiO_2 \leq 0.4$)
4. Cough strength (≥moderate)
5. Patient alertness (≥eyes open to voice)
6. Sputum color (clear or white)
7. Sputum nature (thin and easy to suction)
8. Tracheal suction frequency (≤1–2 hourly)
9. Above cuff secretions (≤1 ml per hour)

This study revealed that nearly all participants achieved successful cuff deflation on the first attempt, even with some participants not meeting all criteria. Pryor et al. also suggested that requiring patients to meet all nine criteria may not be appropriate. Instead, clinicians should consider the overall medical and respiratory stability of the patient and the ability to control oral secretions. In this study, factors that indicated the need for reinflation of the cuff included frequent coughing, overt discomfort or distress, increased sputum load, and clinically significant changes from a patient's baseline.

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Inflated tracheostomy tube cuff

Deflated tracheostomy tube cuff

There is little consensus among clinicians as to the duration of the initial cuff deflation trial or the necessity of intermittent subsequent trials to determine tolerance of cuff deflation, but this study supports that with the use of key selection criteria and good clinical judgement, most patients can progress in a single step to continuous cuff deflation, regardless of the reason for insertion.

Requiring a patient to demonstrate tolerance of cuff deflation over an arbitrarily determined length of time or number of days may only delay the patient's physiological and psychological recovery and return to verbal communication and oral intake (Bach et al., 2014). Deflating the tracheostomy tube cuff is necessary prior to placement of a biased-closed, no-leak Valve. By withholding the placement of a Valve until a patient demonstrates tolerance of continuous cuff deflation over a long period of time, the clinician is also requiring that the patient tolerate the negative effects of an open aerodigestive system, such as decreased positive pressure in the upper airway. This may increase the patient's work of breathing and appear as though the patient is not tolerating cuff deflation. This may also impact swallow function by decreasing subglottic pressure, sensation of airflow and secretions, and airway protection and cough reflex to expel secretions, which could also present as poor cuff deflation tolerance (Suiter et al., 2003). These factors may be eliminated by placement of a Valve after establishing initial cuff deflation and airway patency, improving the patient's overall success and length of cuff deflation tolerance.

Considering Mechanical Ventilation and Benefits of Cuff Deflation

For patients requiring mechanical ventilation, cuff deflation trials may be conducted during ventilator weaning trials. Under the care of a physician and a respiratory therapist, adjustments to the ventilator may be needed to augment or compensate for the leak created by the deflated cuff and to allow more comfortable and efficient breathing. Sutt et al. (2016) provided evidence that with the cuff deflated and a speaking Valve in place, patients receiving mechanical ventilation demonstrated improved diaphragmatic function, increased lung recruitment, and overall faster weaning times.

Clinicians should also consider other benefits of cuff deflation. Early cuff deflation may potentially avoid the negative consequences related to the inflated cuff, such as increased risk of tracheal injury, disuse atrophy of the upper airway, and restricted laryngeal movement, which may negatively affect swallow function (King & Harrell, 2019). Cuff deflation aids in restoring positive airway pressures by returning the patient to a more normal physiology, and it assists in reducing tracheal mucosa damage by allowing the upper airway to filter, warm, and humidify the air. Research also suggests that early cuff deflation may assist in lowering the risk of respiratory infections. The inflated cuff allows for pooling of oropharyngeal secretions, which are colonized with pathogenic bacteria (Marik, 2001). The inflated cuff is not able to form a complete seal against the tracheal wall, and secretions and other material may leak around the cuff into the lower airway, increasing the risk of aspiration and respiratory infection with an inflated cuff (Hernandez, 2013).

Summary

Cuff deflation tolerance is a necessary step towards ventilator weaning and decannulation, but it is also important for achieving multiple benefits when the patient will not be weaning or decannulated. To best serve patients with tracheostomies, clinicians should understand the benefits and risks associated with the tracheostomy cuff and its management, while developing an evidence-based approach to achieving early cuff deflation tolerance.

References:

Bach, J. R., Gonçalves, M. R., Rodriguez, P. L., Saporito, L., & Soares, L. (2014). Cuff deflation: Rehabilitation in critical care. *American Journal of Physical Medicine & Rehabilitation, 93*(8), 719–23. https://doi.org/10.1097/PHM.0000000000000112

Harrell, M. (2018). Tracheostomy tube cuff: Purpose and practice through team management. *Aerodigestive Health*. Retrieved from https://www.passy-muir.com/wp-content/uploads/2019/01/AH_2018_web_lr.pdf

Hernandez, G., Pedrossa, A., Ortiz, R., Accuaroni, M. C., Cuena, R., Collado, C., V., Plaza, S. G., Arenas, P. G., & Fernandez, R. (2013). The effects of increasing effective airway diameter on weaning from mechanical ventilation tracheostomized patients: A randomized controlled trial. *Intensive Care Medicine, 39*(6), 1063-70. https://doi.org/10.1007/s00134-013-2870-7

King, K. & Harrell, M. (2019). Tracheostomy tube cuff considerations: Impact, management, and purpose. *Dysphagia Café*. https://dysphagiacafe.com/2019/10/14/tracheostomy-tube-cuff-considerations-impact-management-and-purpose/

Marik, P. E. (2001). Aspiration pneumonitis and aspiration pneumonia. *New England Journal of Medicine, 344,* 665-671. https://doi.org/10.1056/NEJM200103013440908

Mehta, A. B., Syeda, S. N., Bajpayee, L., Cooke, C. R., Walkey, A. J., & Weiner, R. S. (2015). Trends in tracheostomy for mechanically ventilated patients in the United States, 1993-2012. *American Journal of Respiratory and Critical Care Medicine, 192*(4), 446 – 454. https://doi.org/10.1164/rccm.201502-0239OC

Mitchell, R. B., Hussey, H. M., Setzen, G., Jacobs, I. N., Nussenbaum, B., Dawson, C., Brown, C. A., III, Brandt, C., Deakins, K., Hartnick, C., & Merati, A. (2013). Clinical consensus statement: Tracheostomy care. *Otolaryngology – Head and Neck Surgery, 148*(1), 6-20. https://doi.org/10.1177/0194599812460376

Pryor L. N., Ward. E. C., Cornwell, P. L., O'Connor, S. N., & Chapman, M. J. (2016). Clinical indicators associated with successful tracheostomy cuff deflation. *Australian Critical Care, 29*(3), 132-137. http://dx.doi.org/10.1016/j.aucc.2016.01.002

Speed, L., & Harding, K. E. (2013). Tracheostomy teams reduce total tracheostomy time and increase speaking valve use: A systematic review and meta-analysis. *Journal of Critical Care, 28*(2), 216.e1-10. https://doi.org/10.1016/j.jcrc.2012.05.005

Suiter, D., McCullough, G. H., & Powell, P. W. (2003). Effects of cuff deflation and one-way speaking valve placement on swallow physiology. *Dysphagia, 18,* 284-292. https://doi.org/10.1007/s00455-003-0022-x

Sutt, A. L., Caruana, L. R., Dunster, K. R., Cornwell, P. L., Anstey, C. M. & Fraser, J. F. (2016) Speaking valves in tracheostomised ICU patients weaning off mechanical ventilation – do they facilitate lung recruitment? *Critical Care, 20*(91). https://doi.org/10.1186/s13054-016-1249-x

Cuff deflation aids in restoring positive airway pressures by returning the patient to a more normal physiology.

Article Summary

Diagnostic yield of speaking-valve trials in pediatric tracheostomy patients: identifying previously unrecognized airway pathology.

Henningfeld, J., Sanchez Castillo, A., Shay, S., & Keppel, K. (2026). Diagnostic yield of speaking-valve trials in pediatric tracheostomy patients: Identifying previously unrecognized airway pathology. *American Journal of Respiratory and Critical Care Medicine, 212* (Issue Supplement_1), aamag162.4648, https://academic.oup.com/ajrccm/article/212/Supplement_1/aamag162.4648/8684337

This retrospective study of 259 pediatric patients with tracheostomies aimed to evaluate the diagnostic value of speaking valve trials for detecting hidden airway pathology in pediatric patients with tracheostomies, which goes beyond the traditional use of speaking valves and speaking valve assessments. The researchers found that of the 259 patients reviewed, 107 patients (41.3%) did not demonstrate initial tolerance of the speaking valve. Subsequent endoscopy of all patients revealed previously unrecognized airway pathology in 39.4% of the cohort. Significantly, children who "failed" the speaking valve trial were more likely to have new airway lesions (such as suprastomal granulation or subglottic narrowing) compared to those who passed (42.0% vs. 33.1%; p=0.0088). The authors concluded that speaking valve tolerance provides clinically meaningful diagnostic information and that failure to tolerate a trial serves as a useful screening tool for hidden airway abnormalities, prompting necessary clinical evaluations that inform long-term management and decannulation planning.

PMV® 2001 (Purple Color®)

Measuring Transtracheal Pressure During Passy Muir Valve Application: Impact on Patient Outcomes

Laura Brooks, MEd, CCC-SLP, BCS-S

Introduction

The Passy Muir® Valve (PMV®) is the only bias-closed, no-leak speaking Valve, which means that it is the only Valve that allows for 100% of the exhalation to return through the patient's upper airway when the Valve is placed on a tracheostomy tube hub or in-line in the ventilator circuit. While other speaking valves have a leak and may still allow a patient to vocalize, the design of the Passy Muir Valve has been shown to restore subglottic pressure for glottic or vocal cord closure (Gross et al., 2003; Gross et al., 2006). This restoration of subglottic pressure not only provides benefits to the patient (coughing, swallowing, bearing down, and restoring intrathoracic pressure), but also allows the clinician to gain insight into the pressure within the trachea when the Passy Muir Valve is applied. It is critical to know this measurement, as any obstruction compromising the exhalation may increase the pressure within the trachea, also known as transtracheal pressure (TTP).

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Airway Patency

The airway is separated into the upper and lower airways. The upper airway includes the oral cavity (lips, tongue, jaw, palate), nasopharynx, pharynx, and larynx (glottis). The supraglottis is the area above the vocal cords, the glottis area is the true vocal cords, and the subglottis is the area below the vocal cords. The lower airway includes the trachea and the lungs.

When the PMV is placed on a tracheostomy tube hub or in-line in the ventilator circuit, it can be difficult to determine if the patient adequately exhales, particularly for infants. Stress signs, whoosh after removal, and coughing with placement of the PMV are subjective signs but are often misleading. The clinician needs to ensure airway patency or opening of the trachea before any negative outcomes, such as oxygen desaturation or bradycardia, are associated with poor tolerance. Measuring transtracheal pressure with PMV application is an objective way to ensure that the pressure intended to remain in the airway, the positive end-expiratory pressure (PEEP), remains the same with the use of the PMV. If the airway is not patent and there is some level of obstruction at the level of the tracheostomy tube or above, the patient may not be able to tolerate the speaking valve. Measuring TTP has the following benefits, including, but not limited to (Brooks et al., 2020; Utrarachkij et al., 2005; Young et al., 2024):

1. Ensuring airway patency when applying the PMV and ensuring patient safety.
2. Guiding workup for the causes of high pressures: downsizing the tracheostomy tube if the trache-ostomy tube is too large, repeating DLB [direct laryngoscopy and bronchoscopy] for airway evaluation to assess the presence of unknown upper airway obstruction with a need for intervention.
3. Determining readiness for capping trials.
4. Determining readiness for possible decannulation.
5. Identifying complete tracheostomy tube obstruction or complete mucous plug, prompting urgent tracheostomy tube exchange.

Transtracheal pressure. Transtracheal pressure is the pressure within the trachea at the end of exhalation. For a patent (open) airway without obstruction, when a patient is on the ventilator, the TTP should read close to the set and delivered PEEP. For ventilator-dependent patients, the PMV is placed in-line (in the ventilator circuit) with the manometer to measure airway patency. The adapters may vary depending on the ventilator circuit. (See Image 1 for PMV and manometer placement in-line with mechanical ventilation).

Because the PMV allows the patient to receive support "one-way" during inhalation, the PEEP that was delivered from the ventilator reached the patient's airway with the PMV in-line. Therefore, the intended set PEEP from the ventilator would be close to the pressure measured within the trachea if the airway is patent. If the airway was not patent, the TTP would increase because the patient had been unable to exhale adequately, and the manometer would reflect a number at the end of exhalation that

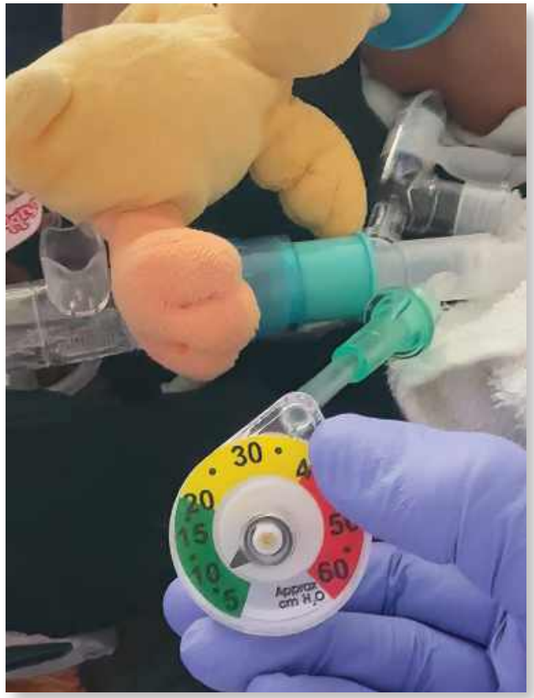

Image 1: Manometer + PMV in the ventilator circuit.

Image 2: Manometer with resting breaths.

Image 3: Manometer with vocalization.

was higher than the intended PEEP. For example, if the PEEP is set at 5 cmH_2O, the measured TTP would be 5 if the airway is patent. If the measured TTP is higher than 5 cmH_2O, then there is some level of obstruction.

Off the ventilator, the pressure at the end of exhalation should ideally read 5 cmH_20 or less. If there was a little resistance, the manometer might read between 0 and 5 cmH_20, and the patient may still comfortably wear the PMV. TTPs that are higher than 5 cmH_20 may indicate some degree of obstruction, as the inability to adequately exhale increases the pressure within the trachea and causes higher TTP readings.

When the PMV is placed on a tracheostomy tube (no ventilator), and the TTP is 0 cmH_20 (the analog manometer needle does not move), the clinician should also test the manometer by asking the patient to cough or vocalize. If the needle moves, this demonstrates that the manometer is working (see Images 2 and 3).

If the clinician needs to obtain the exact pressure measurement, a digital manometer is recommended (see Image 4). This is connected to the adapters in the same way the analog manometer is connected in Image 1.

Image 4: Digital manometer

The benefits of using TTP are illustrated in the following case study.

Case Study

CS is a 21-month-old male who was born at 24 weeks of gestation. His past medical history included severe bronchopulmonary dysplasia (BPD), chronic lung disease (CLD), and tracheostomy with ventilator dependence. He was also briefly admitted for G-tube dislodgement. His LTV ventilator settings were as follows: mode, SIMV, PC/PS; and settings, PIP 18 cmH_20, PEEP 9 cmH_2O, PS +8 cmH_20, and tidal volumes ranged 85-110 ml. His tracheostomy tube

continued next page

was a 4.0 cuffed Bivona inflated with 2 ml of water. He was referred for a PMV trial. The PMV was placed in-line, and his TTP increased with every breath up to 30 cmH_20 after < 30 seconds, so the SLP removed the Valve. He was in a calm state, and his TTP was measured with resting breaths. This indicated likely some upper airway obstruction compromising his ability to exhale with the PMV in-line.

Three months later, he had a direct laryngoscopy and bronchoscopy (DLB) during which the ENT found a completely obstructive suprastomal granuloma, which was then removed. He was seen one month later for a Videofluoroscopic Swallow Study. The pulmonologist agreed to have the SLP retest TTP with the PMV. There was an improvement in TTP to 15 cmH_20 but still higher than his PEEP, indicating some level of obstruction. He could not be cleared for PMV use at that time, but ENT planned to take him back to the OR for a repeat DLB in a few months. PMV trials were ongoing at outpatient pulmonology clinic visits and with SLP visits.

Teaching Points for the Case Study

Vent. LTV ventilator is a home ventilator.

Ventilator settings. Mode of SIMV PC/PS and settings of PIP 18 cmH_20, PEEP of 9 cmH_2O, PS +8 cmH_20, and tidal volumes ranging 85-110 ml. His mode of ventilation was SIMV, pressure control, and pressure support. Synchronized Intermittent Mandatory Ventilation with Pressure Support (SIMV/PS) tends to be a very comfortable mode for patients. The ventilator delivers a predetermined number of breaths per minute, and pressure support can be provided during spontaneous breathing. In pressure control mode, the pressure is set (PIP = 18 cmH_20), and the volume is variable (TV range 85-110 ml). Pressure support is the support that the ventilator provides when the patient takes a breath, and the patient's peak inspiratory pressure (PIP) is the PS value + PEEP value. In his case, a PS of 8 cmH_2O and PEEP of 9 cmH_2O equaled a PIP of 17 cmH_20. Note that his PIP (PS + PEEP) for his spontaneous breaths is close to his set PIP for his ventilator breaths: 17, 18, respectively.

TTP on the ventilator. Should be consistent with the set PEEP if the airway is patent. A discrepancy between his TTP and his PEEP indicated some level of obstruction. This could be due to upper airway obstruction (oral, nasal, pharyngeal, laryngeal) or at the level of the tracheostomy tube. The ENT would consider downsizing if the DLB did not reveal any other upper airway obstruction. In his case, his ENT planned to take him back to the OR for a DLB in a few months.

