NTSP Podcast series

National Tracheostomy Safety Project

This month's top papers: March 2026

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://twitter.com/NTSP_UK

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This month's top papers

This monthly "Top Papers" educational companion accompanies the Trachy Talk podcast series and provides clinically relevant summaries of recent literature relevant to:

- Next Generation Sequencing of Tracheal Aspirates (with a special guest to explain)
- Robotic PDT
- Bronchoscopy and PDT
- Staff roles and view of PDT
- Machine learning limitations for predicting PDT

The summaries are designed for multidisciplinary healthcare teams and aim to support reflective evidence-based practice.

FEATURED PAPERS – MARCH 2026

1. Brensing P et al.
   Next Generation Sequencing of Tracheal Aspirates in Children With Tracheostomy: A Prospective Case-Control Study.
   Pediatric Pulmonology. 2026.
2. Tang Y et al.
   Design and Evaluation of a Prototype Medical Device for Robotic and Manual Percutaneous Dilatational Tracheostomy.
   PLoS One. 2026.
3. Añón JM et al.
   Fiberoptic Bronchoscopy Monitoring During Percutaneous Dilatational Tracheostomy: The FIBERTRACH Randomized Clinical Trial.
   Critical Care Medicine. 2026.
4. Moran M et al.
   Staff Experiences of Percutaneous Tracheostomy in Intensive Care: Challenges, Complications and Potential Solutions.
   Anaesthesia Reports. 2026.
5. Wiesmueller F et al.
   Limitations of Retrospective Machine Learning Models for Predicting Tracheostomy After Cardiac Surgery.
   Diagnostics. 2026.

PAPER 1

Next Generation Sequencing of Tracheal Aspirates in Children With Tracheostomy: A Prospective Case-Control Study

Brensing P et al.
Pediatric Pulmonology. 2026.

LAY SUMMARY

Children with tracheostomies often develop bacterial colonisation in their airways, but distinguishing harmless colonisation from genuine infection can be difficult.

This study explored whether next-generation sequencing (NGS), an advanced molecular testing technique, could improve identification of airway organisms in tracheostomised children.

The researchers compared tracheal samples from children with long-term tracheostomies to samples from children without lung disease. They found significantly higher rates of potentially difficult-to-treat bacteria including Pseudomonas aeruginosa and Staphylococcus aureus in children with tracheostomies.

The study suggests NGS may offer a broader and faster method of identifying microorganisms in airway samples, although further research is needed before it can be routinely used in clinical practice.

SUMMARY FOR HEALTHCARE PROFESSIONALS

Background

Differentiating airway colonisation from acute infection in tracheostomised children remains clinically challenging. Standard microbiological culture methods may fail to fully characterise airway microbial diversity or identify difficult-to-detect organisms.

Methods

Prospective monocentric case-control study comparing tracheal aspirates from:
• children with established tracheostomies
• control children undergoing elective surgery without lung disease

Samples underwent:
• bacterial culture
• PCR testing
• next-generation sequencing (NGS) analysis

Key Findings

• 107 children recruited; 45 samples included in final analysis
• Tracheostomised children demonstrated significantly higher prevalence of:

- Pseudomonas aeruginosa
- Staphylococcus aureus
- Stenotrophomonas maltophilia
- Moraxella catarrhalis
  • NGS identified broader microbial diversity than standard methods
  • Pseudomonas aeruginosa was dominant in 44% of positive samples
  • The study reinforces the altered airway microbiome seen in long-term paediatric tracheostomy populations

Clinical Relevance

The paper highlights increasing interest in molecular diagnostics for tracheostomy airway surveillance and antimicrobial stewardship.

Potential advantages of NGS include:
• faster pathogen identification
• broader organism detection
• identification of mixed microbial populations
• potential future support for targeted antimicrobial therapy

However, interpretation remains difficult because detection of organisms does not necessarily equate to clinically significant infection.

Strengths

• Prospective study design
• Inclusion of healthy controls
• Comparison of multiple diagnostic techniques
• Focus on clinically relevant paediatric tracheostomy population

Limitations

• Small final sample size
• Single-centre study
• High exclusion rate
• Clinical outcomes not linked to sequencing results
• Unclear impact on antibiotic prescribing or patient outcomes

Future Directions

Further studies are needed examining:
• clinical integration of NGS into infection pathways
• cost-effectiveness
• relationship between microbial diversity and respiratory outcomes
• antimicrobial stewardship applications

PAPER 2

Design and Evaluation of a Prototype Medical Device for Robotic and Manual Percutaneous Dilatational Tracheostomy

Tang Y et al.
PLoS One. 2026.

