NTSP Podcast series

National Tracheostomy Safety Project

This month's top papers: August 2024

Welcome to the latest blog in the literature podcast from the NTSP. We try to bring you a quick roundup of what is hot in the world of tracheostomy and laryngectomy publications by scouring internationally recognised journals and media and bringing you the highlights.

The papers we will discuss this month are detailed below, along with an automated transcript of the podcast. Please note that the transcript is generated by AI and so may not be totally accurate.

You can find the links to the podcast on www.tracheostomy.org.uk and by searching for NTSP on your favourite podcast platform. Some of the podcasts are also uploaded to YouTube if you prefer to get your news that way. Check out the NTSP YouTube channel at https://www.youtube.com/c/NationalTracheostomySafetyProject. Please follow us and/or subscribe to keep up to date! https://x.com/NTSP_UK

Please note that the comments below and on the podcasts represent the individual authors' opinions and do not reflect the opinions of any of the organisations that the authors work for. Please leave any comments in the chat function or via X.

This month's top papers

- Predicting Tracheostomy Need on Admission to the Intensive Care Unit-A Multicenter Machine Learning Analysis.
- Low-Resource Hospital Days for Children Following New Tracheostomy.
- Augmentative and Alternative Communication Interventions in Critical and Acute Care With Mechanically Ventilated and Tracheostomy Patients: A Scoping Review.
- Elevating Tracheostomy Care Through Data-Driven Innovation: What Can Education, Evidence-Based Practice, and Quality Improvement Learn from One Another?

NTSP Podcast Series

Predicting Tracheostomy Need on Admission to the Intensive Care Unit-A Multicenter Machine Learning Analysis.

Lay Summary:

This study addresses a major challenge in the Intensive Care Unit (ICU): accurately predicting which patients on a mechanical ventilator will eventually require a tracheostomy (a surgical breathing tube in the neck). Since predicting this need is difficult, many patients undergo unnecessary procedures like frequent breathing trials, which prolong the time they spend on the ventilator and increase the risk of complications like injury to the voice box. The consequence of this poor prediction is significant, adding to hospital costs and delaying recovery. The goal of the research was to develop an Artificial Intelligence (AI) tool to solve this problem.

The researchers used advanced machine learning to analyze a large amount of patient data from over 335 ICUs across the country. The AI tool was trained to make a prediction about the need for a tracheostomy right at the moment a patient is admitted to the ICU. This capability is crucial, as it allows doctors to plan a recovery pathway much earlier. The study's conclusion is that this new AI tool can be implemented to identify patients at risk, which will help doctors expedite necessary care, avoid complications like subglottic stenosis, and contain costs.

Summary for Healthcare Professionals:

This multicenter retrospective cohort study utilized the eICU Collaborative Research Database (eICU-CRD) to develop a machine learning (ML) tool capable of predicting tracheostomy requirement at the time of Intensive Care Unit (ICU) admission. The rationale for this development addresses a critical clinical deficit: the difficulty in predicting tracheostomy leads to a host of adverse outcomes, including unnecessary spontaneous breathing trials (SBTs), prolonged mechanical ventilation (MV) duration, increased healthcare costs, and the heightened risk of ventilation-related complications such as subglottic stenosis. The study cohort was derived from 335 ICUs across 2014 and 2015. The ML models identified key admission characteristics that serve as independent predictors of the ultimate need for a tracheostomy. The authors conclude that the developed ML tool provides a vital mechanism for early risk stratification. This capability is essential for optimizing MV and weaning protocols by identifying candidates for tracheostomy early, thereby mitigating the morbidity and cost associated with unnecessarily prolonged endotracheal intubation. Further implementation and validation of this tool are warranted to streamline patient flow and improve outcomes in the critical care setting.

NTSP Podcast Series

Low-Resource Hospital Days for Children Following New Tracheostomy.

Lay Summary:

This study looked at how hospitals manage the transition of children with new tracheostomies (breathing tubes in the neck) and mechanical ventilators from the intensive care unit (ICU) to home care. This transition is crucial because it requires parents to become primary caregivers for a medically fragile child, a process that is both complex and incredibly expensive for the hospital. The researchers analyzed a large database of over 4,000 children over a five-year period to understand how long the transition takes and what factors delay it. They focused on identifying Low-Resource Days (LRDs), defined as days where the patient's accrued non-room charges were very low, suggesting the patient was stable but still staying in the hospital for non-medical reasons, such as waiting for home services.