When considering the use of TTP to evaluate airway patency, the TTP measurement ranges, for both on and off the ventilator, provide an indication of how patent the airway is. This patency may impact considerations for use of the PMV. The following tables provide an overview of the TTP measurements ranges:

If the patient is ON a ventilator

Likely to pass: Resting TTP ≤ 10 cmH_2O (consistent with PEEP delivered).	TTP 10-14 borderline – may tolerate PMV but will be patient specific.	TTP 15-20 likely to be too high but patient specific.	Likely to fail: resting TTP > 20 cmH_20.
Action: Proceed with PMV trial.	• Start with SLP as tolerating. • Closely monitor for work of breathing or stress signs.	• Strict monitoring by SLP • Closely monitor for work of breathing or stess signs. • May need cuffless tracheostomy tube or downsizing of tracheostomy tube.	• Review possible confounding effects, such as obstruction, large tracheostomy tube, and more. • Consider contacting ENT. • Next steps may include assessment of upper airway, downsizing tracheostomy tube.

If the patient is OFF the ventilator

Likely to pass: Resting TTP ≤ 5 cmH_2O	TTP 5-10 borderline – may tolerate PMV but will be patient specific.	TTP 10-15 likely to be too high but patient specific.	Likely to fail: resting TTP > 15 cmH_20.
Action: Proceed with PMV trial.	• Start with SLP as tolerated. • Closely monitor for work of breathing or stress signs.	• Strict monitoring by SLP • Closely monitor for work of breathing or stess signs. • Contact ENT. Next steps may include assessment of upper airway (DLB), downsizing tracheostomy tube, or changing to cuffless tracheostomy tube.	• Review possible confounding effect, obstruction, large tracheostomy tube. • Contact ENT. • Next steps may include assessment of upper airway, downsizing tracheostomy tube, or changing to cuffless tracheostomy tube.

Summary

Using TTP provides an objective measure to ensure that airway patency is sufficient for PMV use. When considering the needs of patients with tracheostomies, the PMV restores a more normal closed system, which allows for airflow through the upper airway and may impact vocalizations, feeding and swallowing, trunk support, and more. The case study illustrated the benefits of objectively measuring transtracheal pressure to ensure airway patency for tracheostomy-dependent patients on and off the ventilator. Measuring TTP when using the PMV has the potential to positively impact patient outcomes and safety.

Children's Healthcare of Atlanta Institutional Review Board approved this project, IRB number STUDY00002271.

References:

Brooks, L., Figueroa, J., Edwards, T., Reeder, W., McBrayer, S., & Landry, A. (2020). Passy Muir valve tolerance in medically complex infants and children: Are there predictors for success? *The Laryngoscope, 130*(11), E632-E639.

Gross, R., Mahlmann, J., & Grayhack, J. P. (2003). Physiologic effects of open and closed tracheostomy tubes on the pharyngeal swallow. *Annals of Otology, Rhinology & Laryngology, 112*(2), 143-152. https://doi.org/10.1177/000348940311200207

Gross, R., Steinhauer, K., Zajac, D., & Weissler, M. (2006). Direct measurement of subglottic air pressure while swallowing. *The Laryngoscope, 116*(5), 753-761. https://doi.org/10.1097/01.mlg.0000205168.39446.12

Utrarachkij, J., Pongsasnongkul, J., Preutthipan, A., & Chantarojanasri, T. (2005). Measurement of end-expiratory pressure as an indicator of airway patency above tracheostomy in children. *Journal of Medical Association of Thailand, 88*(7), 928-933.

Young, A., Walsh, K., Ida, J., Thompson, D. M., & Hazkani, I. (2024). Transtracheal pressure for evaluation of decannulation readiness. *The Laryngoscope, 134*(7), 3377-3383. https://doi.org/10.1002/lary.31280

PMV® Placement in Tracheostomy Patients: Clinical Considerations and Benefits

Gabriela Ortiz, BSRT, RCP

The number of patients requiring tracheostomies has increased in recent years, with more being discharged to long-term care facilities before weaning and decannulation. As a result, clinicians across a wide range of healthcare settings are increasingly involved in their care. A key component of tracheostomy management is maintaining airway patency and supporting communication and rehabilitation throughout the weaning process. Patients with tracheostomies who are unable to communicate are at increased risk for psychological distress, including depression and post-traumatic stress disorder (Freeman -Sanderson et al., 2016). For patients in the intensive care unit (ICU), step-down units, sub-acute care, and homecare settings, restoration of verbal communication is an important component of rehabilitation and quality of life. One intervention that can facilitate communication is the use of a speaking valve.

The Passy Muir® Valve (PMV) is a bias-closed, no-leak speaking Valve, designed for use on and off mechanical ventilation. The Valve opens during active inspiration and closes at the end of inspiration, redirecting exhaled airflow through the upper airway. By re-establishing physiologic airflow through the nose and mouth, the Valve helps return the aerodigestive tract to a more normal physiological state. In addition to enabling speech, restoration of upper airway airflow, sensation, and positive airway pressure may contribute to other important clinical benefits for patients with tracheostomies, including improvements in swallowing, secretion management, cough effectiveness, and overall airway protection.

The PMV can be used with both pediatric and adult patients; however, its use is often delayed due to concerns regarding patient candidacy. It is common for the use of speaking valves in the ICU to be delayed due to the perception that patients are “too sick” to participate. However, emerging literature suggests that this conservative, hands-off approach may contribute to further functional decline, whereas early intervention may minimize or potentially reverse these effects (Burkhead, 2011). Early intervention may help reduce functional decline and enhance rehabilitation outcomes. Successful speaking Valve placement typically involves collaboration between a speech-language pathologist (SLP) and a respiratory therapist (RT) to assess readiness and optimize airway management. In a 2024 study, Huang et al. found that when hospitals implement structured protocols for patient selection and readiness assessment, the occurrence of speaking valve trials increased from 75% to 95%, including an improvement in first attempt success from 60% to 75%. These findings underscore the importance of clear protocols and interdisciplinary teamwork in facilitating safety, early rehabilitation, and communication for patients with tracheostomies.

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Who is a good candidate for Valve placement?

From a clinical standpoint, the timing of PMV placement is often cited as a barrier to implementation. Traditional recommendations suggest that Valve placement may be considered 48-72 hours following a surgical tracheostomy, once the patient is medically stable and appropriate airway criteria are met. However, emerging evidence and clinical practice demonstrate that earlier Valve use may be feasible and safe in select patients with percutaneous tracheostomies. Martin et al. (2021) investigated earlier use and reported on successful placement in less than 24 hours post-tracheotomy. Their findings also indicated that Valve candidacy should be based on physiologic readiness and interdisciplinary assessment, rather than a fixed time-based threshold alone.

Early intervention may help reduce functional decline and enhance rehabilitation outcomes.

General Clinical Approach to Valve Placement

1. Verify patient readiness and eligibility

Assessment and placement of the Valve requires a physician’s order; therefore, confirm which clinician is responsible for allocating the order. Before placement, confirm that the patient meets basic physiologic criteria, including:

- Hemodynamic stability
- Adequate level of alertness to tolerate intervention
- Manageable secretions
- Deflated tracheostomy cuff (for cuffed tubes)
- Patent upper airway (no significant obstruction suspected)

Interdisciplinary input from the tracheostomy team is strongly recommended during this stage.

2. If the patient has a cuffed tracheostomy tube, ensure that cuff deflation can be pursued

- Fully deflate the tracheostomy tube cuff prior to Valve use, being sure that all residual air has been removed from the cuff pilot line and balloon.
- Confirm the patient can exhale around the tracheostomy tube via the upper airway.

3. Suction the airway as needed

- Perform tracheal and oral suctioning prior to cuff deflation and before placement of the Valve to optimize airway patency and secretion control.

4. Airway Patency Assessment

Once the cuff is completely deflated:

- Evaluate airflow movement to the upper airway by observing the patient during coughing, throat clearing, counting, voicing, or blowing.
- Use finger occlusion on the tracheostomy tube hub or by auscultating with a stethoscope for exhaled airflow through the upper airway.

5. Place the Valve if airway patency is confirmed

- Which Valve to use is determined by the clinical staff, supply, and patient choice, as all Valves function the same way.
- Place the Valve lightly on the hub of the tracheostomy tube, with a quarter twist to the right. Secondary to a friction fit, the Valve will only go on as far as appropriate. Do not push or force the Valve onto the tracheostomy tube hub.

6. Observe initial use closely

Monitor the patient continuously for:

- Work of breathing
- Oxygen saturation
- Respiratory rate and pattern
- Ability to phonate
- Signs of distress (e.g., increased WOB, anxiety, desaturation)

7. Gradual trial period

- Begin with short-duration trials.
- Gradually increase wear times as tolerated.
- Remove the Valve if the patient shows signs and experiences symptoms of distress.

8. Ongoing assessment and adjustment

- Reassess secretion management, airway patency, and use throughout the Valve trial.
- Adjust timing and duration based on patient response.
- Continue collaboration between SLP and RT for optimization.

PMV placement should never be performed without full cuff deflation in cuffed tracheostomy tubes, as this can prevent exhalation through the upper airway and result in life-threatening air trapping.

Rehabilitation Programs

Individualized rehabilitation programs can be developed based on each patient’s level of function and medical status. Therapeutic interventions often require modification to accommodate the patient’s endurance, cognitive status, secretion burden, and overall tolerance.

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One-way Valve use has long been utilized to restore airflow through the upper airway and facilitate verbal communication in patients with tracheostomies. However, clinicians should also consider the broader physiologic benefits associated with restoration of upper airway function. Re-establishing expiratory airflow through the upper airway may help generate more physiologic positive airway pressure, thereby supporting alveolar recruitment and potentially improving oxygenation.

Ambulation and exercise performed with PMV in place have been found to be safe and beneficial. Research findings have indicated that Valve use is associated with improved lung recruitment and greater participation in rehabilitation activities (Churchill et al., 2025; Sutt et al., 2015; Massery, 2014).

The Valve may also function as a transitional step toward decannulation in patients who do not initially tolerate tracheostomy tube capping, allowing gradual acclimation to upper airway airflow and respiratory demands prior to capping trials.

Conclusion

Early restoration of airflow with Passy Muir Valve use represents more than a communication intervention; it is a rehabilitative strategy that may positively influence safe swallowing, respiratory mechanics, mobility, overall aerodigestive function, and quality of life. As evidence supporting early intervention continues to grow, interdisciplinary teams should consider speaking Valve assessment and upper airway rehabilitation as integral components of comprehensive tracheostomy care.

References:

Burkhead, L. (2011). Swallowing evaluation and ventilator dependency – Considerations and contemporary approaches. *Perspectives: SIG 13, 20*,18.

Churchill, L., Caruana, I., White, N., Fraser, J. F., Mandrusiak, A., Paratz, J., Sutt, A., Thomas, P. J., Verner-Wren, S., & Tronstad, O. (2025). Exercise in patients with a tracheostomy and speaking valve: a randomized crossover-controlled trial. *Critical Care, 29*,368. https://doi.org/10.1186/s13054-025-05621-2

Huang, V. W., DeVore, E. K., Kaul, S., Parikh, M., Hayes, M. M., & Teng, S. E. (2025). Valves for the voiceless: Time to speaking valve use in post tracheostomy patients after multidisciplinary initiative. *Otolaryngology, Head and Neck Surgery, 172*(2), 710-716. https://doi.org/10.1002/ohn.1016

Freeman-Sanderson, A. L., Togher, L., Elkins, M. R., & Phipps, P. R. (2016). Return of voice for ventilated tracheostomy patients in ICU: A randomized controlled trial of early-targeted intervention. *Critical Care Medicine, 44*(6), 1075-81. https://doi.org/10.1097/CCM.0000000000001610

Martin, K. A., Cole, T.D.K., Percha, C. M., Asanuma, N., Mattare, K., Hager, D. N., Brenner, M.J., & Pandian, V. (2021). Standard versus accelerated speaking valve placement after percutaneous tracheostomy: A randomized controlled feasibility study. *Annals of the American Thoracic Society, 18* (10). https://doi.org/10.1513/annalsats.202010-1282oc

Massery, M. (2014). Expert Interview: The Role of the Passy-Muir Valve in Physical Therapy. *Talk Muir* (3 Feb. 2014), 2-4.

Sutt, A., Caruana, L. R., Dunster, K. R., Cornwell, P. L., & Fraser, J. F. (2015). Improved lung recruitment and diaphragm mobility with an in-line speaking valve in tracheostomised mechanically ventilated patients– An observational study. *Australian Critical Care, 28*(1), 45. https://doi.org/10.1016/j.aucc.2014.10.021

Article Summary

Ventilation distribution and temporal heterogeneity introduced by speaking valves in prolonged tracheostomy's patients weaned from mechanical ventilation.

Zhang, B., Li, Q., Li, M., Wang, H., Wang, J., Shen, J., Liu, Q., Deng, J., Zhao, Z., & Jiang, H. (2025). Ventilation distribution and temporal heterogeneity introduced by speaking valves in prolonged tracheostomy's patients weaned from mechanical ventilation. *Lancet,* https://dx.doi.org/10.2139/ssrn.5191143

This study investigated 102 patients with tracheostomies who had been weaned from mechanical ventilation for at least 48 hours. The authors aimed to investigate the impact of speaking valves (SVs) on ventilation distribution and respiratory effort when not on mechanical ventilation. Electrical impedance tomography (EIT) was used to assess regional ventilation at three time points: baseline, 3.5 hours into SV use, and 10 minutes after SV removal. The study demonstrated that SV activated patients' respiratory muscles by increasing the ventilation distribution in the dorsal regions of the lungs and introducing temporal heterogeneity between the ventral and dorsal regions. The findings revealed that the application of SVs may increase inspiratory airflow resistance and work of breathing by restoring PEEP (post-end expiratory pressure), which requires the diaphragm to overcome more resistance to drive the breathing process, expand the chest volume, and increase lung volume, which promotes lung recruitment and ventilation.

Passy Muir®

Patient Troubleshooting Guide

PROBLEM	TIPS & TROUBLESHOOTING
Excessive coughing:	1. If a cuff is present, use slow cuff deflation. 2. Clear secretions orally or suction again. 3. Remove Valve and check for complete cuff deflation. 4. Check tracheostomy tube alignment and body positioning. 5. Check with your physician to: a. Consider tracheostomy downsize or different tracheostomy tube type. b. If coughing persists, see your physician and consider ENT consult.
Honking noise with Valve use:	1. Clean the Valve according to manufacturer's instructions. 2. If no improvement, check with your speech therapist: a. On how to breathe with the Valve, b. To work on controlled exhalations, c. To address respiratory support for breathing and speech, d. For relaxation techniques, or e. Try other methods to normalize respirations. 3. Intermittent honking may require an ENT evaluation your airway. 4. If honking occurs after extended use of the Valve and cleaning does not work, consider replacing the Valve.
Limited or strained voicing, with decreased airflow through the upper airway:	1. Remove the Valve. 2. If a cuff is present, ensure cuff is completely deflated. 3. Check tracheostomy tube alignment and body positioning. 4. Suction again, if needed. 5. See your physician for evaluation and consider ENT consult.
Weak cough or voicing, with good airflow through the upper airway:	1. Check that your position is upright and straight, if possible, for good breath support. 2. Assure the position of the tracheostomy tube is correct. 3. Speak with your speech-language pathologist about the possibility of respiratory muscle strength training (RMST) to improve breath support. 4. Consult with your speech-language pathologist for assessment. 5. Speak with your physician and consider ENT consult for assessment.
Air leak around stoma during Valve use:	1. Speak with your physician or respiratory therapist about options for occluding the stoma leak. 2. Ask if a silicone stoma pad or a hydrophilic dressing would be appropriate.
Good airway patency, but difficulty saturating:	1. See your physician immediately and ask about: a. Low flow supplemental oxygen. 2. Ask your respiratory therapist or speech-language pathologist about breathing techniques to increase deep breathing and coordination of respiration and speech with appropriate pausing.
Back pressure (air escapes in a whoosh when removing the Valve) occurs with Valve removal:	1. Stop Valve use and see your physician prior to using the Valve again. 2. Causes of back pressure to consider: a. Poor airway patency. b. Increased secretions. c. Anxiety, stress, or tension. d. Swelling, infection, or medical status change.

For detailed instructions, warnings and contraindications, please refer to the Instructions for Use booklet.

Assessment Considerations for PMV® Candidacy in the Pediatric Population

Jessica Shaw, MS, CCC-SLP

Premature birth is defined as birth before 37 weeks gestation and is the leading cause of death in babies in the United States. According to the March of Dimes, for the first time in eight years, the preterm birth rate in United States has increased to 9.63% as reported by the National Center for Health Statistics (NCHS) (2016 Premature Birth Report Card, 2016). These premature infants often face health issues such as respiratory complications, jaundice, retinopathy of prematurity, developmental delays, and gastrointestinal complications, among others. The National Academy of Medicine reports that preterm birth costs $26 billion dollars annually. Due to advances in medical technology and scientific innovation, more micro-preemies, those born at less than 26 weeks gestation or less than 800g, and those with congenital abnormalities are surviving, but not without frequently facing prolonged medical challenges.