LAY SUMMARY

This engineering study explored a new prototype device designed to simplify percutaneous tracheostomy insertion.

The device, called "TrachyPen", combines puncture and dilation into a single instrument, potentially reducing the number of procedural steps required during tracheostomy insertion.

Researchers tested the device on porcine tissue models and compared it with a standard Blue Rhino dilator system. The prototype generated lower insertion forces and produced smaller stoma sizes during testing.

Although this remains an early experimental prototype rather than a clinically tested device, the study highlights ongoing interest in robotic assistance, procedural simplification and device innovation in tracheostomy care.

SUMMARY FOR HEALTHCARE PROFESSIONALS

Background

Percutaneous dilatational tracheostomy (PDT) remains associated with procedural complications including posterior tracheal wall injury, bleeding and excessive force during dilation.

Current PDT techniques require multiple sequential procedural steps and manipulation of several instruments.

Methods

Engineering and prototype development study evaluating "TrachyPen", a device designed to combine:
• tracheal puncture
• tract dilation

within a single procedural step.

Bench testing involved:
• 50 simulated PDT insertion/dilation procedures
• porcine skin tissue models
• comparison against the Ciaglia Blue Rhino system

Key Findings

• TrachyPen produced:

- lower insertion force
- smaller stoma size
  compared with standard Blue Rhino dilation

• Device intended for:

- robotic-assisted use
- semi-autonomous future PDT systems
- manual operation if required

• Clinician design priorities identified included:

- procedural accuracy
- minimising bleeding
- reducing procedure time
- ease of use

Clinical Relevance

The paper reflects broader trends toward:
• procedural automation
• human factors engineering
• robotic procedural support
• reduction in technical complexity during PDT

The concept is particularly interesting in anatomically challenging cases where procedural precision may be difficult.

Strengths

• Innovative multidisciplinary collaboration
• Strong user-centred design principles
• Clear engineering rationale
• Objective force measurement testing

Limitations

• Pre-clinical prototype study only
• No human clinical testing
• Porcine tissue models may not replicate real airway anatomy
• Safety and workflow integration remain unproven

Future Directions

Future research should explore:
• cadaveric and clinical testing

• integration with bronchoscopy or ultrasound guidance
• human factors and usability
• procedural learning curves
• regulatory and safety validation

PAPER 3

Fiberoptic Bronchoscopy Monitoring During Percutaneous Dilatational Tracheostomy: The FIBERTRACH Randomized Clinical Trial

Añón JM et al.
Critical Care Medicine. 2026.

LAY SUMMARY

Bronchoscopy is commonly used during percutaneous tracheostomy procedures to visualise the airway and improve safety. However, whether routine bronchoscopy actually reduces complications has remained uncertain.

This large multicentre randomised trial compared tracheostomy procedures performed with bronchoscopy guidance against procedures performed without bronchoscopy in critically ill patients.

The researchers found no significant difference in complication rates between groups. However, bronchoscopy-guided procedures were associated with higher airway pressures and slightly higher carbon dioxide levels during the procedure.

The authors conclude that routine bronchoscopy may not be necessary for all tracheostomies, particularly when experienced teams perform the procedure in low-risk patients.

SUMMARY FOR HEALTHCARE PROFESSIONALS

Background

Bronchoscopic guidance during PDT is widely used but remains controversial due to:
• uncertain complication reduction
• increased costs
• procedural delays
• physiological effects including hypercapnia and raised airway pressures

Methods

Multicentre randomised controlled trial conducted across four ICUs in Spain.

442 critically ill adults requiring PDT were randomised to:
• endoscopic-guided PDT
• non-endoscopic-guided PDT

All procedures used:
• experienced operators
• single-dilator technique
• patients without high-risk anatomy

Key Findings

• Perioperative complications:

- 11.3% in bronchoscopy group
- 13.1% in non-bronchoscopy group
- no statistically significant difference

• Bronchoscopy group demonstrated:

- higher peak inspiratory pressures
- higher $PaCO_2$ levels during procedure

• Authors suggest bronchoscopy may be most useful:

- during training
- in difficult anatomy
- for complex airways

Clinical Relevance

This is one of the largest randomised studies addressing routine bronchoscopy use during PDT and challenges assumptions that bronchoscopy universally improves procedural safety.