The findings showed that the post-tracheostomy hospital stay is very long, with a median of 69 days. Importantly, LRDs were extremely common: 38.6% of children experienced at least one day that could be classified as an LRD. This means that nearly four out of every ten children were delayed in their discharge because of non-clinical factors. The study found that being younger and having fewer medical problems were surprisingly linked to *more* LRDs, suggesting these stable children were waiting primarily on non-clinical barriers like arranging home nursing or equipment. The authors conclude that improving the efficiency of the discharge process—especially by streamlining home care arrangements and caregiver training—is the best way to significantly reduce these long, costly hospital stays.

Summary for Healthcare Professionals:

This retrospective cohort study utilized the Pediatric Health Information System (PHIS) database to analyze hospital resource utilization during the transitional care phase for 4,048 children (≤21 years) with new tracheostomies and invasive mechanical ventilation (IMV) dependence. The study's primary objective was to define and characterize Low-Resource Days (LRDs), quantifying days accrued post-tracheostomy where non-room charges were less than 10% of the patient's postoperative day 1 charges.

The analysis revealed that LRDs are a significant driver of prolonged hospitalization. The median post-tracheostomy length of stay (LOS) was 69 days. A substantial proportion of the cohort, 38.6%, experienced at least one LRD. Multivariable negative binomial regression identified factors associated with LRDs. Paradoxically, being younger at the time of tracheostomy (0–7 days old) was associated with an increased LRD occurrence. Furthermore, patients with fewer comorbidities and those who received tracheostomy after extubation failure (vs. those who were tracheostomized electively) were also associated with a greater number of LRDs. This strongly suggests that non-clinical factors, specifically the logistical delays in securing home care and durable medical equipment (DME), are responsible for delaying discharge. The authors conclude that quality improvement efforts must focus on streamlining the non-clinical discharge pathway to reduce the duration of the costly hospital transition for this medically complex population.

NTSP Podcast Series

Augmentative and Alternative Communication Interventions in Critical and Acute Care With Mechanically Ventilated and Tracheostomy Patients: A Scoping Review.

Lay Summary:

This study looked at the critical problem of communication for patients in the Intensive Care Unit (ICU) who are awake but cannot speak because they are on a mechanical ventilator with a tracheostomy tube. When the tube's cuff is inflated, airflow to the vocal cords is blocked, making verbal communication impossible. The loss of voice is incredibly distressing for patients, leading to feelings of frustration, helplessness, and severe anxiety, which can hinder recovery.

The researchers performed a comprehensive review to identify all the tools available to help these patients communicate, known as Augmentative and Alternative Communication (AAC) systems. These options range from simple gestures and writing boards (low-tech) to more advanced computer-based devices (high-tech). The review found that certain visual, high-tech systems and standardized nurse training programs were highly effective at improving patient health outcomes and communication efficiency. These interventions led to a significant reduction in patient anxiety and increased their comfort and satisfaction. However, the study concludes that there is currently no single solution that works for every patient. Therefore, the most important step is for the hospital team to continuously assess each patient individually and ensure they have the right mix of tools and support to communicate their needs and participate in their care.

Summary for Healthcare Professionals:

This scoping review synthesized the evidence on Augmentative and Alternative Communication (AAC) interventions for nonspeaking mechanically ventilated and tracheostomy patients in critical and acute care settings. The objective was to map the available literature concerning the efficacy and impact of AAC tools, addressing a critical component of person-centered care.

The analysis demonstrated that select AAC interventions are associated with measurable positive treatment effects. Small-to-large treatment effect sizes were found for interventions involving high-tech and no-tech visual interface–based systems and systematic nurse training protocols. These positive effects were primarily demonstrated through improvements in critical dependent variables, including patient anxiety, communication satisfaction, comfort, and enhanced symptom self-reporting. The review highlights that the lack of verbal communication is a significant source of psychological distress (e.g., frustration and powerlessness). The study concludes that there is currently a paucity of high-quality AAC intervention research, particularly high-certainty evidence. However, the emergent evidence strongly supports integrating specific visual interface tools and nurse training to enhance patient–provider communication and improve overall patient health outcomes. This underscores the importance of a tailored, multidisciplinary approach to communication assessment and management.