Due to the underdevelopment of the respiratory system and risk for development of Bronchopulmonary Dysplasia (BPD), respiratory support via mechanical ventilation is imperative for children who survive early birth. Bronchopulmonary Dysplasia is a form of chronic lung disease that can develop in preterm infants who have been treated with oxygen or positive pressure ventilation. Symptoms of BPD include tachypnea (increased respiratory rate), tachycardia (increased heart rate), frequent desaturations, and increased respiratory effort. Increased respiratory effort may be evidenced by any of the following: retractions, grunting, or nasal flaring. This is despite the introduction of surfactant therapy and increased use of noninvasive positive pressure ventilation (Overman et al., 2013). Many of these infants will require tracheostomy placement due to the need for prolonged mechanical ventilation or the presence of upper airway abnormalities which prohibit successful extubation. Supportive research has stated that early tracheostomy has reduced the occurrence of associated subglottic and tracheal stenosis for children who have had prolonged intubation (Overman et al., 2013).

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Impact of a Tracheostomy

Tracheostomy is the outcome of the tracheotomy procedure that creates an artificial airway in the trachea and redirects airflow, bypassing the patient's upper airway. This procedure is performed by a pediatric surgeon or otolaryngologist. One method for this procedure is to have a vertical or horizontal incision made below the level of the vocal folds over the 3rd-4th cartilage ring (Alladi et al., 2004), creating a stoma wherein a tracheostomy tube is placed to create the artificial airway. Indications for tracheostomy placement include the need for long-term mechanical ventilation, upper airway obstruction, poor pulmonary hygiene, and poor secretion management (Abraham, 2003). When looking at the reasons for tracheostomy in 184 infants, 78.8% of those born at extremely low birth weight had more than one reason for tracheostomy placement, including diagnoses such as bronchopulmonary dysplasia, congenital heart defect, subglottic stenosis, respiratory failure, and laryngeal ortracheomalacia (Overman et al., 2013). While tracheostomy placement is often lifesaving, the placement of tracheostomy is not without secondary complications.

Documented complications of tracheostomy placement include tracheal infections, accidental decannulation, obstruction, reduced or absent airway protection, reduced secretion management, swallowing deficits, and reduced ability to produce voice (Abraham, 2003). In children who undergo tracheostomy prior to the development of speech during infancy or early childhood, the development of oral communication and verbal interaction with their environment may be delayed. Use of a Passy Muir® Tracheostomy and Ventilator Speaking and Swallowing Valve (PMV) can aid in the ability to restore airflow through the upper airway, which would allow a child to produce a cry or voicing and normalize aspects of language development.

Additionally, the use of the PMV has been documented to improve secretion management, aid in weaning of respiratory support, and improve airway protection responses in both adults and children due to the restoration of upper airway sensation (Sutt et al., 2015; Blumenfeld et al., 2011). It has been stated that use of PMV in appropriate candidates less than two years of age has resulted in more normal acquisition of vocal exploration and speech development (Engleman & Turnage-Carrier, 1997; Jiang & Morrison, 2003). Considering the positive outcome with PMV use, clinicians working with the pediatric population with tracheostomies should aim to establish PMV use as soon as medically and clinically appropriate.

Assessment For Passy Muir Valve Use In Children

Assessment for PMV use in children can create additional challenges for the clinician when compared to evaluation for use in adults. Children, specifically infants and those under the age of two years or those with developmental delays, are not able to voice on command which would typically be a method used with older children or adults during assessment of upper airway patency. When initially assessing with digital occlusion, voicing or attempting to voice is generally used to look for an ability to pass air around the tracheostomy tube and up through the vocal cords. Very young children also cannot articulate feelings of discomfort during PMV trials. Furthermore, in young children who have had a tracheostomy for the majority of their life, they may not be able to complete a more normalized exhalation process and may not be able to coordinate exhalation with phonation. Because volitional voicing may not be possible with infants and young children, other considerations must be used during assessment and treatment. A clinician may have to target this coordination with therapeutic interventions until true voicing can be heard. This is different when compared to an older child or an adult patient with a tracheostomy who has had prior experience of vocalizing and speaking without the presence of the artificial airway.

Clinical Assessment Considerations

When moving toward assessment of the nonverbal or young child, the first step is to complete a thorough review of their medical history and discuss it with the child's medical team to rule out any contraindications for PMV use. Contraindications for PMV use may include severe subglottic stenosis, severe tracheomalacia, tracheal edema, bilateral vocal fold paralysis in the adducted position, severely reduced lung compliance, or the presence of an inflated cuff or foam-filled cuff tracheostomy tube.

Due to the small size of the pediatric trachea, there is a greater risk of airway obstruction. The airway diameter in infants less than six months of age is approximately 4 mm and grows to 8-11 mm by the time a child is approximately 10 years of age. Considering this small tracheal size, even slight congenital or inflammatory obstruction can lead to increased risk of airway obstruction (Alladi et al., 2004). Therefore, the proper sizing of the diameter of the tracheostomy tube in relation to the size of the child's airway is crucial to adequate airflow through the upper airway and for successful usage of a PMV.

In the pediatric population, both pediatric and neonatal tracheostomy tubes may be used. The difference between the two is length, with the pediatric tube being longer than the neonatal tube but the inner diameter remaining the same. It is the inner diameter of the tracheostomy tube that is often described when the question is asked, "what size tracheostomy tube do they have?" Throughout the time that a child may remain tracheostomized, the size and length of the tracheostomy tube requires modification to accommodate changes in airway due to growth or respiratory support needs. A pediatric otolaryngologist can assess the airway and tracheostomy by direct laryngoscopy to determine appropriate size and length. Because of these potential changes, the clinician must continually monitor and evaluate the needs of the child.

Another variable to consider that affects the tracheostomy and potential obstruction in a child's trachea is the presence or absence of a cuff. Placement of the PMV requires full deflation of the cuff, yet having the added circumference of the deflated cuff material present can reduce airflow and affect the ability to use the Valve. When working as part of an interdisciplinary team, it is beneficial to attempt to transition a child to a cuffless trach as soon as medically appropriate, to reduce its impact on the child's transition to Valve use.

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Airway Assessment: Digital Occlusion

Successful use of the PMV is directly related to the amount of air that will flow around the tracheostomy tube and up through the larynx, nose, and mouth. Variables affecting this airflow include tracheostomy tube size in relation to patient's tracheal diameter, as well as the presence or absence of any anatomical or structural narrowing (i.e. subglottic stenosis). One way that assessment of airway patency can be completed is via bronchoscopy; however, this is an invasive procedure that is unable to be conducted in a wide variety of environments and involves many disciplines (Utrarachkij et al., 2005).

Current standard practice for bedside evaluation of PMV candidacy in pediatrics is to assess upper airway patency via digital occlusion of the tracheal hub. The clinician occludes the hub by lightly placing a gloved fingertip over the end of the trach tube hub. After digital occlusion and with close clinical monitoring, the clinician then waits to hear voicing or listens for upper airway breath sound, via stethoscope, or by assessing for airflow out through the nose and mouth (e.g. use of a mirror under the nose to look for fogging). While these assessment measures will demonstrate a clinical measure of airflow, it does not give information to the clinician regarding the amount of exhaled air that is moving up and out through the mouth and nose. Use of spirometry has been documented as an objective measure of upper airway patency; however, the use of spirometry continues to depend on the child's ability to follow commands and coordinate breathing into the spirometer, which can be difficult for some younger or developmentally disabled patients (Utrarachkij et al., 2005). The added medical complexity and cognitive limitations of this younger population may make identification of successful and unsuccessful PMV trials difficult to distinguish from each other.

Prior to placement of the PMV, the clinician should note the baseline measurements for the infant or child. These would include heart rate, respiratory rate, and oxygen saturations. The clinician also should acquire a good indication of skin color and respiratory pattern through observation. Once baseline measurements are obtained, one indicator of successful PMV use is with observed adequate voicing. With an infant or young child this may include crying, cooing, babbling, or any other vocalizations. Moreover, the child should be comfortable, without changes in respiratory pattern or increased respiratory effort.

Utilization of the PMV is often seen as the first step towards removal of the tracheostomy in a patient who is deemed a candidate for eventual decannulation by their medical team.

During this time, the clinician should not only be monitoring for impact on respiratory function but should be observing the overall state of the child and monitor for changes in physiological or autonomic indicators such as heart rate, oxygen saturation, and respiratory rate. Furthermore, clinical observations should be taken in relation to the child's coloring, looking for signs of perioral cyanosis and other indicators of decompensation (becoming flushed, sweating, etc.)

Utilization of the PMV is often seen as the first step towards removal of the tracheostomy in a patient who is deemed a candidate for eventual decannulation by their medical team. When a patient achieves wearing the PMV for all waking hours and is on a weaning protocol, the next step is capping of the tracheostomy tube. During capping trials, a solid cover is placed on the tracheostomy hub which completely closes off the tracheostomy and normalizes the use of patient's upper airway. As part of the medical team, the clinician will assess tolerance of tracheostomy by capping, utilizing a similar protocol as for the PMV assessment. Once a patient is wearing a cap during all waking hours, the patient may then be referred to their otolaryngologist or pulmonologist for consideration for decannulation. In some facilities, this may involve repeat bronchoscopy or an overnight sleep study to assess respiratory readiness for decannulation.

Airway Assessment: Transtracheal Pressure Measurement

As we move towards more objective and data driven clinical practice, the question is asked: how can we more instrumentally and objectively assess the status of a child's upper airway when they are non-verbal at the time of evaluation? There is documentation in the literature to support the use of end expiratory pressure (EEP) or transtracheal pressure (TTP) during passive exhalation to non-invasively assess upper airway patency as part of the assessment procedures in the pediatric patient for PMV use (Utrarachkij, et al., 2005). This is accomplished using a manometer attached to the PMV via connection tubing and a Washington Tee adapter, or similar adapter that is then placed onto the tracheal hub. The manometer provides a reading of pressure at the level of the tracheostomy at the end of the exhalation. Research has shown a positive relationship between children who demonstrate a clinical inability to wear the PMV as judged by change in heart rate, oxygen saturation, report of respiratory difficulties (chest tightness or coughing), or abnormal breathing patterns during a five minute PMV trial and higher TTP measurements of greater than 10 cmH_2O (Utrarachkij et al., 2005). Furthermore, TTP of < 6 cmH_2O was associated with observed clinical tolerance and easier transition of children to PMV wearing schedules (Buckland et al. 2012; Abraham, 1997, 1995). Research has shown that TTP up to 10 cmH_2O is consistent with successful PMV wearing (Buckland et al., 2012). It is important to note that these TTP measures are to be completed during passive exhalation, such as resting breaths; coughing and other more forceful exhalations will result in increased numbers in TTP and will skew the readings. These measurements also must be taken when a child is calm and quiet, as play and other activities may increase the numbers. Therefore, when air is purposefully expelled with increased force in order to produce voice, in an attempt to clear the airway, or increased due to play or other activities, the manometer pressure reading is not accurate.

Behavioral Factors

An additional factor in PMV usage in children is a behavioral response to the placement of the PMV during assessment and ongoing trials. Children who have undergone tracheotomy at a very early age are often hypersensitive to the feeling of upper airflow through their nose and mouth. For infants and many young children, this may be something that they have not experienced in their lifetime. Due to this lack of experience, children may demonstrate various clinical presentations that appear as respiratory difficulties but require behavioral adjustments. A child may exhibit blowing off the PMV or breath holding, which otherwise may be interpreted as clinical intolerance. The difficulty a clinician faces is determining if these observed symptoms are behavioral or due to reduced upper airway patency or airflow. The presentation of the two may look very similar to the naked eye of the clinician. Monitoring TTP can help determine the etiology of the observed behaviors; whereas, if the TTP is < 6 cmH_2O then research has shown it is less likely that the clinical presentation is due to a structural or anatomical issue.

If it is determined to be behavioral in nature, clinicians working with a pediatric population should engage the child in some desensitization and use distraction or play therapy during PMV trials. Often with young children, the clinician will institute these techniques prior to the initial assessment in order to set the child up for success. By doing so, the clinician may elicit a period of time that a child can demonstrate passive exhalations while wearing the PMV by helping the child become more comfortable and relaxed during the assessment. As previously discussed, transtracheal pressures are most accurately and reliably measured during passive exhalation. By achieving adequate and accurate TTP measurements, the clinician will have a better clinical assessment for use of the PMV.

Troubleshooting

If a child demonstrates elevated TTP, further assessment completed by a physician and the clinical team to evaluate airway management may assist with improving upper airway patency and use of the PMV. Elevated TTP, in conjunction with laryngoscopy demonstrating poor tracheal lumen fit (tracheostomy tube size within the diameter of the trachea), provides sufficient clinical information to support the need for a change in tracheostomy tube size. Changing the tracheostomy tube size may allow for improved upper airflow in those children without identified structural or anatomical etiology. Reducing the outer diameter of the tracheostomy tube and increasing the space in the tracheal lumen can improve airflow through the upper airway. This, in turn, can improve use of the PMV and improve clinical tolerance for wearing the Valve secondary to the increased room surrounding the cannula for airflow to move around the tracheostomy tube and into the upper airway.

Post-Assessment

After assessment of the pediatric patient is completed, if a child demonstrates clinical tolerance of the Valve as evidenced by all physiologic parameters remaining stable and TTP pressure of no greater than 10 cm H_2O during passive exhalations, the patient should be started on a wearing schedule based on their behavioral tolerance. This wearing schedule should be advanced until the child reaches the goal of wearing their PMV during all waking hours. During the advancement of the PMV schedule, these children are participating in speech and language therapy with the clinician. Goals of therapy are often focused

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on advancing language skills, improving functional vocalizations, or cognitive therapy, based on the child's current and premorbid functioning. Additionally, while research has mixed data on the effects of reducing laryngeal penetration or aspiration in children with tracheostomies (Ongkasuwan et al., 2014), due to the restoration of upper airflow and improved airway protection via improved cough that is linked to PMV placement (Suiter et al., 2003), clinicians may consider addressing PMV placement prior to initiating therapeutic feeding goals.

If initial assessment does not indicate that a child is a candidate for Valve use at the time of evaluation, the reason for the difficulty should be considered. If it is due to change in any physiologic parameters previously mentioned or the TTP is consistently above 10 cmH_2O, then the medical team must further assess the options. Another consideration is to monitor for increasing TTP with each exhalation. Changes in physiologic parameters or TTP being high may involve a referral to a pediatric otolaryngologist to assess the airway for any signs of stenosis or narrowing and for consideration for reduction in the size of the tracheostomy tube.

Summary

Pediatric tracheostomy placement is occurring with greater incidence due to the advancements in medical interventions and the increased survival rate of infants who are premature and those with congenital abnormalities. Long term tracheostomy placement has been associated with delayed acquisition of language and social development (Cowell et al., 2013). Additionally, long term tracheostomy can impact parent-child bonding and the ability of the child's family to know their wants and needs due to the communication impairment (Lieu et al., 1999). Assessment and usage of PMV is important for the normalization and development of the social and language development of these children and can be seen as a first step towards decannulation. Due to the limited volitional participation of infants and young children, the clinical assessment of pediatric use of the PMV presents with specific challenges that are unlike those observed in the adult population. Airway patency is directly related to the successful wearing of a PMV but is difficult to assess objectively through clinical judgement alone. The use of transtracheal pressure monitoring through manometry is a great asset to the evaluation for PMV use in the pediatric population.

References:

2016 Premature Birth Report Card. (2016). March of Dimes Foundation. Retrieved from: http://www.marchofdimes.org/materials/premature-birth-report-card-united-states.pdf

Abraham, S. (1997). Little tikes with trachs + Passy Muir: Airway safety secretions and swallow. [Abstract]. *ASHA, 39*(10), 179.

Abraham, S. (2003). Babies with tracheostomies. *The ASHA Leader, 8*, 4-26 Retrieved from http://leader.pubs.asha.org/article.aspx?articleid=2341211 doi:10.1044/leader.FTR2.08052003.4

Abraham, S. and Gereau, S. (1995). Tracheostomized pediatric patients + Passy Muir: Protocol for candidacy. [Abstract] *ASHA, 37*(10), 7.

Alladi, A., Rao, S., Das, K., Charles, A. R., and D'Cruz, A. J. (2003). Pediatric tracheostomy: a 13-year experience. *Pediatric Surgery International, 20*(9), 695-698. doi: 10.1007/s00383-004-1277-5

Barraza, G., Halaby, C., Islam, S., Gutekunst, W., Simpser, E., and Pirzada, M. (2014). Safety of Passy-Muir tracheostomy valve in pediatric patients during sleep: A pilot study. *American Journal of Otolaryngology, 35*, 636-640.

Blumenfield, L., Salgado, M., Wade, K., Dhupa, A., Ling, E., and Belafsky, P. (2011). The effects of tracheostomy valve use on disordered swallowing. DRS Poster presentation.

Brigger, M. T., and Hartnick, C. J. (2009). Drilling valves: A modification to improve vocalization in tracheostomy dependent children. *The Laryngoscope, 119*(1), 176 -179. doi:10.1002/lary.20077

Buckland, A., Jackson, L., Ilich, T., Lipscombe, J., Jones, G., and Vijayasekaran, S. (2012). Drilling valves to promote phonation in tracheostomy-dependent children. *The Laryngoscope, 122*(10), 2316-2322. doi:10.1002/lary.23436

Buswell, C., Powell, J., and Powell, S. (2016). Paediatric tracheostomy valves: Our experience of forty-two children with an adapted Passy-Muir Valve. *Clinical Otolaryngology, 42*(4), 941-944. doi:10.1111/coa.12776

Donzelli, J., Brady, S., Kaszuba, S., and Wesling, M. (2008). S189- Tracheotomy tube occlusion status and swallowing function. *Otolaryngology - Head and Neck Surgery, 139*(2). doi:10.1016/j.otohns.2008.05.363

Engleman, S. G., and Turnage-Carrier, C. (1997). Tolerance of the Passy-Muir Valve(™) in infants and children less than 2 years of age. *Pediatric Nursing, 23*(6), 571-573.