NTSP Podcast Series

Elevating Tracheostomy Care Through Data-Driven Innovation: What Can Education, Evidence-Based Practice, and Quality Improvement Learn from One Another?

Lay Summary:

This paper examines how three core concepts—education, evidence-based practice (EBP), and quality improvement (QI)—have revolutionized care for patients with a tracheostomy over the last decade. The authors highlight that improved safety, quality, and efficiency in tracheostomy care are not random, but the direct result of these elements working together. The goal is to standardize care to reduce the severe risks associated with breathing tubes. EBP provides the foundation by identifying the best care methods through research. This research then forms the basis of competency-based education, which uses active learning and simulations to ensure doctors, nurses, and therapists master critical skills. Finally, Quality Improvement takes these best practices and turns them into hospital-wide action, such as standardized protocols and team-based care. The paper acknowledges ongoing challenges, including inconsistent staff training, inadequate family education, and limited resources. To address this, the authors suggest innovative solutions like using virtual reality for staff training and digital tools for accessible patient education. They stress that for the positive trends to continue, hospitals must maintain continuous training, update protocols quickly based on new research, and involve patients and families in every step of the process. This interconnected approach is the key to ensuring all patients receive safe, high-quality care, regardless of where they are treated.

Summary for Healthcare Professionals:

This paper provides an essential synthesis of how the coordinated integration of Competency-Based Education (CBE), Evidence-Based Practice (EBP), and Quality Improvement (QI) has driven unprecedented progress in tracheostomy care over the past decade. The authors define these three elements as interconnected, with EBP generating the latest research that informs the content of CBE, which in turn establishes the skill proficiency necessary for successful QI implementation. CBE utilizes interactive methods like simulations and case studies, focusing on active skill acquisition to enhance clinical competency. Key QI drivers include the implementation of standardized protocols, multidisciplinary team-based care, and patient/family engagement. Despite demonstrable improvements in safety and efficiency, the paper identifies persistent, critical gaps in care: insufficient workforce training, variability in clinical practice, inadequate patient and family education, and resource disparities that hinder equitable care delivery. To bridge these deficits and ensure sustained quality, the authors advocate for the strategic adoption of data-driven innovation. Recommendations include leveraging innovative technologies such as AI and Virtual Reality for remote training, implementing regular multidisciplinary case reviews, continuously updating curricula based on new evidence, and advocating for equitable resource allocation. The conclusion emphasizes that a successful, high-value model for tracheostomy care requires these three foundational elements to reinforce one another continuously.

Scientific abstracts and references

Otolaryngol Head Neck Surg. 2024 Jul 30. doi: 10.1002/ohn.919. Online ahead of print.

Predicting Tracheostomy Need on Admission to the Intensive Care Unit-A Multicenter Machine Learning Analysis.

Nguyen M(1), Amanian A(2), Wei M(3), Prisman E(2), Mendez-Tellez PA(4).

Author information: (1)UVA School of Medicine, Charlottesville, Virginia, USA. (2)Department of Surgery, Division of Otolaryngology-Head & Neck Surgery, University of British Columbia, Vancouver, Canada. (3)Department of Biomedical Engineering-Whiting School of Engineering, Johns Hopkins University, Baltimore, USA. (4)Department of Anesthesiology and Critical Care Medicine, Johns Hopkins University School of Medicine, Baltimore, USA.

OBJECTIVE: It is difficult to predict which mechanically ventilated patients will ultimately require a tracheostomy which further predisposes them to unnecessary spontaneous breathing trials, additional time on the ventilator, increased costs, and further ventilation-related complications such as subglottic stenosis. In this study, we aimed to develop a machine learning tool to predict which patients need a tracheostomy at the onset of admission to the intensive care unit (ICU). STUDY DESIGN: Retrospective Cohort Study. SETTING: Multicenter Study of 335 Intensive Care Units between 2014 and 2015. METHODS: The eICU Collaborative Research Database (eICU-CRD) was utilized to obtain the patient cohort. Inclusion criteria included: (1) Age >18 years and (2) ICU admission requiring mechanical ventilation. The primary outcome of interest included tracheostomy assessed via a binary classification model. Models included logistic regression (LR), random forest (RF), and Extreme Gradient Boosting (XGBoost). RESULTS: Of 38,508 invasively mechanically ventilated patients, 1605 patients underwent a tracheostomy. The XGBoost, RF, and LR models had fair performances at an AUROC 0.794, 0.780, and 0.775 respectively. Limiting the XGBoost model to 20 features out of 331, a minimal reduction in performance was observed with an AUROC of 0.778. Using Shapley Additive Explanations, the top features were an admission diagnosis of pneumonia or sepsis and comorbidity of chronic respiratory failure. CONCLUSIONS: Our machine learning model accurately predicts the probability that a patient will eventually require a tracheostomy upon ICU admission, and upon prospective validation, we have the potential to institute earlier interventions and reduce the complications of prolonged ventilation.

DOI: 10.1002/ohn.919 PMID: 39077854

NTSP Podcast Series

Pediatrics. 2024 Aug 8:e2023064920. doi: 10.1542/peds.2023-064920. Online ahead of print.

Low-Resource Hospital Days for Children Following New Tracheostomy.

Cecil CA(1), Dziorny AC(2), Hall M(3), Kane JM(4), Kohne J(5), Olszewski AE(1), Rogerson CM(6), Slain KN(7), Toomey V(8), Goodman DM(#)(1), Heneghan JA(#)(9).

Author information: (1)Ann and Robert H. Lurie Children's Hospital of Chicago; Northwestern University Feinberg School of Medicine, Chicago, Illinois. (2)School of Medicine, University of Rochester Medical Center, Rochester, New York. (3)Children's Hospital Association, Lenexa, Kansas. (4)Pritzker School of Medicine, University of Chicago Comer Children's Hospital, Chicago, Illinois. (5)CS Mott Children's Hospital, University of Michigan, Ann Arbor, Michigan. (6)Division of Critical Care, Department of Pediatrics, Indiana University, Indianapolis, Indiana. (7)University Hospitals Rainbow Babies and Children's Hospital, Cleveland, Ohio. (8)Children's Hospital Los Angeles; University of Southern California Keck School of Medicine, Los Angeles, California; and. (9)University of Minnesota Masonic Children's Hospital, University of Minnesota, Minneapolis, Minnesota. (#)Contributed equally

BACKGROUND AND OBJECTIVES: Children with new tracheostomy and invasive mechanical ventilation (IMV) require transitional care involving caregiver education and nursing support. To better understand hospital resource use during this transition, our study aimed to: (1) define and characterize low-resource days (LRDs) for this population and (2) identify factors associated with LRD occurrence. METHODS: This retrospective cohort analysis included children ≤21 years with new tracheostomy and IMV dependence admitted to an ICU from 2017 to 2022 using the Pediatric Health Information System database. A LRD was defined as a post tracheostomy day that accrued nonroom charges <10% of each patient's accrued nonroom charges on postoperative day 1. Factors associated with LRDs were analyzed using negative binomial regression. RESULTS: Among 4048 children, median post tracheostomy stay was 69 days (interquartile range 34-127.5). LRDs were common: 38.6% and 16.4% experienced ≥1 and ≥7 LRDs, respectively. Younger age at tracheostomy (0-7 days rate ratio [RR] 2.42 [1.67-3.51]; 8-28 days RR 1.8 (1.2-2.69) versus 29-365 days; Asian race (RR 1.5 [1.04-2.16]); early tracheostomy (0-7 days RR 1.56 [1.2-2.04]), and longer post tracheostomy hospitalizations (31-60 days RR 1.85 [1.44-2.36]; 61-90 days RR 2.14 [1.58-2.91]; >90 days RR 2.21 [1.71-2.86]) were associated with more LRDs. CONCLUSIONS: Approximately 1 in 6 children experienced ≥7 LRDs. Younger age, early tracheostomy, Asian race, and longer hospital stays were associated with increased risk of LRDs. Understanding the postacute phase, including bed utilization, serves as an archetype to explore care models for children with IMV dependence.

DOI: 10.1542/peds.2023-064920 PMID: 39113630

Conflict of interest statement: CONFLICT OF INTERESTS DISCLOSURES: The authors have indicated they have no conflicts of interest relevant to this article to disclose.