Jiang, D. and Morrison, G .A. (2003). The influence of long-term tracheostomy on speech and language development in children. *International Journal of Pediatric Otorhinolaryngology, 67*, Suppl 1: S217-20.

Lieu, J. E., Muntz, H. R., Prater, D., and Stahl, M. B. (1999). Passy-Muir valve in children with tracheotomy. *International Journal of Pediatric Otorhinolaryngology, 50*(3), 197-203. doi:10.1016/s0165-5876(99)00245-1

Ongkasuwan, J., Turk, C. L., Rappazzo, C. A., Lavergne, K. A., Smith, E. O., and Friedman, E. M. (2013). The effect of a valve on laryngeal aspiration and penetration in children with tracheotomies. *The Laryngoscope, 124*(6), 1469-1474. doi:10.1002/lary.24457

Overman, A. E., Liu, M., Kurachek, S. C., Shreve, M. R., Maynard, R. C., Mammel, M. C., and Moore, B. M. (2013). Tracheostomy for infants requiring prolonged mechanical ventilation: 10 years' experience. *Pediatrics, 131*(5). doi:10.1542/peds.2012-1943

Passy Muir Resource Guide - The Passy-Muir® Valve. (n.d.). Retrieved February 11, 2017, from http://www.passy-muir.com/sites/default/files/pdf/resource_guide.pdf

Suiter, D. M., McCullough, G. H., and Powell, P. W. (2003). Effects of cuff deflation and one-way tracheostomy valve placement on swallow physiology. *Dysphagia, 18*, 231-234.

Sutt, A., Caruana, L. R., Dunster, K. R., Cornwell, P.L., and Fraser, J. F. (2015). Improved lung recruitment and diaphragm mobility with an in-line valve in tracheostomised mechanically ventilated patients–An observational study. *Australian Critical Care, 28*(1), 45. doi:10.1016/j.aucc.2014.10.021

Use of Passy-Muir Valve in a non-ventilated patient. (n.d.). Retrieved from http://www.pmh.health.wa.gov.au/services/speech_path/brochures/guideline_development.pdf

Utrarachkij, J., Pongsasnongkul, J., Preutthipan, A., and Chantarojanasri, T. (2005). Measurement of end-expiratory pressure as an indicator of airway patency above the tracheostomy in children. *Journal of Medical Association Thailand, 88*(7), 928-932.

Woodnorth, G. H. (2002). Assessing and managing medically fragile children: Tracheostomy and ventilatory support. *Perspectives on Voice and Voice Disorders, 12*(3), 7. doi:10.1044/vvd12.3.7

Using an Active or Passive Circuit With a Passy Muir® Valve: What is the Difference?

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The use of speaking valves for patients on mechanical ventilation has primarily been centered around patient tolerance and the knowledge level of clinicians. Speaking valves, such as the Passy-Muir Tracheostomy & Ventilator Swallowing and Speaking Valve (PMV), allow patients with tracheostomies to communicate verbally. The benefits of the PMV extend beyond speech, with research finding improved swallowing, reduced aspiration risk, and aid in weaning from the ventilator (Sutt et al., 2016).

Originally, the Passy-Muir Valve was designed to be used in-line with mechanical ventilation, allowing patients who were dependent on mechanical ventilation to speak (Passy-Muir, Inc., 2024). While the initial development was for in-line use, some healthcare professionals have posed questions associated with its use in clinical practice. These questions typically relate to concerns with airway pressure, secretion management, air trapping, and hyperinflation. Proper staff training, Valve placement, and patient monitoring are crucial to ensure safe and efficacious use of the Valve.

Clinician knowledge and training are essential for the appropriate and effective use of speaking valves. This knowledge includes understanding indications, contraindications, proper fitting techniques, and the ability to monitor for signs of patient distress. Comprehensive education helps clinicians build confidence and competence in using speaking valves and ultimately enhances patient care.

The PMV is compatible with traditional modes of ventilation, whether volume or pressure ventilating in a control or spontaneous mode. Screen features, setting options, and circuits will vary from ventilator to ventilator; therefore, the clinician running the ventilator must be knowledgeable about how the ventilator reacts to changes in flow and pressures. Whether in acute care or transitioning to the homecare setting, the type of ventilator may impact some of the considerations for Valve use. If the ventilator accommodates two pre-set settings and has the option to choose a circuit with "active" or "passive" exhalation valves, this affects how the ventilator measures and controls parameters.

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Active Circuit includes an exhalation valve that actively manages the flow of air during inspiration and expiration. This active exhalation valve can manage a single or dual limb circuit, allowing for precise control over the timing and volume of breaths delivered to the patient. The exhalation side of the circuit plays a crucial role in maintaining positive end-expiratory pressure (PEEP) by preventing complete exhalation, which helps improve oxygenation and prevent lung collapse (De Mattia et al., 2018).

Passive Circuit is single-limb, for both inhalation and exhalation, with an intentional leak to direct exhaled air out of the circuit. The intentional leak is created by the passive ("whisper swivel") exhalation valve. This configuration can be used for invasive and non-invasive ventilation. The passive circuit is often preferred in certain settings for its simplicity and reduced complexity, providing a low-resistance pathway for the delivery of oxygen and air to the patient's airway.

Active or Passive – when should one be used over the other?

Though a ventilator circuit may seem straightforward, it involves complexities that require careful attention. A ventilator circuit is essential for delivering the correct flow and pressure of air or oxygen to the patient. It consists of tubing and connectors that link the ventilator to the patient's tracheostomy tube or endotracheal tube, ensuring that air reaches the lungs effectively.

An active circuit is normally chosen for a critically ill patient who requires close monitoring since it allows precise control over the timing and volume of breaths delivered to the patient (Phillips-Respironics).

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This configuration is often common for pediatric care. A passive circuit is usually the choice for patients in a stable state who are transitioning to a step-down level of care or to home. The circuit is simple, easy to manage, and less costly. But passive circuits usually cause the most issues when placing a Valve in-line, being that it has a greater leak.

The best way for a ventilator to calculate and measure patient parameters is when there are no leaks within the circuit, as even minor leaks can significantly impact the performance of the ventilator and the patient's ability to use a PMV safely. When there is a leak, the ventilator is unable to deliver the prescribed volume or pressure of air to the patient, which could lead to hypoventilation, inadequate oxygenation, or even respiratory distress if not properly managed. Understanding this leak, its cause and how to compensate for it when needed, is essential when using a Valve in-line with mechanical ventilation.

Proper humidification, secretion management, and awareness of potential obstructions are additional factors clinicians must manage when working with a patient on or off mechanical ventilation. One of the key roles of humidification is to prevent the drying out of the airway, which can lead to discomfort, mucosal damage, and impaired secretion clearance. In mechanical ventilation, especially in long-term use, it becomes crucial to ensure that the airway remains adequately humidified to keep secretions thin and easier to manage. This is especially important when using invasive ventilation, as the air delivered through the ventilator can be dry and lead to mucosal drying if humidification is not provided.

Considerations When Placing a Valve

A Passy Muir Valve is designed for patients who are stable medically, can tolerate cuff deflation, and have manageable secretions and a patent airway. The patient's ventilator parameters may also serve as support for Valve use and medical stability. The typical guidelines are that $FiO_2 \leq 50\%$, PEEP $\leq$ 10 cmH_2O, and PIP $\leq$ 40 cmH_2O. If the patient's measurements fall within these suggested parameters, the assessment usually progresses to cuff deflation and potentially Valve placement.

The assessment becomes complex when adjustments need to be made to meet specific patient needs. Integrating a speaking valve into the circuit requires proper ventilation settings and management. Maintaining positive-end expiratory pressure and monitoring the patient for signs of respiratory distress or inadequate airflow are essential during the assessment process. To address proper ventilator management, one must first understand how the Valve works.

Understanding how the Valve works. Knowing how the Valves work and how they affect flow is crucial for their effective and safe use. The Passy-Muir Valve is designed for patients with tracheostomy tubes. It allows airflow to go in through the tracheostomy tube but closes at the end of inhalation. It is closed throughout exhalation and redirects airflow up to the vocal cords, out through the nose and mouth. This redirection of flow enables speech. This redirection also restores more normal subglottic pressure, which improves swallowing safety and reduces aspiration risk (Nickisch, 2020). Other benefits include an easier ability to cough, which helps clear secretions.

When used with mechanical ventilation, settings may need to be adjusted to accommodate the use of the Valve. A PMV will interrupt the flow of air being delivered to the patient; therefore, interrupting the air returning to the ventilator. This may involve changes to the mode of ventilation or the level of support to ensure the patient is comfortable and can still exhale adequately. Adjustment may also be dependent on the type of circuit being used. For example, if using a passive circuit, the ventilator may rely more heavily on the patient's breathing effort. The Valve's involvement in respiration may lead to challenges in maintaining the prescribed tidal volume or pressure support. Therefore, adjustments to the ventilator may include reducing support levels to allow the patient to breathe more freely, time or flow limiting a breath, or switching to a mode that is more flexible in responding to the patient's own respiratory efforts.

Some modes of ventilation, such as adaptive modes (i.e., Assured Volume Adjusted Pressure Support (AVAPS)), may compensate well with the Valve in-line but may not be ideal due to the inability of the ventilator to measure and calculate, thus making it difficult for the clinician to adjust for adequate ventilation. In AVAPS, the ventilator adjusts the pressure support to ensure that the patient receives a consistent tidal volume, compensating for changes in the patient's compliance or resistance. However, with the PMV in place, this dynamic becomes more complicated because the PMV redirects exhalation out through the upper airway and alters the airway pressures during the respiratory cycle. As a result, the ventilator may not be able to accurately assess and adjust based on the patient's true respiratory status. The machine may either overestimate or underestimate the amount of support needed. This could lead to under- or over-ventilation, putting the patient at risk for complications like hypoventilation or discomfort.

Because of these issues, it may sometimes be better to use conventional ventilator modes. Pressure Support Ventilation (PSV) or Assist-Control Ventilation (ACV) may be more adaptable in these situations, but they require careful monitoring and adjustment to ensure that the patient is not over-burdened with the effort of breathing or under-supported.

Active Circuit. With initial consideration of Valve placement, the active circuit may be the better choice compared to the passive circuit. The active circuit setting allows more freedom to adjust alarms; they should be set at levels that allow for safe alarm practices, prevent false positives, and reduce alarm fatigue.

Alarms. The ones that monitor low exhaled volume, low tidal volume, and low minute volume cannot be monitored when the Valve is in-line, as no flow comes back to the ventilator. Low exhaled volume alarms may be managed by dialing them down or turning them off if available. Low minute volume (LMV) and low minute ventilation can be turned off to help prevent alarm fatigue. It is crucial to have safe alarm practices, which would mean a "disconnect" alarm (if the ventilator is unable to detect breathing or flow) and a "high pressure" alarm (to ensure the ventilator does not deliver excessive pressure) for patient safety and best practice.

Positive End-Expiratory Pressure (PEEP). With most ventilators, PEEP is managed by the amount of bias flow that is flowing through the circuit, creating back pressure to prevent the collapse of the alveoli. If the bias flow is interrupted by a leak in the system (cuff deflated or PMV), the ventilator will react with an auto trigger, auto-cycle, or air turbulence in the patient's airway, all of which can be very uncomfortable. Therefore, it is suggested to decrease the level of PEEP prior to deflating the patient's tracheostomy tube cuff (Sutt et al., 2017). In the active circuit setup, PEEP can be dialed down to zero.

Triggers. There are two ways a patient can trigger a breath: via a pressure trigger or a flow trigger. A pressure trigger occurs with minimal inspiratory effort from the patient; the vent senses the drop in pressure and cycles into the delivery of the breath. A flow trigger may be more common, but in this instance, with the Valve in-line, a decrease in resistance will divert bias flow away from the circuit and could also cause auto-triggering. So, at this point, a pressure trigger may be more comfortable and convenient. Some ventilators offer a flow and pressure trigger, which can help fine-tune the response. If there are trigger issues, adjusting how the ventilator triggers the breath may allow for more comfortable breathing.

Passive-Circuit. Application of the Valve with a passive circuit may be a little tricky. With a specific home care ventilator, clinicians are limited when adjusting settings and alarms (see above discussion under active circuit for alarm information).

For instance, with PEEP, the lowest available level is 4 cmH_2O. While PEEP itself does not directly cause auto-triggering, if the ventilator is set to deliver breaths based on pressure or flow triggers, the PEEP may affect the overall pressure and flow dynamics in the system. An auto-trigger may occur during or after cuff deflation. When we change the dynamics of the bias flow, such as diverting away from the circuit with cuff deflation, auto-triggering may be observed. This becomes the challenge during Valve placement with a passive circuit. However, in other instances, depending on the ventilator's software, the vent may not react significantly to the change in pressure. The patient may not feel discomfort, especially if the patient has already been using the Valve with an active circuit set up. The clinician should monitor and ensure adequate ventilation. The key is that the clinician must ensure the patient gets the benefits of the PMV while avoiding issues like auto-triggering, especially as their needs or ventilator settings shift.

Conclusion

Placement of the Passy Muir Valve is patient-specific; some patients may tolerate changes in airflow just fine, and others may not. Use of a PMV offers many benefits, including the ability to communicate, a reduction in the risk of aspiration, an easier ability to eat and drink, and the restoration of positive airway pressure. Though a patient must be medically stable and meet certain guidelines of stability, every patient deserves the right to communicate effectively. Of course, technical aspects must be considered, but with proper education and training, clinicians will know how to manipulate ventilator settings to ensure patient comfort and best efficacy, no matter what mode of ventilation or type of circuit being used.

References:

De Mattia, E., Falcier, E., Lizio, A., Lunetta, C., Sansone, V. A., Barbarito, N., Garabelli, B., Iatomasi, M., Roma, E., Rao, F., & Carlucci, A. (2018). Passive versus active circuit during invasive mechanical ventilation in subjects with Amyotrophic Lateral Sclerosis. *Respiratory Care, 63* (9) 1132-1138. https://doi.org/10.4187/respcare.05866

Nickisch, B. (2020). The role of pressures in swallowing and impact of the Passy Muir Valve. *Dysphagia Café.* https://dysphagiacafe.com/the-role-of-pressures-in-swallowing-and-impact-of-the-passy-muir-valve/

Passy-Muir, Inc (2024). Passy-Muir Tracheostomy & Ventilator Swallowing and Speaking Valves Patient Education Handbook. https://www.passy-muir.com/wp-content/uploads/2023/04/PH-R0322_comp_single-pages.pdf

Philips Respironics (2004-2024). Trilogy accessory guide.

Sutt, A., Caruana, L. R., Dunster, K. R., Cornwell, P. L., Anstey, C. M., & Fraser, J. F. (2016). Speaking valves in tracheostomised ICU patients weaning off mechanical ventilation - Do they facilitate lung recruitment? *Critical Care, 20*(1), 91. https://doi.org/10.1186/s13054-016-1249-x

Sutt, A. L., Anstey, C. M., Caruana, L. R., Cornwell, P. L., & Fraser, F. F. (2017). Ventilation distribution and lung recruitment with speaking valve use in the tracheostomized patient weaning from mechanical ventilation in the intensive care. *Journal of Critical Care, 40,* 164-170. https://doi.org/10.1016/j.jcrc.2017.04.001

Speaking Valve Use During Mechanical Ventilation: Restoring Voice, Physiology, and Recovery in the Intensive Care Unit

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Patients requiring tracheostomy and mechanical ventilation frequently experience loss of voice, impaired swallowing, reduced airway sensation, respiratory muscle weakness, and psychological distress. Historically, speaking valve use during mechanical ventilation was delayed because critically ill patients were considered "too unstable" to tolerate cuff deflation or airflow through the upper airway. However, evidence suggests that early speaking valve intervention may improve communication, swallowing, respiratory function, rehabilitation participation, and overall quality of life (Sutt et al., 2022; Freeman-Sanderson et al., 2018; Freeman-Sanderson et al., 2023). When reviewing the physiologic rationale, interdisciplinary management strategies, and current evidence supporting the use of one-way speaking valves, particularly the Passy Muir® Valve, during mechanical ventilation, one begins to understand the importance of intervening early and providing patients with state-of-the-art care. Updated research demonstrates that restoring airflow through the upper airway may contribute to improved lung recruitment, reduced aspiration risk, enhanced secretion management, earlier mobilization, and improved psychosocial outcomes (O'Connor et al., 2019; Sutt et al., 2017; Sutt et al., 2021; Freeman-Sanderson et al., 2018). Another consideration is the importance of collaboration between speech-language pathologists and respiratory therapists in safely implementing speaking valve trials and promoting functional recovery in critically ill patients.

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Restoring Voice, Physiology, and Recovery in the Intensive Care Unit

Imagine being fully awake in an intensive care unit yet unable to speak, ask questions, express discomfort, or communicate with loved ones. For many patients requiring tracheostomy and mechanical ventilation, this is a daily reality. The inability to communicate while mechanically ventilated has been associated with anxiety, depression, emotional distress, and post-traumatic stress symptoms (Freeman-Sanderson et al., 2016; Freeman-Sanderson et al., 2023). Although lifesaving, prolonged mechanical ventilation can dramatically alter airway physiology and impair swallowing, coughing, respiratory strength, and participation in rehabilitation without appropriate management and interventions.

The Passy Muir Valve is widely recognized as the bias-closed speaking valve approved for use during mechanical ventilation. During inspiration, the valve opens to allow airflow into the lungs. At the end of inspiration, the valve closes, redirecting exhaled air around the tracheostomy tube and through the vocal folds, mouth, and nose. This restoration of airflow does more than produce speech—it helps normalize upper airway physiology.

In recent years, clinicians have increasingly recognized that speaking valve use may influence much more than communication. Research now suggests that speaking valve implementation can positively impact swallowing, cough effectiveness, lung recruitment, secretion management, patient participation in therapy, and even respiratory outcomes (Han et al., 2022; Martin et al., 2021; O'Connor et al., 2019; Sutt et al., 2022). These findings have prompted a shift from viewing speaking valves solely as communication tools toward recognizing them as rehabilitation devices that support holistic recovery.

Psychological and Functional Consequences of Mechanical Ventilation

Patients receiving prolonged mechanical ventilation often experience profound physical and emotional challenges. Communication barriers contribute significantly to fear, frustration, and helplessness. Egbers et al. (2014) reported that the inability to communicate is a major source of distress among ventilated intensive care unit (ICU) patients. When patients cannot speak, even basic needs become difficult to express, increasing dependence on caregivers and reducing autonomy. Speaking valves have transformed care for patients with tracheostomies by restoring airflow through the upper airway and enabling verbal communication, cough, restored pressures, improved secretion management, and more (O'Connor et al., 2019).

Mechanical ventilation and tracheostomy also contribute to physiologic deconditioning. Prolonged oral intubation, reduced airflow through the upper airway, immobility, infection, sedation, and critical illness can lead to ICU-acquired weakness, including respiratory muscle dysfunction and dysphagia. Mirzakhani et al. (2013) demonstrated that muscle weakness in mechanically ventilated patients predicts pharyngeal dysfunction and symptomatic aspiration.

Respiratory muscle weakness is particularly concerning. Studies have shown that diaphragmatic force generation can decline significantly within days of starting mechanical ventilation, contributing to difficult ventilator weaning and prolonged ICU stays. Schellekens et al. (2016) emphasized the importance of strategies that maintain or restore respiratory muscle function during critical illness. In working to improve or restore respiratory function for a patient on mechanical ventilation, to have effective interventions for respiratory function, it is essential to restore the closed system and airflow through the upper airway.

The loss of airflow through the upper airway may also reduce laryngeal and pharyngeal sensation, negatively affecting swallowing safety. Without normal airflow, pressure, and sensory input, patients may develop impaired airway protection, ineffective cough, and aspiration risk (Freeman-Sanderson et al., 2021).

Restoring Physiology Through Speaking Valve Use

The physiologic benefits of speaking valves extend beyond phonation. When the tracheostomy cuff is fully deflated, and a no-leak speaking valve is placed in-line with mechanical ventilation, exhaled airflow returns through the larynx and upper airway. This restoration of airflow re-establishes positive subglottic pressure, improves sensation, and promotes more normal respiratory mechanics. Emerging evidence supports the clinical value of restoring upper airway airflow. Han et al. (2022) demonstrated that speaking valve use may reduce aspiration by improving subglottic pressure and swallowing biomechanics.

Additionally, Sutt et al. (2015) found that speaking valve use in mechanically ventilated cardiothoracic ICU patients improved communication while avoiding an impact on ventilation time. Sutt et al. (2016) also found that speaking valves may improve lung recruitment. They reported improved end-expiratory lung impedance when speaking valves were used with reduced or zero positive end-expiratory pressure (PEEP). The researchers suggested that restoring expiratory airflow through the upper airway may recreate physiologic resistance that supports alveolar recruitment.

Beyond respiratory benefits, clinicians frequently observe improvements in patient engagement once verbal communication is restored. Patients often become more active participants in therapy sessions, medical decision-making, and social interaction. For critically ill individuals, regaining the ability to speak can represent a major psychological turning point.

Early Speaking Valve Placement in the ICU

Historically, speaking valve intervention was delayed until patients were nearing ventilator liberation. Many clinicians feared that cuff deflation would compromise ventilation or increase patient instability. However, more recent evidence suggests that carefully selected patients may benefit from speaking valve placement earlier than previously believed.

Martin et al. (2021) investigated accelerated versus standard speaking valve placement after percutaneous tracheostomy and found that earlier speaking valve trials were feasible and safe in appropriately selected patients. Their findings support the growing movement toward early rehabilitation interventions in the ICU.

Early speaking valve implementation requires careful patient selection and interdisciplinary collaboration. Patients who are most likely to tolerate cuff deflation are typically medically stable, awake, responsive, and able to participate in therapy. Before valve placement, clinicians must assess airway patency, secretion burden, respiratory stability, and the patient's ability to tolerate cuff deflation.

The process should never be rushed. Some patients require gradual exposure to upper airway airflow after prolonged periods of cuff inflation. Clinicians may observe coughing, throat clearing, anxiety, or temporary dyspnea as patients reacclimate to normal airflow sensations.

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Interdisciplinary Role of the Speech-Language Pathologist and Respiratory Therapist

Successful speaking valve use during mechanical ventilation depends heavily on collaboration between speech-language pathologists (SLPs) and respiratory therapists (RTs). This partnership combines expertise in airway management, ventilation strategies, swallowing physiology, communication, and rehabilitation.

Respiratory therapists play a central role in managing ventilator settings, monitoring respiratory status, adjusting alarms, and ensuring adequate ventilation during cuff deflation and valve placement. Ventilator modifications may include reducing or eliminating PEEP, adjusting sensitivity settings, or modifying delivered volumes to compensate for altered airflow dynamics.

Speech-language pathologists contribute expertise in upper airway assessment, swallowing function, communication strategies, and patient cueing. During speaking valve trials, SLPs often help patients coordinate breathing with phonation and swallowing while monitoring voice quality, secretion management, and signs of fatigue.

This interdisciplinary approach also supports early mobilization. Massery (2014) emphasized that glottic closure and upper airway airflow contribute to trunk stability, postural control, coughing, and functional movement. Patients participating in physical and occupational therapy may demonstrate improved stability and endurance once airflow through the upper airway is restored.

Considerations for Ventilator Management During Speaking Valve Trials

One of the most common concerns regarding speaking valve use during mechanical ventilation is whether adequate ventilation can be maintained with the tracheostomy cuff deflated. Evidence suggests that many patients can successfully ventilate with cuff deflation when managed appropriately.

Bach and Alba (1990) reported that most ventilator-dependent patients with neuromuscular disease could maintain adequate ventilation with deflated cuffs or cuffless tracheostomy tubes. More recent clinical practice continues to support cuff deflation as a viable strategy for many mechanically ventilated patients. In 2015, Sutt et al. initiated a series of investigations that addressed speaking valve use during mechanical ventilation. Their findings from these studies indicate that patients actually exhibit improved lung recruitment, faster weaning from mechanical ventilation, and improved respiratory function, especially diaphragmatic function.

During speaking valve trials, clinicians must monitor peak inspiratory pressure (PIP), respiratory rate, oxygen saturation, patient comfort, and signs of ventilator asynchrony. Because exhaled air no longer returns through the ventilator circuit, exhaled tidal volume measurements may not accurately reflect ventilation status.

Airway patency assessment remains essential before valve placement. Clinicians may evaluate upper airway airflow by assessing voicing, auscultating exhalation through the upper airway, or measuring reductions in PIP during cuff deflation. Significant reductions in inspiratory pressure or exhaled volume may indicate adequate airflow around the tracheostomy tube and through the upper airway. Sutt et al. (2021) reported that a 40-50% drop in PIP or tidal volumes was indicative of a patent airway.

If the airway is not patent, some patients may require tracheostomy downsizing or tube changes to improve airflow and speaking valve tolerance. Johnson (2021) advocated for the use of tracheostomy manometry and downsizing strategies to optimize speaking valve placement and improve patient comfort.

For placement of the Valve in-line with mechanical ventilation, guidelines suggest considering the following sequence:

1) Patient selection with consideration for medical stability, communicative intent, and level of alertness.
2) Note patient's baseline measurements for vitals.
3) Proper ventilator management for cuff deflation, including consideration for PEEP reduction (Sutt et al., 2021).
4) Slow cuff deflation, allowing the patient to adjust to changes in airflow.
5) Upper airway patency assessment, with appropriate troubleshooting as needed (Sutt et al., 2021).
6) With a patent airway, place the Valve in-line using the appropriate connections and position the Valve close to the patient (see Passy Muir Connections Guide).
7) Manage the ventilator and alarms for patient safety and to ascertain that the patient is ventilating the same as prior to cuff deflation.
8) Have the patient count, cough, or vocalize, and continue to monitor airway patency during use.

The patient may wear the Valve as long as staff can monitor the patient's status; the patient is awake, alert, and attempting to communicate; and appropriate baseline ventilation is being maintained.

Alternative Communication Methods

Although speaking valves provide substantial physiologic and communicative benefits, not every patient initially tolerates full cuff deflation. Alternative communication approaches may be necessary for medically fragile patients.

Above-cuff vocalization systems deliver airflow through a subglottic suction port above the cuff to facilitate speech. McGrath et al. (2016) described this approach as a potential option for patients unable to tolerate cuff deflation. However, limitations include reduced voice quality, mucosal drying, stoma leakage, and potential laryngeal irritation.

Partial cuff deflation techniques have also been proposed. While partial cuff deflation may permit limited airflow and voicing, it may not fully restore upper airway physiology or subglottic pressure. Furthermore, increased airflow demands and altered ventilator dynamics can increase the work of breathing in some patients.

Whenever clinically feasible, complete cuff deflation with a no-leak speaking valve remains the preferred approach for restoring physiologic airflow patterns.

Pediatric Considerations

Speaking valve use is increasingly recognized as beneficial in pediatric tracheostomy patient populations. Beyond communication gains, pediatric studies suggest potential reductions in respiratory complications. Li et al. (2021) found that tracheostomy-dependent children who could use the Passy Muir valve experienced fewer respiratory-related hospitalizations. Restoring airflow through the upper airway may support secretion management, improve airway clearance, and promote more typical respiratory physiology in pediatric patients.

As with adults, pediatric speaking valve trials require careful airway assessment, multidisciplinary collaboration, and individualized patient selection.

Future Directions in Research and Clinical Practice

Despite growing evidence supporting speaking valve use during mechanical ventilation, additional research is needed to establish standardized protocols and identify optimal patient selection criteria. Questions remain regarding the ideal timing of speaking valve placement, ventilator management strategies, respiratory muscle training protocols, and long-term outcomes.

Recent reviews emphasize the need for larger randomized controlled trials evaluating communication outcomes, swallowing safety, respiratory mechanics, ICU length of stay, and quality of life measures (Zhang et al., 2022). Future studies may further clarify how speaking valve use influences ventilator liberation and rehabilitation outcomes.

Clinically, the culture surrounding speaking valve implementation in critical care continues to evolve. Many ICUs are shifting toward earlier rehabilitation, sedation minimization, and patient-centered communication strategies. In this environment, speaking valves are increasingly viewed not as optional devices, but as integral components of recovery-focused critical care.

Conclusion

Speaking valve use during mechanical ventilation represents far more than a communication intervention. By restoring airflow through the upper airway, speaking valves help normalize respiratory and swallowing physiology while supporting communication, rehabilitation, and psychosocial recovery.

Modern critical care increasingly emphasizes patient-centered rehabilitation and early mobilization. Within this framework, speaking valves provide clinicians with a powerful tool to improve quality of life and potentially enhance physiologic recovery. Successful implementation requires thoughtful airway assessment, ventilator management, interdisciplinary collaboration, and individualized patient care.

For many critically ill patients, the ability to speak again is not merely a clinical milestone—it is the first step toward reclaiming autonomy, dignity, and participation in their own recovery.

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References:

Bach, J. R., & Alba, A. S. (1990). Tracheostomy ventilation: A study of efficacy with deflated cuffs and cuffless tubes. *Chest, 97*(3), 679–683. https://doi.org/10.1378/chest.97.3.679

Egbers, P. H., Bultsma, R., Middelkamp, H., & Boerma, E. C. (2014). Enabling speech in ICU patients during mechanical ventilation. *Intensive Care Medicine, 40*(7), 1057–1058. https://doi.org/10.1007/s00134-014-3315-7

Freeman-Sanderson, A., Hemsley, B., Thompson, K., Rogers, K. D., Knowles, S., & Hammond, N. E. (2023). Communication functions of adult patients admitted to intensive care: A multicentre, binational point prevalence study. *Australian Critical Care, 36*(6), 1084-1089. https://doi.org/10.1016/j.aucc.2023.01.009

Freeman-Sanderson, A. L., Togher, L., Elkins, M. R., & Kenny, B. (2018). Quality of life improves for tracheostomy patients with return of voice: A mixed methods evaluation of the patient experience across the care continuum. *Intensive Critical Care Nursing, 46*,10-16. https://doi.org/10.1016/j.iccn.2018.02.004

Freeman-Sanderson, A. L., Togher, L., Elkins, M. R., & Phipps, P. R. (2016). Return of voice for ventilated tracheostomy patients in ICU: A randomized controlled trial of early-targeted intervention. *Critical Care Medicine, 44*(6), 1075–1081. https://doi.org/10.1097/CCM.0000000000001610

Freeman-Sanderson, A., Ward, E. C., Miles, A., de Pedro Netto, I., Duncan, S., Inamoto, Y., McRae, J., Pillay, N., Skoretz, S. A., Walshe, M., & Brodsky, M. B. (2021). A consensus statement for the management and rehabilitation of communication and swallowing function in the ICU: A global response to COVID-19. *Archives of Physical Medicine and Rehabilitation, 102*(5), 835-842. https://doi.org/10.1016/j.apmr.2020.10.113

Han, X., Ye, Q., Meng, Z., Pan, D., Wei, X., Wen, H., & Dou, Z. (2022). Biomechanical mechanism of reduced aspiration by the Passy-Muir valve in tracheostomized patients following acquired brain injury: Evidences from subglottic pressure. *Frontiers in Neuroscience, 16,* 1004013. https://doi.org/10.3389/fnins.2022.1004013

Johnson, D. C. (2021). Speaking valve placement: Use manometry and downsizing. *Annals of the American Thoracic Society, 18*(11), 1927–1928. https://doi.org/10.1513/AnnalsATS.202103-417LE

Li, L., Wikner, E., Behzadpour, H., Perez, G., & Mudd, P. (2021). Decrease in respiratory related hospitalizations in tracheostomy-dependent children who tolerate Passy-Muir valve use. *Annals of Otology, Rhinology & Laryngology, 130*(6), 640–646. https://doi.org/10.1177/0003489420966612

Martin, K. A., Cole, T. D. K., Percha, C., Asanuma, N., Mattare, K., Hager, D. N., Brenner, M. J., & Pandian, V. (2021). Standard versus accelerated speaking valve placement after percutaneous tracheostomy: A randomized controlled feasibility study. *Annals of the American Thoracic Society, 18*(10), 1693–1701. https://doi.org/10.1513/AnnalsATS.202010-1282OC

Massery, M. (2014). The role of the Passy-Muir valve in physical therapy. *Talk Muir,* 2–4.

McGrath, B., Lynch, J., Wilson, M., Nicholson, L., & Wallace, S. (2016). Above cuff vocalisation: A novel technique for communication in the ventilator-dependent tracheostomy patient. *Journal of the Intensive Care Society, 17*(1), 19–26. https://doi.org/10.1177/1751143715607549

Mirzakhani, H., Williams, J., Mello, J., Joseph, S., Meyer, M. J., Waak, K., Schmidt, U., Kelly, E., & Eikerman, M. (2013). Muscle weakness predicts pharyngeal dysfunction and symptomatic aspiration in long-term ventilated patients. *Anesthesiology, 119*(2), 389–397. https://doi.org/10.1097/ALN.0b013e31829373fe

O'Connor, L. R., Morris, N. R., & Paratz, J. (2019). Physiological and clinical outcomes associated with use of one-way speaking valves on tracheostomised patients: A systematic review. *Heart & Lung, 48*(4), 356-364. https://doi.org/10.1016/j.hrtlng.2018.11.006

O'Connor, L. R., Morris, N., & Paratz, J. (2021). The safety and efficacy of prolonged use of one-way speaking valves. *Australian Critical Care, 34*(4), 319-326. https://doi.org/10.1016/j.aucc.2020.09.003

Schellekens, W. M., van Hees, H. W. H., Doorduin, J., Roesthuis, L. H., Scheffer, G. J., Hoeven, J. G., & Heunks, L. M. (2016). Strategies to optimize respiratory muscle function in ICU patients. *Critical Care, 20*, 103. https://doi.org/10.1186/s13054-016-1280-y

Sutt, A., Cornwell, P., Mullany, D., Kinneally, T., & Fraser, J. F. (2015). The use of tracheostomy speaking valves in mechanically ventilated patients results in improved communication and does not prolong ventilation time in cardiothoracic intensive care unit patients. *Journal of Critical Care, 30*(3), 491–494. https://doi.org/10.1016/j.jcrc.2014.12.002

Sutt, A., Cornwell, P., Mullany, D., Kinneally, T., & Fraser, J. F. (2016). Speaking valves in tracheostomised ICU patients weaning off mechanical ventilation—Do they facilitate lung recruitment? *Critical Care, 20*, 91. https://doi.org/10.1186/s13054-016-1249-x

Sutt, A. L., Wallace, S., & Egbers, P. (2021). Upper airway assessment for one-way valve use in a patient with a tracheostomy. *American Journal of Speech-Language Pathology, 30*(6), 2716-2717. https://doi.org/10.1044/2021_AJSLP-21-00174

Sutt, A., Cornwell, P., Hay, K., Fraser, J., & Rose, L. (2022). Communication success and speaking valve use in intensive care patients receiving mechanical ventilation. *American Journal of Critical Care, 31*(5), 411-415. https://doi.org/10.4037/ajcc2022516

Zhang, Y., Jiang, H., & Wang, X. (2022). Clinical utility and future direction of speaking valve: A review. *Frontiers in Surgery, 9,* 913147. https://doi.org/10.3389/fsurg.2022.913147

Tips for Ventilator Application | Sudderth

Effects Of:

Cuff Inflation	Reduced Upper Airway Stimulation	Reduced Positive Airway Pressure	Tracheostomy
Reduced Laryngeal Movement/ Tethering	Loss of Voice	Reduced Swallow Function	Quality of Life
Necrosis/ Trauma	Reduced/ Lost Taste and Smell	Weak or No Cough	Weaning
Reflux	Change in Sensation	Reduced Trunk Strength/ Support	Length of Stay
Reduced Upper Airway Airflow	Negative Impact on Swallowing	Reduced PEEP	

Tips For Ventilator Application

Monitor PIP and EVT to assess upper airway patency during deflation

Slow cuff deflation, with frequent oral care and suctioning as needed

Make ventilator adjustments to improve cuff deflation management

Consider:
- Decreasing PEEP
- Increasing Vt in increments of 50-100 to return to pre-PMV PIP

Assure adequate alveolar ventilation by monitoring PIP and WOB

Use safe alarm practice

Infants and Children With Tracheostomy and Ventilator Dependence in the Intensive Care Units: Candidacy and Early Intervention With a Bias-Closed, No-Leak Speaking Valve

Laura Brooks, MEd, CCC-SLP, BCS-S

Extensive research on the Passy Muir® Tracheostomy & Ventilator Swallowing and Speaking Valve (PMV®) exists within the adult population to support the benefits of voicing, secretion management, physiologic PEEP, swallowing, olfaction, quality of life, and weaning. However, working with infants and children, who have tracheostomies with or without ventilator support, can be more challenging than with adults due to multiple factors. Developmental factors, in combination with medical concerns, impact treatment considerations, but the research literature in the pediatric population is inadequate to provide sufficient evidence-based practices (Suiter, et al, 2003). Review of recent literature suggests that approximately half of all pediatric patients who receive a tracheostomy are younger than one year of age (Barbato, et al., 2012; Lewis, et al., 2003). Early tracheostomy may lead to an opportunity for early application of the PMV that may otherwise be missed if the medical team does not have a clear understanding of practice guidelines for PMV application.