NTSP Podcast Series

Am J Speech Lang Pathol. 2024 Aug 15:1-20. doi: 10.1044/2024_AJSLP-23-00310. Online ahead of print.

Augmentative and Alternative Communication Interventions in Critical and Acute Care With Mechanically Ventilated and Tracheostomy Patients: A Scoping Review.

LaValley M(1), Chavers-Edgar T(2), Wu M(1), Schlosser R(3)(4)(5), Koul R(1)(4).

Author information: (1)Department of Speech, Language, and Hearing Sciences, The University of Texas at Austin. (2)Waisman Center at the University of Wisconsin, Madison. (3)Department of Communication Sciences and Disorders, Northeastern University, Boston, MA. (4)Centre for Augmentative and Alternative Communication, University of Pretoria, South Africa. (5)Department of Otolaryngology and Communication Enhancement, Boston Children's Hospital, MA.

PURPOSE: Communication with nonspeaking patients is a critical challenge of person-centered care. This scoping review aimed to map the literature on augmentative and alternative communication (AAC) interventions for nonspeaking mechanically ventilated and tracheostomy patients in critical and acute care settings. METHOD: Electronic database, ancestry, and forward citation searches were conducted using eligibility criteria established a priori. Data were extracted, synthesized, and summarized according to scoping review methodology. Studies were categorized by type of intervention and summarized in terms of purpose, participants, design, quality appraisal (including validity and reliability of selected efficacy measures), and efficacy. RESULTS: Small-to-large treatment effect sizes indicated demonstrable impact on patient health and communication efficacy with high-tech and no-tech visual interface-based interventions and systematic nurse training interventions. Treatment effects primarily pertained to dependent variables of patient anxiety, communication satisfaction, comfort, symptom self-reporting, and nursing practice changes. CONCLUSIONS: There is a paucity of high-quality AAC intervention research for mechanically ventilated and tracheostomy patients in critical and acute care settings. Emergent evidence suggests that select visual interface and nurse training interventions can impact efficacy of patient-provider communication and patients' overall health. SUPPLEMENTAL MATERIAL: https://doi.org/10.23641/asha.26506102.

DOI: 10.1044/2024_AJSLP-23-00310 PMID: 39146218

Tracheostomy (Warrenville). 2024;1(2):1-6. Epub 2024 Jun 30.

Elevating Tracheostomy Care Through Data-Driven Innovation: What Can Education, Evidence-Based Practice, and Quality Improvement Learn from One Another?

Brenner MJ(1), Pandian V(2).

Author information: (1)Department of Otolaryngology Head and Neck Surgery, University of Michigan. (2)School of Nursing, Johns Hopkins University.

The past decade has witnessed unprecedented progress in tracheostomy care, through communication, dissemination, and implementation of key drivers including interprofessional education, team-based care, standardized protocols, patient and family engagement, and data-driven practice. Improved safety, efficiency, and quality of tracheostomy care reflects contributions from fields of competency-based education, evidence-based practice, and quality improvement. These elements are interconnected, reinforcing one another to enhance patient care. Competency-based interactive education emphasizes active and practical learning through simulations and case studies, which enhance the clinical skills essential for high-quality care. These educational strategies are grounded in clinical research, ensuring that care practices are continually updated and aligned with the latest evidence, thereby bridging the gap between research findings and clinical application. Quality improvement processes such as Plan-Do-Study-Act (PDSA) cycles refine care delivery in real-world settings. Implementation science promotes the uptake of evidence-based practices, ensuring that discoveries translate to improved health outcomes, quality of care, and overall system performance. In each of these domains, patient and family engagement ensures alignment with patient needs and values. The Global Tracheostomy Collaborative leverages this integrated approach through international educational symposia and webinars, comprehensive data analyses, and a learning community that promotes innovative technologies like in situ simulation and augmented and virtual reality. Together, these approaches enhance the learning and application of best practices in tracheostomy care. The continuous, dynamic interaction of education, research, and quality improvement, grounded in patient-centered care, fosters excellence and innovation in care of patients with tracheostomy.

PMCID: PMC11345906 PMID: 39188761

Conflict of interest statement: Conflicts of Interests/Disclosures None