Because of the paucity of research in pediatrics, it is challenging to have consensus among physicians and clinicians regarding candidacy for Passy Muir Valve application with medically complex infants and children. This is particularly difficult for infants in the Neonatal Intensive Care Unit (NICU), patients who are ventilator dependent, and individuals with airway compromise (i.e. stenosis or vocal fold paralysis). As a result, patients who may be a candidate for Valve placement may not receive this intervention due to physician concern for use in what is viewed as a higher risk population.

Therefore, it is critical that the speech-language pathologist has a thorough understanding of the ventilator and the patient's specific settings, how the PMV changes the mechanics of inspiration and expiration when on the ventilator, and medical co-morbidities that may compromise successful PMV application. The clinicians and facility should have a practice guideline in order to ensure consistent application of the PMV and to provide an understanding of any potential contraindications.

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Understanding the Ventilator

The PMV was invented for use in-line with ventilator circuitry (for patients who are ventilator dependent) by a patient who was ventilator dependent. It is a bias-closed, one-way Valve that allows inspiratory support from the ventilator and allows 100% of exhalation to occur out through the patient's nose and mouth. For best practice, the PMV is typically placed in the ventilator circuit and not directly on the tracheostomy hub. Placement of the PMV on the hub of the tracheostomy tube may create torque. If torque or movement of the tracheostomy tube occurs, there is a higher risk for potential tissue erosion, laceration of the skin, or an exacerbation of granulation tissue growth (Keens et al., 2017). Because of the variety of hospital and home ventilators and circuits, clinicians and caregivers must understand the differences between them and the level of support that the patient is receiving from the ventilator.

Some ventilators are designed for use with patients in intensive care units. These ventilators are precise and most frequently used for higher risk patients, who require more ventilator support. Home ventilators, such as the LTV and Trilogy, are more portable, less expensive, and may be used for patients transitioning from the ICU to the acute care floor and then to home. Pediatric candidates for home ventilators are children who have relatively stable ventilator settings, with lower FiO_2 (<40%) and peak inspiratory pressure (PIP) (<40 cmH_2O) (Keens et al., 2017).

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When working with patients on mechanical ventilation, an understanding of the ventilator settings and patient parameters is essential for all healthcare professionals. There are two primary types of ventilation: pressure controlled and volume controlled. A physician orders the type of ventilation, depending on the patient's needs. The following terms are some of the common terms related to the care of a patient on mechanical ventilation with which the healthcare professional should be familiar:

Breath Types:

Volume breath: Ventilator delivers a pre-set volume, regardless of the pressure required to do so. Volume is constant, whereas pressure is variable (pressure varies depending on lung compliance/resistance).

Pressure breath: Ventilator delivers a pre-set pressure over a pre-set inspiratory time. Pressure is constant, whereas volume is variable (volume varies depending on lung compliance/resistance).

Common Modes of Ventilation:

Pressure Control Ventilation (PC or PC/PS): Ventilator delivers a predetermined number of breaths per minute, with a pre-set pressure over a pre-set inspiratory time. Pressure support may be provided during spontaneous breathing on some ventilators.

Assist Control (A/C): Ventilator delivers a predetermined number of breaths per minute, using either a specified volume or pressure. All triggered breaths are fully supported.

Synchronized Intermittent Mandatory Ventilation with Pressure Support (SIMV/PS): Ventilator delivers a predetermined number of breaths per minute using either a specified volume or pressure. Pressure support is provided during the spontaneous breath.

Pressure Regulated Volume Control (PRVC): Ventilator adjusts the pressure delivered during each breath to ensure target volumes are delivered.

Pressure Support with Continuous Positive Airway Pressure (PS w/ CPAP): Continuous positive airway is maintained during exhalation, while each spontaneous breath is supported with a set pressure.

Ventilator Settings (what the physician orders):

Breath types:

Pressure breaths: Physician orders set pressure.

Volume breaths: Physician orders set volume.

Positive End-Expiratory Pressure (PEEP): Amount of pressure that remains in the lungs at the end of exhalation.

CPAP: Continuous positive airway pressure.

Pressure Support (PS): Positive pressure provided during a spontaneous breath.

Respiratory Rate (RR): Number of breaths per minute delivered by the ventilator.

Fraction of Inspired Oxygen (FiO_2): Percentage of oxygen the ventilator delivers. For reference, room air has FiO_2 of 21%.

Tidal Volume (Vt): Volume of gas inhaled with each breath, recorded in cc/ml. Physicians prescribe tidal volume using ideal body weight and lung pathology.

Other:

Peak Inspiratory Pressure (PIP): Highest level of pressure applied to the lungs during inhalation.

End-Tidal Carbon Dioxide ($EtCO_2$): Capnograph measures exhaled CO_2. This value can either be found on the ventilator or on a separate machine. $EtCO_2$ readings may indicate the quality of ventilation or cardiac output and is the gold standard to confirm endotracheal tube placement.

Partial Pressure Carbon Dioxide ($PaCO_2$): Measured from an arterial blood sample. Normal values range from 35-45 mmHg.

Inspiratory Time/I-Time: Duration of inspiration in seconds.

Indications for the Tracheostomy

When working with this patient population, it is important to understand the indications for a tracheostomy. The disease process and reason for tracheostomy may impact the timing of intervention as it relates to PMV use. With infants and children, several causes may lead to a tracheostomy. Three main categories of tracheostomy indications include airway obstruction, lung disease, and neuromuscular/neurological involvement. These categories include, but are not limited to, chronic obstruction within the airway, such as choanal atresia, subglottic stenosis, tracheomalacia, laryngomalacia, and bronchomalacia; vocal cord paralysis, leading to chronic aspiration or poor pulmonary toileting with an inability to clear secretions; severe CNS (Central Nervous System) impairment, such as seen with Arnold-Chiari malformation, Werdnig Hoffmann disease, and Congenital Hypoventilation Syndrome; craniofacial anomalies, such as seen with Pierre Robin sequence and Treacher Collins, Beckwith-Wiedemann, and CHARGE syndromes; and chronic lung disease, including bronchopulmonary dysplasia (Shaker & Mutnik, 2012). Timing of interventions and establishing access to the upper airway for communication, speech-language development, cough, and other pulmonary functions is crucial. Early intervention and use of a PMV provides benefits which may assist in the recovery process.

If the patient has neurologic indications for a tracheostomy, but the lungs are healthy and the muscles are weak, these patients generally do not require frequent changes in ventilator settings (Keens et al., 2017). For patients with upper airway anomalies requiring a tracheostomy, the ability of the patient to adequately exhale around the tracheostomy tube is of concern and would need to be considered during the evaluation. This diagnosis may even require a Direct Laryngoscopy and Bronchoscopy (DLB) to be performed by the otolaryngologist. This assessment would address the severity of the obstruction. Because of the wide variety of causes for a tracheostomy, the history provides crucial information which may impact the assessment process.

Understanding the Impact of a Cuff and Its Proper Management

Generally, uncuffed tracheostomy tubes are the preferred tracheostomy tube type for children. However, patients with severe restrictive lung disease or neuromuscular disease require a high pressure be delivered, and it is done more effectively with the cuff inflated (Hess & Altobelli, 2014). Previously, only uncuffed tracheostomy tubes were available for pediatrics, but in the past decade, cuffed tracheostomy tubes have become more popular (Watters, 2017). The choice of cuffed versus uncuffed tracheostomy tubes is usually institution or patient dependent. The uncuffed tracheostomy tube has benefits not observed in cuffed tracheostomy tubes, such as reducing the incidence of acquired tracheal wall injury (Hess & Altobelli, 2014) and improving phonation (DeMauro et al., 2014; Cowell et al., 2000).

The patient with an uncuffed tracheostomy tube also may have less difficulty with the application of the PMV as there is less change in the exhalation physiology. Typically, a patient inhales and exhales through the tracheostomy tube, which is either cuffed or cuffless. Cuffed trach tubes must be completely deflated prior to PMV application, and the deflated cuff material may still cause some resistance when exhaling (Beard & Monaco, 1993). A tight to the shaft (TTS) tracheostomy tube or uncuffed tracheostomy tube may allow for more space in the tracheal lumen for exhalation out through the mouth and nose. When the PMV is placed, a child still inhales through the Valve and tracheostomy tube, but the Valve closes at the end of inspiration and redirects airflow out through the upper airway, mouth, and nose. For children, the most common reasons for PMV success involve both physiologic and behavioral factors (Lieu et al., 1999). As such, uncuffed tracheostomy tubes can help prepare the patient physiologically and behaviorally for the change in exhalation. Additionally, an uncuffed tracheostomy tube has the potential to allow the patient to sense the secretions in their pharynx, resulting in a swallow or cough in response. One study with critically ill patients with a tracheostomy, who were randomized to groups, found that deflating the tracheostomy tube cuff shortened weaning time, reduced respiratory infections, and improved swallowing (Hernandez et al., 2013).

Another Consideration: Ventilator Circuits

When working with a patient who is ventilator dependent, the speech-language pathologist (SLP) and the respiratory therapist (RT) must be familiar with the different ventilator circuits that may be used. The type of circuitry will dictate the type of adapters that may be needed for successful placement of the PMV in-line with the ventilator circuit. The types of adapters are usually either a 15/22 mm step-down adapter or a 22mm silicone adapter (*see Image 1*).

It is important to understand the different circuits and know whether the patient is on a single limb circuit or double limb circuit. In addition, the team should be aware if the circuit is a passive circuit or an active circuit. An example of a ventilator that has both an active and passive circuit that is used often in pediatrics is the Trilogy. Both circuits are single limb circuits. The passive circuit has the whisper swivel valve, and the active circuit has a mushroom valve for exhalation. With the passive circuit, the PMV is used with patients who require pressure ventilation. With an active circuit, the PMV is used with patients who are volume ventilated.

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Image 1

PMV-AD1522™ Step-down Adapter (on left):
Color coded for use with the PMV® 007 (Aqua Color™), the adapter provides a secure connection between the Passy Muir Valve and ventilator tubing, closed suction systems, or other adapters. 15mm OD – 22mm ID.

PMV-AD22™ Flexible Silicone Adapter (on right):
Color coded for use with the PMV® 2001 (Purple Color™), the adapter provides a secure connection between the Passy Muir Valve and tubing, closed suction systems, or other adapters. Stretches to fit 22mm.

The SLP and the RT work together as a team and rely heavily on the expertise and support of the other team members when determining patient candidacy, problem solving ventilator application, and evaluating and treating the patient for Valve use. For successful application and early intervention in critical care, all team members should have extensive understanding of PMV use; otherwise, there may be roadblocks to early application of the Valve on a patient who is ventilator dependent. While the SLP should be educated on ventilator settings, modes, and circuits to help advocate for application of the PMV, the SLP relies on the expertise of the RT for ventilator adjustments and patient safety. The RT relies on the SLP to provide assessment of voice, swallowing, speech and language skills, and cognition.

Application of the PMV:
How to Maximize Safety and Success

Understanding the value of the PMV application for patients and the benefits that may be achieved assist with improved patient use and care. However, many patients are underserved due to a lack of clinician and physician consensus for understanding the range of benefits and for determining candidacy. Members of the medical team may ask such questions as: is this patient too young? Too small? Too sick? On too much PEEP? Can the patient tolerate the PMV with any degree of airway obstruction or narrowing?

The benefits of using a bias-closed, one-way valve have been reported in the literature and include access for the infant to be able to communicate via cries and other sounds; have improved taste and smell; generate subglottic pressure for cough, cry, and swallowing; reduce the potential for further vocal cord dysfunction; restore laryngeal/pharyngeal sensation; and improve secretion management (O'Connor et al., 2019; Hull et al., 2005; Torres & Sirbegovic, 2004). Abraham (2009) investigated the use of a PMV in children and reported that children wearing a Passy Muir Valve during waking hours normalized secretion management within two weeks due to improved sensation of secretions. Benefits also were reported for reduced time to decannulation and restored physiologic PEEP, which led to diminished WOB (work of breathing) (Hull et al, 2005; Torres & Sirbegovic, 2004; Sutt et al., 2016).

Review of the current literature supports safety of PMV application with certain patients, depending on the medical comorbidities. Passy Muir Valves have been used with both pediatric and adult populations, with the PMV being used with infants as young as one day old and within the NICU (Torres & Sirbegovic, 2004). Some specialists may have concerns that an infant's airway is too small and will not have enough room around the tracheostomy tube (Torres & Sirbegovic, 2004). However, the concerns related to upper airway patency may be assessed in two different ways: visual observation by the otolaryngologist via DLB and testing with manometry. If it is determined initially that the patient's upper airway is not patent via endoscopy or manometry, then the infant should be followed and retested, as appropriate, during their admission. Retesting is warranted because an infant or young child may have significant improvement in airway patency secondary to changes in age, weight, or growth which may affect the size of the trachea.

Once it is established that the patient is a good candidate and has a patent upper airway, additional criteria are considered. For Valve placement, the following criteria may be considered for patients who are ventilator dependent:

a. The patient must tolerate cuff deflation. Set the patient up for success by slowly deflating the cuff. Some patients may even require deflation to take place over several minutes to adjust to the change in airflow (Hess & Altobelli, 2014).

b. PMV, in the pediatric population, should be trialed following the patient's first trach change. The first trach change is often done by the surgeon as the immature stoma poses some risk for damage (Hess & Altobelli, 2014).

c. The patient must be hemodynamically stable.

d. Contraindications for PMV application:

   i. Significant upper airway obstruction (e.g. grade 4 subglottic stenosis).

   ii. Copious, thick secretions.

   iii. Foam-filled cuff, as these cuffs cannot be safely deflated (Hofmann, Bolton, & Ferry, 2008).

e. With the Trilogy ventilators: For the passive circuit, use the PMV with patients who require pressure ventilation. With an active circuit, use the PMV with patients who are volume ventilated.

f. FiO2 < 50%

g. PEEP ≤ 10 cmH_2O

h. PIP/PAP= ≤ 40 cmH_2O

* *some variation exists between facilities (e.g. some use PEEP of 12 or less).*

It is recommended that the medical team continue to apply heated humidification. However, a heat-moisture exchanger (HME) should not be used with the PMV, as no exhaled gas passes to the HME through the tracheostomy tube when the Valve is in place (Hess & Altobelli, 2014).

When using the Passy Muir Valve during mechanical ventilation, respiratory therapists may make some adjustments, under physician direction, to improve patient comfort and safety. Some common and simple adjustments may include:

Reduction or elimination of PEEP:
The establishment of a closed respiratory system and exhalation through the oronasopharynx restores physiologic PEEP. This enables the clinician to reduce or eliminate set mechanical PEEP (Sutt et al., 2016). This adjustment may also eliminate any unnecessary continuous airflow within the circuit. Continuous flow in the circuit may make it difficult for the patient to close the vocal cords and may stimulate continuous coughing and auto-triggering of the ventilator.

Volume compensation:
For patients with inspiratory volume loss, after cuff deflation, additional Tidal Volume (Vt) may be provided until baseline Peak Inspiratory Pressure (PIP) is reached. When considering use of a PMV with mechanical ventilation, factors such as inspiratory support may be managed by ensuring the patient achieves baseline Peak Inspiratory Pressures.

Alarm adjustments:
All alarms on the ventilator must be re-evaluated for appropriate adjustments before, during, and after use of the Valve. Proper alarm management is essential for patient safety and best standard of care.

Options for alarm management are dependent upon facility policy. Patient safety is the priority and proper management of the ventilator is key. With clear understanding of the ventilator and the changes that the PMV applies to the respiratory system, the members of the care team may advocate for adjustments for best practice and improved likelihood of patient satisfaction and comfort (ordered by the physician). It is recommended that a procedure be in place to identify when settings were changed. Proper documentation allows for the ventilator to be returned to the baseline settings when the PMV is removed.

Manometry: Measuring Transtracheal Pressure and Ensuring Airway Patency

To address the issue of the airway and atypical airflow, the step of assessing airway patency with manometry may provide information to the medical team regarding the patient's ability to exhale adequately around the trachea. If there is obstruction and the patient cannot adequately exhale, pressure can incrementally increase with each breath, known as breath stacking or air trapping (Hess, 2005; Hofmann et al., 2008). Additionally, a higher end-expiratory pressure reading with manometry may indicate patient discomfort, even if the patient is not breath stacking.

For medically complex infants in ICUs, initiating Transtracheal Pressure (TTP) testing as part of every PMV assessment is a helpful tool for objective feedback to physicians and the team regarding safety and readiness for Valve application. Transtracheal pressure testing equipment includes a manometer to be applied within the ventilator circuit with O_2 tubing and an adapter. Adapters, such as the 15/22mm step-down adapter or a 22mm silicone adapter (*see Image 1*), may be added into the circuit as well

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as aiding proper fit of the Valve. The assessment team, typically respiratory therapy and speech-language pathology, determines how to place the Valve into the circuit, with and without the manometer.

Image 2

Transtracheal Pressure (TTP) measurement equipment with Tracheostomy P.A.M.™ (Pediatric Airway Model).

A TTP value is the number at the end of the exhalation or end-expiratory pressure with resting breaths only. This reading provides the patient's physiologic PEEP (positive end-expiratory pressure). When placing the PMV, a closed system is reestablished which restores a more normal physiologic PEEP, as compared to the PEEP provided by the ventilator. An adequate TTP reading provides feedback to the team that the airway is patent, and the patient may adequately exhale around the tracheostomy tube. The pediatric population presents a special challenge during evaluation because any movement or vocalization will increase the pressure and compromise the ability to read resting breaths. If an infant is crying, moving, vocalizing, or pushing, the pressures will be increased, and it will not be an accurate reading. Challenges with pediatrics occur not only because of the smaller anatomy but due to the difficulties with following specific directions, such as "just breathe" or "don't move."

One option to address these issues is to obtain TTP readings while the patient is sleeping in order to test true resting breaths, as the measurement can be taken in as little as 20 seconds. However, the team should consider that despite current literature supporting application of the PMV during sleep (Barraza et al., 2014), use of the Valve during sleep is an off-label use. Alternatives to placing the Valve for TTP measurement during sleep is to catch the child in either a drowsy state or to distract with toys or videos.

Another consideration is the current discrepancy as to what value is deemed acceptable, meaning what TTP reading or number demonstrates that the airway is patent, and the patient may comfortably and adequately exhale around the tracheostomy tube. An early study suggested that a tracheal pressure greater than 5 cmH_2O during passive exhalation may indicate excessive expiratory resistance (Hess, 2005). However, most studies have reported that pressures in the range of 2-6 cmH_2O indicate a patent airway and that assessment for use of the Valve may occur (Barraza et al., 2014; Buswell, Powell, & Powell, 2016). Additionally, recent research has indicated that children with end-expiratory pressure up to 10 cmH_2O may tolerate the Valve (Utrarachkij et al., 2005). In an earlier study, Trotter (1995) found accurate predictions for success with the PMV occurred when patients' end-expiratory pressures were 15 cmH_20 or lower. Trotter also indicated that SpO_2 was not a good predictor for Valve use. The literature provides a range of airway patency measurements at which predicting success for Valve use has occurred. The use of TTP is one method for providing an objective measurement that may assist with evaluating patients and may identify potential airway difficulties or even successes. Due to the range of measurements, further research is warranted.

Obtaining an accurate TTP reading requires a good understanding of respiratory and ventilator basics, such as PIP and PEEP, and the differences between ventilators and circuits. Therefore, it may be helpful initially to test airway patency via manometry to obtain baseline measurements without the PMV. Generally, the manometer, without the PMV in place, will read PIP (inspiration) to PEEP (peak end-expiratory pressure) values, which are similar to what is set with the ventilator. For example, if the patient's ventilator is set to a PEEP of 8 cmH_2O and a PIP of 20 cmH_2O, the manometer should fluctuate between 8-20 cmH_2O with each breath. This consistency may provide a means of calibrating the TTP and identifying accurate readings. Although, at times, the PIP value on the manometer may be slightly lower than the ventilator PIP, such as when there is an exhalation valve, as seen with the Trilogy.

Obtaining an accurate TTP reading requires a good understanding of respiratory and ventilator basics, such as PIP and PEEP.

Once the SLP and RT obtain a patient's manometry baseline, the PMV is placed in-line with the manometer and adapters. With resting breaths only, the TTP reading is the value at the end of exhalation. While this process may seem simple, in actuality, it is challenging to get accurate readings without proper training. The numbers may be misread, especially if a clinician is not familiar with the ventilator, respiratory function, or manometry readings. Importantly, the clinician should not initially read the high number as the inhalation or PIP and the low number as the exhalation or PEEP. In fact, with initial placement, a high number may be the exhalation, but once the patient settles and resting breaths are measured, the high number may be the PIP. It is helpful to watch the baby or child and the manometer for indicators. The RT also contributes information from the ventilator by monitoring inhalation via the ventilator and providing an indication when the patient is at the end of exhalation. Marking the end of exhalation provides a more accurate reading for expiratory pressure. Watching the infant's chest rise and fall provides relevant information as well. TTP readings may be impacted by position and state, so pressures may need to be retested if the child is moving, agitated, crying, or engaging in other activities that may interfere with readings. Because of the factors that may impact TTP measurements, the SLP and RT may need multiple sessions to get a proper measurement.

If the pressure is too high, breath stacking occurs, or discomfort is visible during exhalation through the nose and mouth, the following should be considered:

1. Repeat the DLB/endoscopy to examine the airway.
2. Downsize the tracheostomy tube (Mehta & Chamyal, 1999).
3. Change from a cuffed tracheostomy tube to an uncuffed one (Hess, 2005).

It should be noted that even if the airway is patent, other factors can interfere with use of the PMV. Therefore, the SLP and RT must offer the opportunity to use the Valve safely and consistently (Hull, 2005).

A Facility's Guideline to Passy Muir Valve Application and Best Practice

With limited research on PMV application in the pediatric, medically complex, ventilator-dependent population, it is recommended that facilities develop best practice guidelines for PMV application. Often these guidelines have input from and are approved by pulmonology, otolaryngology, respiratory therapy, and speech-language pathology, among other specialties. To provide best practice and state-of-the-art care for the medically complex, pediatric patient with tracheostomy or ventilator dependence, it is essential that the clinical professionals be familiar with all aspects of respiratory function, including appropriate interventions and assessments, to enhance access to and use of the PMV.

This sample guideline provides suggested steps for patient selection; proper ventilator and alarm considerations; and assessment and application processes for use of the PMV in the pediatric patient population:

I. PROCEDURE:

A. Criteria for candidacy:

1. Placement after first trach change.
2. Tolerance of cuff deflation.
3. Being hemodynamically stable.
4. Physician to review the most recent airway examination and determine if follow up is needed, before Valve placement.
5. Physician to consider indication for tracheostomy, size of tracheostomy tube, and upper airway obstruction to determine if a patient is a candidate for Valve placement.
6. Patient's age and weight.
7. Contraindications:
   a. Significant upper airway obstruction per ENT or pulmonology.
   b. Copious, thick secretions.
   c. Foam-filled cuff.
   d. Airway stenting.

B. Ventilator parameter recommendations for candidacy:

1. $FiO_2 < 50\%$
2. PEEP $\leq$ 10 cmH_2O
3. PIP/PAP < 40 cmH_2O

C. Application of PMV for patients who are on a ventilator.

1. Physician to order:
   a. Passy Muir Valve trial (Respiratory order) through SLP consult.
   b. SLP conducts bedside evaluation, in conjunction with respiratory therapy.
2. Supplies for in-line placement *(see Image 1)*.

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3. Pressure testing supplies *(see Image 2)*.
4. Position patient upright.
5. Observe baseline vitals.
6. Oral care and suctioning, as needed.
7. RT to:
   a. Deep suction tracheostomy, if needed.
   b. Observe PIP and exhaled Vt.
   c. Deflate cuff slowly.
   d. Suction trach and mouth again, as needed.
   e. Look for loss of exhaled Vt.
   f. Observe changes in vitals, color, work of breathing, and signs of stress.
8. Proceed, if tolerating the above steps.
9. Apply PMV and transtracheal pressure manometry in-line with the ventilator circuitry (not directly to the tracheostomy hub so as to avoid torque) with adapters and pressure testing supplies. Monitor transtracheal reading/pressure testing, which measures end-expiratory pressure.

D. Application of PMV for patients with tracheostomy tube only (without a ventilator)

1. Physician order.
2. SLP conducts bedside evaluation for use of PMV, in conjunction with RT, for initial placement.
3. Pressure testing supplies *(see Image 2)*
4. Position patient upright.
5. Observe baseline vitals.
6. Oral care and suctioning, as needed.
7. RT to deep suction trach, if needed.
8. Slowly deflate cuff.
9. Suction trach and mouth again, as needed.
10. Observe changes in vitals, color, work of breathing, and signs of stress.
11. Support tracheostomy tube neck flange with one hand and gently apply PMV and transtracheal pressure manometry to the tracheostomy hub, using a gentle quarter turn twist to the right to seat the Valve on the tracheostomy hub. To remove, support the tracheostomy tube neck flange and turn to the right, while using a gentle pulling off motion.
12. Monitor transtracheal reading/pressure testing, which measures end-expiratory pressure.
13. Monitor stability.
14. Pressure reading values:

Likely Pass: Resting TTP < 10 cmH_2O	**10-20 cmH_2O, Borderline**	**Possible Fail: Resting TTP > 20 cmH_2O**
1. Action: Proceed with PMV trial. **a.** Children with mean TTP < 5 cmH_2O are more likely to proceed to full tolerance status. **b.** Children with mean TTP 5-10 cmH_2O- likely to cope with longer 1:1 supervised trials.	**1. Action:** Proceed with short trials with SLP, as tolerated. **2.** Closely monitor for work of breathing or stress signs.	**1. Action:** Review possible confounding effects. **a.** If deemed inaccurate, action is to retrial. **b.** Contact ENT. Next steps may include assessment of upper airway or downsizing tracheostomy tube.

E. Signs that the patient has not tolerated the Valve

1. Significant change in vitals with cuff deflation or Valve placement.
2. Stress signs, such as changes in color or increased work of breathing.
3. High-pressure testing with TTP.
4. If a “whoosh” sound occurs when the Valve is removed following resting breaths, there is a concern for breath stacking.

F. Additional information:

1. The patient may cough because of an increased sensation of secretions. This type of cough is not a sign of poor PMV tolerance.
2. Oxygen may be delivered via T-piece, trach collar, PMV oxygen adapter, or ventilator.
3. Humidity may be provided via a tracheostomy collar or T-piece. Humidification does not affect the function of Valve.
4. Alarms may need to be adjusted or managed by RT with physician orders.

G. Following the PMV trial

1. Either the SLP or the RT will document the patient’s ability to wear the Valve.
2. The SLP, RT, and ordering physician will determine the plan for ongoing Valve trials, and the physician will write any appropriate orders.
3. Ongoing pressure testing will likely not be completed, unless concerns are noted.

References

Abraham, S. S. (2009). Perspectives on the pediatric larynx with tracheotomy. In: Fried M., Ferlito, A. (eds): *The Larynx*. San Diego: Plural Publishing, Chapter 32.

Barbato, A., Bottecchia, L., & Snijders, D. (2012). Tracheostomy in children: an ancient procedure still under debate. *European Respiratory Journal, 40*(6), 1322-1323.

Barraza, G. Y., Fernandez, C., Halaby, C., Ambrosio, S., Simpser, E. F., & Pirzada, M. B. (2014). The safety of tracheostomy speaking valve use during sleep in children: A pilot study. *American Journal of Otolaryngology, 35*(5), 636-640.

Beard, B., & Monaco, F. J. (1993). Tracheostomy discontinuation: Impact of tube selection on resistance during tube occlusion. *Respiratory Care, 38*(3), 267-270.

Buswell, C., Powell, J., & Powell, S. (2016). Paediatric tracheostomy speaking valves: Our experience of forty-two children with an adapted Passy Muir® Speaking Valve. *Clinical Otolaryngology, 42*(4), 941-944. doi:10.1111/coa.12776

Cowell, J., Schlosser, D., & Joy, P. (2000). Language outcomes following infant tracheostomy. *Asia Pacific Journal of Speech, Language, and Hearing, 5*(3), 179-186. Published online 2013. http://dx.doi.org/10.1179/136132800805576942

DeMauro, S. B., D'Agostino, J. A., Bann, C., Bernbaum, J., Gerdes, M., Bell, E. F., Carlo, W. A., D'Angio, C. T., Das, A., Higgins, R., Hintz, S. R., Laptook, A. R., Natarajan, G., Nelin, L., Poindexter, B. B., Sanchez, P. J., Shankaran, S., Stoll, B. J., Truog, W., & Kirpalani, H. (2014). Developmental outcomes of very preterm infants with tracheostomies. *Journal of Pediatrics, 164*(6), 1303-10.

Hernandez, G., Pedrosa, A., Ortiz, R., Accuaroni, M. D., Cuena, R., Collado, C. V., Plaza, S. G., Arenas, P. G., & Fernandez, R. (2013). The effects of increasing effective airway diameter on weaning from mechanical ventilation in tracheostomized patients: A randomized controlled trial. *Intensive Care Medicine, 39*(6), 1063-1070. doi:10.1007/s00134-013-2870-7

Hess, D. R. (2005). Facilitating speech in the patient with a tracheostomy. *Respiratory Care, 50*(4): 519-525.

Hess, D. R. & Altobelli, N. P. (2014). Tracheostomy tubes. *Respiratory Care, 59* (6): 956-971. Doi: 10.4187/respcare.02920

Hofmann, L., Bolton, J., & Ferry, S. (2008). Passy-Muir speaking valve use in a children’s hospital: An interdisciplinary approach. *Perspectives on Voice and Voice Disorders, 18*(2): 76 – 86. Doi: 10.1044/vvd18.2.76

Hull, E. M., Dumas, H. M., Crowley, R. A., & Kharasch, V. S. (2005). Tracheostomy speaking valves for children: Tolerance and clinical benefits. *Pediatric Rehabilitation, 8*(3), 214-219. doi: 10.1080/13638490400021503

Keens, T., Kun, S., & Davidson Ward, S. (2017). Chronic respiratory failure. In W. Morris, K. McMillan, & D. Schaffner (eds). *Roger’s Handbook of Pediatric Intensive Care*. Philadelphia, PA: Walters Kluwer.

Lieu, J. E. C., Muntz, H. R., Prater, D., & Stahl, M. B. (1999). Passy-Muir Valve in children with tracheotomy. I*nternational Journal of Pediatric Otorhinolaryngology, 50*(3), 197-203.

Lewis, C. W., Carron, J. D., Perkins, J. A., Sie, K. C., & Feudtner, C. (2003). Tracheotomy in pediatric patients: A national perspective. *Archives of Otolaryngology–Head & Neck Surgery, 129*(5), 523-529.

Mehta, A. K. & Chamyal, P. C. (1999). Tracheostomy complications and their management. *Medical Journal Armed Forces India, 55* (3), 197 – 200.

O’Connor, L. R., Morris, N. R., & Paratz, J. (2019). Physiological and clinical outcomes associated with use of one-way speaking valves on tracheostomised patients: A systematic review. *Heart & Lung, 48*(4), 356-364. doi:10.1016/j.hrtlng.2018.11.006

Shaker, C. & Mutnik, C. (2012). Baby Trachs: Use of the Passy-Muir® Valve in the NICU to Optimize Swallowing and Feeding. [self-study webinar]. www.passymuir.com/ceus

Suiter, D., McCullough, G. H., & Powell, P. W. (2003). Effects of cuff deflation and one-way tracheostomy speaking valve placement on swallowing physiology. *Dysphagia, 18*(4), 284-292. doi:10.1007/s00455-003-0022-x

Sutt, A. L., Caruana, L. R., Dunster, K. R., Cornwell, P. L., Anstey, C. M., & Fraser, J. F. (2016). Speaking valves in tracheostomised ICU patients weaning off mechanical ventilation--do they facilitate lung recruitment? *Journal of Critical Care, 20*:91. doi: 10.1186/s13054-016-1249-x.

Torres, L. & Sirbegovic, D. J. (2004). Clinical benefits of the Passy Muir Tracheostomy and Ventilator Speaking Valves in the NICU. *Neonatal Intensive Care, 17*(4): 20-23.

Trotter, L. B. (1995). Success predictors for Passy Muir Speaking valve use in a pediatric population: a method evaluation.[abstract]. *Respiratory Care, 40*(11), 1099-1242.

Utrarachkij, J., Pongsasnongkul, J., Preutthipan, A., & Chantarojanasri, T. (2005). Measurement of end-expiratory pressure as an indicator of airway patency above tracheostomy in children. *Journal of the Medical Association of Thailand, 88*(7), 928-33.

Watters, K. F. (2017). Tracheostomy in infants and children. *Respiratory Care, 62*(6), 799-825. doi:10.4187/respcare.05366

Weaning and Decannulation: Role of a No-leak Speaking Valve

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Research demonstrates that early use of the Passy Muir Valve, including in-line application with mechanical ventilation, provides both pediatric and adult patients with many benefits, including augmenting and expediting ventilator weaning (Sutt et al., 2016; O'Connor et al., 2018; Forni et al., 2020; You et al., 2022). Beyond improving access to communication and allowing the patient to become a more motivated participant in treatment interventions for weaning and recovery, use of the Passy Muir Valve re-establishes a closed aerodigestive system and restores physiologic positive end-expiratory pressure (PEEP), which improves oxygenation and may lead to reduced need for ventilatory support and tracheostomy (Sutt et al., 2016; Obi et al., 2018).

The study by Sutt et al. (2016) investigated the use of the Passy Muir Valve with adult cardiothoracic patients undergoing ventilator weaning in the ICU. The study evaluated end-expiratory lung impedance (EELI) and standard bedside respiratory parameters of these patients, before, during, and after use of a Passy Muir Speaking Valve, both in-line with mechanical ventilation and with high flow t-piece. An increase in EELI was observed following use of the Passy-Muir Valve and was maintained for at least 15 minutes following removal. Length of time for maintaining increased EELI following removal of the Passy Muir Valve was limited by the time constraints of the study, which allowed for 15 minutes of post-Valve monitoring only. Speaking valve use resulted in a reduced respiratory rate, reduced end-tidal carbon dioxide, and improved lung volumes (Sutt et al., 2016).

Benefits of Early Intervention

Additional research has shown that early intervention with the use of a Passy Muir Valve improves overall patient psychological well-being and assists with improving ventilator requirements for respiratory function. With the improved lung recruitment, patients demonstrated improved oxygenation when using the Valve. Weaning times also were found to be shortened with the implementation of a multi-disciplinary team, including a speech-language pathologist as a team member to increase use of the Passy Muir Valve to facilitate communication and upper airway use (Black et al., 2012).

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Another study investigated the role of PEEP in monitoring the ability to wean a patient from mechanical ventilation to a tracheostomy (trach) collar (Obi et al., 2018). Initially, the patients did not do well transitioning from a set PEEP on the ventilator to a tracheostomy collar, with presumed zero-PEEP, due to the open tracheostomy tube. The protocol was changed to require that the Passy Muir Valve (a bias-closed, no-leak design) be used prior to transitioning to a tracheostomy collar and while on a tracheostomy collar. The authors reported greater success with weaning and improved overall respiratory status when using the Passy Muir Valve as a part of the weaning protocol (Obi et al., 2018). This improved efficiency was attributed to restoring a closed system and more normal physiologic PEEP with the use of the Passy Muir Valve (Obi et al., 2018).

Using the Valve as part of an established multidisciplinary approach when treating patients requiring mechanical ventilation may further assist with weaning outcomes.

In response to the COVID-19 pandemic, new protocols were developed that addressed tracheostomy needs for patients with tracheostomies and mechanical ventilation. Many of these new protocols included the use of a Passy Muir Valve during the progression for ventilator weaning and return to oral diet (Cavalli et al., 2023; Tornari et al., 2021). Speaking valves were implemented with a deflated cuff and either with or without a fenestrated tracheostomy tube. Using this type of protocol, patients were successfully weaned from mechanical ventilation and returned to an oral diet prior to discharge or transfer (Cavalli et al., 2023; Tornari et al., 2021).

Using the Valve as part of an established multi-disciplinary approach when treating patients requiring mechanical ventilation may further assist with weaning outcomes. In a study by Black et al. (2012), the authors reported on the implementation of a long-term weaning protocol in an intensive care unit (ICU) at a university teaching hospital in London, UK. This protocol included the establishment of a multidisciplinary team with a physiotherapist [respiratory therapist], nurse consultant, dietician, and speech-language therapist. The findings following implementation of this protocol were that with the use of speaking valves, they had improvement in ICU and hospital survival (Black et al., 2012). They also reported that the time required for mechanical ventilation was reduced by an average of 11 days.

Another Consideration: Decannulation

For decannulation, most teams and physicians opt for occluding the tracheostomy tube with a cap. This cap covers the proximal end of the tracheostomy tube and blocks air from entering or exiting the tracheostomy tube, which forces the patient to inhale and exhale through their nose and mouth. The Passy Muir Valve is a bias-closed position, no-leak valve that may also be placed on the proximal end of the tracheostomy tube. However, unlike a cap, the Valve opens during inhalation and returns to the closed resting position during exhalation. This closure redirects airflow out through the upper airway, vocal folds, mouth, and nose. The Valve can be used as an alternative to tracheal tube plugging/capping for patients who cannot tolerate the plugging/capping due to physiologic or emotional reasons. If a patient is only tolerating capping for short periods of time or not at all, the Valve may be used in the interim (between plugging/capping trials) as a step to assist the patient's transition from an open tracheostomy tube to tracheostomy tube capping. The Valve assists in the tracheostomy decannulation process by allowing the patient to begin adjusting to a more normal breathing pattern through the upper airway on exhalation. This allows the patient to gain confidence and the physician to assess for airway patency.

A patient must have a patent airway to use a cap or a Passy Muir Valve. Some patients may find that capping increases the work of breathing since they are inhaling and exhaling around a tracheostomy tube to the mouth and nose. With the use of a Valve, the patient may experience less work of breathing and perhaps less anxiety (Freeman-Sanderson et al., 2018). The timing of Valve placement and use of capping versus Passy Muir Valve use in decannulation pathways varies. Martin et al. (2021) found that placement of a Passy Muir Valve within 24 hours after a percutaneous tracheotomy led to faster decannulation than when Valves were placed greater than 48 hours after tracheotomy.

Dubin et al. (2021) conducted a prospective, observational cohort study to investigate patient goals and functional outcomes for patients in a long-term care hospital. They found that 18 – 22% percent of the patients reported anxiety and depression. When asked about their goals, the patients rated eating/drinking and speech as their top priority. The Passy Muir Valve was evaluated at the time of the swallowing evaluation, and 92% of the patients achieved verbal communication (Dubin et al., 2021). The authors concluded that restoring speech was critical to patient recovery and to reducing anxiety. With reduced anxiety, patients progress faster towards decannulation.

Rathburn and Imber (2019) reported on a patient with stiff person syndrome who had extreme anxiety at the introduction of capping trials with the tracheostomy. The patient exhibited anxiety-induced muscle spasms, which led to acute hypoxic respiratory failure. Anxiety for capping trials is often described as occurring due to the fear of not being able to breathe. Because of the difference in how breathing occurs with the Passy Muir Valve as compared to capping, interim use of the Valve may reduce anxiety since there is not a sudden and drastic change in breathing pathways.

Maslan et al. (2017) conducted a retrospective study to investigate the decannulation process and to identify successful steps for pediatric patients with chronic tracheostomy. The authors reported that 13% of the patients did not tolerate capping due to anxiety or age (Maslan et al., 2017). Most patients were decannulated after use of both the Passy Muir Valve and daytime capping. Of those patients with whom age was an issue, the authors reported that the only issue arose with a child six months old who was too young to tolerate capping. Another procedure undertaken was to conduct an endoscopy during a sleep study. This allowed assessment for obstruction or other anatomical factors that may impact breathing and cause anxiety. The authors found that the use of the Passy Muir Valve occurring prior to capping worked as a means of transitioning the patients towards capping with lower anxiety and increased success.

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Summary

Anxiety with a change in respiration is common, even more so when a tracheostomy tube is capped. For this discussion, use of a Passy Muir Valve would be beneficial for the patient population with tracheostomies, especially anxiety, due to how it works with the patient's breathing, allowing them to continue to breathe in through the Passy Muir Valve and tracheostomy tube. These are typically steps in a decannulation protocol, with the goal being removal of the tracheostomy tube. Some facilities use the Passy Muir Valve as their marker for timing of decannulation.

Among its many benefits, placing the Passy Muir Valve for patients with tracheostomy and mechanical ventilation, assists with weaning and decannulation. Research supports the use of the Valve as part of a weaning program to wean patients off the ventilator. It also demonstrates that use of the Passy Muir Valve leads to faster weaning from tracheostomy (decannulation) in both the pediatric and adult patient populations.

References:

Black, C. J., Kuper, M., Bellingan, G. J., Batson, S., Matejowsky, C., & Howell, D. C. (2012). A multidisciplinary team approach to weaning from prolonged mechanical ventilation. *British Journal of Hospital Medicine, 73*(8), 462–466.https://doi.org/10.12968/hmed.2012.73.8.462

Cavalli, E., Belfiori, G., Molinari, G., Peghetti, A., Zanoni, A., & Chinelli, E. (2023). Does a decannulation protocol exist in COVID-19 patients? The importance of working in a multiprofessional team. Discover health systems, 2(1), 14. https://doi.org/10.1007/s44250-023-00031-z

Dubin, R., Veith, J. M., Grippi, M. A., McPeake, J., Harhay, M. O., & Mikkelsen, M. E. (2021). Functional outcomes, goals, and goal attainment among chronically critically ill long-term acute care hospital patients. *Annals of American Thoracic Society, 18* (12), 2041- 2048.

Forni, R., Besana, T., Amitrano, A., Voinea, C., & Ogna, A. (2020). Ventilatory weaning and early rehabilitation in COVID-19-related acute respiratory distress syndrome: the experience at Locarno hospital, canton of Ticino, Switzerland. *Swiss Medical Weekly, 150,* w20397. https://doi.org/10.4414/smw.2020.20397

Freeman-Sanderson, A. L., Togher, L., Elkins, M. R., & Kenny, B. (2018). Quality of life improves fortracheostomy patients with return of voice: A mixed methods evaluation of the patient experience across the care continuum. *Intensive Critical Care Nursing, 46,* 10-16. https://doi.org/10.1016/j.iccn.2018.02.004

Martin, K. A., Cole, T., Percha, C. M., Asanuma, N., Mattare, K., Hager, D. N., Brenner, M. J., & Pandian, V. (2021). Standard versus Accelerated Speaking Valve Placement after Percutaneous Tracheostomy: A Randomized Controlled Feasibility Study. *Annals of the American Thoracic Society, 18* (10), 1693–1701. https://doi.org/10.1513/AnnalsATS.202010-1282OC

Maslan, J. T., Feehs, K. R., & Kirse, D. J. (2017). Considerations for the successful decannulation of the pediatric patient: A single surgeon's experience. *International Journal of Pediatric Otorhinolaryngology, 98,* 116 – 120. https://dx.doi.org/10.1016/j.ijporl.2017.04.038

McRae, J., Smith, C., Beeke, S., & Emmanuel, A. (2019). Oropharyngeal dysphagia management in cervical spinal cord injury patients: An exploratory survey of variations to care across specialised and non-specialised units Series and Cases Spinal Cord Series and Cases, 5, 31. https://doi.org/10.1038/s41394-019-0175-y

O'Connor, L. R., Morris, N. R., & Paratz, J. (2019). Physiological and clinical outcomes associated with use of one-way speaking valve on tracheostomized patients: A systematic review. *Heart & Lung, 48* (4), 356 – 364. https://doi.org/10.1016/j.hrtlng.2018.11.006

Obi, O. N., Mazer, M., Bangley, C., Kassabo, Zuheir, Saadah, K., Trainor, W., Stephens, K., Rice, P. L., & Shaw, R. (2018). Obesity and weaning from mechanical ventilation – An exploratory study. *Clinical Medicine Insights: Circulatory, Respiratory and Pulmonary Medicine, 12,* 1 – 9. https://doi.org/10.1177/1179548418801004

Pandian, V., Miller, C. R., Schiavi, A. J., Yarmus, L., Contractor, A., Haut, E. R., Feller-Kopman, D. J., Mirski, M. A., Morad, A. H., Carey, J. P., Hillel, A. T., Maragos, C. S., & Bhatti, N. I. (2014). Utilization of a standardized tracheostomy capping and decannulation protocol to improve patient safety. *The Laryngoscope, 124*(8), 1794–1800. https://doi.org/10.1002/lary.24625

Rathbun, J. T. & Imber, J. (2019). Stiff person syndrome and type 1 diabetes mellitus: a case of the chicken or the egg? *Journal of General Internal Medicine, 34* (6), 1053 – 1057. https://doi.org/10.1007/s11606-019-04835-9

Sutt, A., Caruana, L. R., Dunster, K.R., Cornwell, P. L., Anstey, C. M., and Fraser, J. F. (2016). Speaking valves in tracheostomised ICU patients weaning off mechanical ventilation – Do they facilitate lung recruitment? *Critical Care, 20* (91). https://doi.org/10.1186/s13054-016-1249-x

Tornari, C., Surda, P., Takhar, A., Amin, N., Dinham, A., Harding, R., Ranford, D. A., Archer, S. K., Wyncoll, D., Tricklebank, S., Ahmad, I., Simo, R., & Arora, A. (2021). Tracheostomy, ventilatory wean, and decannulation in COVID-19 patients. *European archives of oto-rhino-laryngology : official journal of the European Federation of Oto-Rhino-Laryngological Societies (EUFOS) : affiliated with the German Society for Oto-Rhino-Laryngology - Head and Neck Surgery, 278* (5), 1595–1604. https://doi.org/10.1007/s00405-020-06187-1

You, P., Dimachkieh, A., Yu, J., Buchanan, E., Rappazzo, C., Raynor, T., Arjmand, E., Bedwell, J., Weber, R. S., Kupferman, M. E., & Chelius, D. C. (2022). Decannulation protocol for short term tracheostomy in pediatric head and neck tumor patients. *International Journal of Pediatric Otorhinolaryngology, 153,* 111012. https://doi.org/10.1016/j.ijporl.2021.111012

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Featured Authors

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PASSY MUIR'S AERODIGESTIVE HEALTH

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Laura attended the University of Florida, finishing in 1997, and the University of Virginia, graduating in 1999. She worked at NYU Medical Center, became the supervisor of the pediatric SLP department, and then joined Children's Healthcare of Atlanta in 2009. She works with patients in the Intensive Care and acute care units; is Board Certified in Swallowing and Swallowing Disorders; and participates in research related to tracheostomies, speaking valves, and evidence-based care.

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Michael Harrell has experience in respiratory care clinical practice, education, and management. Prior to joining the Passy-Muir clinical team in 2005, he was a Director of Respiratory Care in Florida. Michael also presided as President of the Florida Society of Respiratory Care where he brought together his clinical knowledge and strong advocacy for patient care to improve respiratory care in the state of Florida. In his role as Director of Clinical Education-Respiratory with Passy-Muir, Inc., he has presented both domestically and internationally.

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With over 30 years of experience in medical settings, academia, and industry, Dr. King brings a unique perspective to the care of patients, especially following TBI and tracheostomy and ventilator dependency. As a professor, she conducted research and published in peer-reviewed journals on TBI and swallowing disorders. In industry, she works to improve patient outcomes through the development of multi-media education and by participating in product development and regulatory requirements for medical devices. With Passy Muir, she is the host of the CAM Podcast, editor of Aerodigestive Health, and speaks at state, national, and international conferences. She has authored many clinical papers and is co-editor of the book *Tracheostomy and Ventilator Dependence in Adults and Children: Learning Through Case Studies*.

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Tiffany Oakes has been a medical SLP in various settings, treating both adult and medically complex pediatric populations. Tiffany has developed patient care pathways for patients in home health, at both the state and national level. She has participated in research related to patients with TBI and sports concussions, and she has authored various papers. She also is a volunteer for Remote Area Medical (RAM). She develops multimedia education related to healthcare and clinical practice and teaches related courses. She is currently a full-time Clinical Specialist with Passy-Muir, Inc.

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Gabriela Ortiz has experience in respiratory care across acute, sub-acute, sleep therapy, and homecare settings. As a Respiratory Clinical Director and General Manager, she oversaw all aspects of company operations, patient assessment, and case management for adult and pediatric patients. She transitioned into clinical education and sales, specializing in critical care ventilation solutions for acute and sub-acute hospitals. Gabriela teaches courses and is an invited speaker for clinical professionals, educational institutions, state and national conferences, and various support groups. She also has authored clinical articles and white papers, on topics such as ALS progression, neonatal tracheostomy, speaking valves, and respiratory care strategies. She is a full-time Clinical Specialist with Passy-Muir, Inc.

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Jessica Shaw is a licensed Speech-Language Pathologist with 19 years of experience in medical settings, specializing in care for children with complex medical needs. Throughout her career, Jessica has developed her expertise in medically fragile pediatric populations, with specialties in pediatric feeding, dysphagia, and airway management, presenting and publishing on these same topics. She also has contributed previous articles to Passy Muir's Aerodigestive Health publication and a case study for the textbook Tracheostomy and Ventilator Dependence in Adult and Children; Learning Through Case Studies. Jessica currently serves as the Director of Education for St. Mary's Healthcare System's home healthcare agency.

Gail M. Sudderth, RRT

Gail M. Sudderth, RRT, practiced as a respiratory therapist for over 40 years. Her experience included being a lead therapist at a large teaching hospital with a focus on medically complex patients who required tracheostomy and mechanical ventilation and were difficult to wean. She worked closely with the speech-language pathologists and developed training competencies for suctioning and cuff management. Ms. Sudderth had a long history of developing and co-developing web-based presentations and on-site seminars for medical professionals who care for patients with tracheostomy. She was an invited speaker, both domestically and internationally. In addition, she published articles on multidisciplinary airway management teams and speaking valve use. She was a Clinical Specialist – Respiratory Therapy for Passy-Muir, Inc. for 14 years.