The findings may influence:
• procedural workflows
• ICU resource utilisation
• bronchoscopy staffing requirements
• local PDT protocols

Strengths

• Large multicentre RCT
• Pragmatic ICU design
• Experienced procedural teams
• Clinically relevant outcomes

Limitations

• Excluded anatomically difficult patients
• Unblinded design
• High operator expertise may limit generalisability
• Findings may not apply during training or low-volume practice

Future Directions

Future studies may explore:
• bronchoscopy in high-risk anatomy
• ultrasound-guided alternatives
• training implications
• environmental and cost analyses

PAPER 4

Staff Experiences of Percutaneous Tracheostomy in Intensive Care: Challenges, Complications and Potential Solutions

Moran M et al.
Anaesthesia Reports. 2026.

LAY SUMMARY

This qualitative study explored how ICU staff experience and manage percutaneous tracheostomy procedures.

Researchers interviewed doctors, nurses and advanced practitioners across several ICUs to understand procedural challenges, safety concerns and opinions regarding potential guidance technologies.

Participants described tracheostomy as a highly skilled procedure requiring teamwork, supervision and careful preparation. Staff highlighted challenges including obesity, neck swelling and difficult anatomy, which can increase procedural risk.

The study also explored how future guidance devices might improve procedural accuracy and safety.

SUMMARY FOR HEALTHCARE PROFESSIONALS

Background

Despite widespread use of PDT, relatively little qualitative research has explored frontline staff experiences, procedural decision-making and attitudes toward device innovation.

Methods

Qualitative thematic analysis study involving:
• 32 ICU staff members
• three ICUs
• consultants, trainees, nurses, ACCPs and support staff

Semi-structured interviews and focus groups explored:
• procedural safety
• training
• workflow

• complications
• perceptions of guidance devices

Key Findings

Six major themes emerged including:
• procedural skill acquisition
• supervision and trust
• teamwork and environment
• procedural planning
• complication management
• attitudes toward technology integration

Staff identified:
• obesity
• difficult anatomy
• airway instability
as major procedural challenges.

Participants emphasised that bronchoscopy confirms tracheal puncture but does not guide needle trajectory through anterior neck tissues.

Clinical Relevance

The paper provides valuable human factors insight into PDT practice and highlights:
• procedural variability
• training complexity
• importance of team coordination
• user-centred innovation needs

It also demonstrates how end-user perspectives can inform medical device development.

Strengths

• Rich multidisciplinary qualitative data
• Human factors perspective
• Real-world ICU procedural insights
• Strong co-design methodology

Limitations

• Small participant numbers
• UK-specific practice environments
• Subjective qualitative methodology
• No evaluation of actual device performance

Future Directions

Further work should examine:
• implementation science

• device usability in clinical settings
• simulation-based evaluation
• impact on training and procedural outcomes

PAPER 5

Limitations of Retrospective Machine Learning Models for Predicting Tracheostomy After Cardiac Surgery

Wiesmueller F et al.
Diagnostics. 2026.

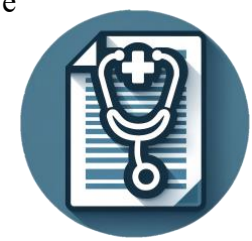
LAY SUMMARY

Artificial intelligence and machine learning are increasingly being explored in healthcare, including predicting which patients may need tracheostomy after surgery.

This study evaluated whether machine learning models could accurately predict tracheostomy after cardiac surgery using retrospective hospital data.

The researchers found that both existing prediction tools and newly developed machine learning models performed poorly.

The paper highlights an important lesson in healthcare AI research: large retrospective datasets alone may not be sufficient to create clinically useful prediction tools.



SUMMARY FOR HEALTHCARE PROFESSIONALS

Background

Early tracheostomy may benefit selected prolonged ventilation patients after cardiac surgery. Reliable prediction models could theoretically support earlier decision-making.

Methods

Retrospective single-centre study including:
• 4744 cardiac surgery patients
• 118 tracheostomy cases

Investigators evaluated:
• an existing prediction model
• newly developed machine learning models

Algorithms included:
• random forest
• naïve Bayes
• nearest neighbour
• deep learning approaches

Key Findings

• Existing prediction model demonstrated poor discrimination:

- AUC 0.57

• Newly developed machine learning models also performed poorly across feature sets and algorithms.

• Authors conclude retrospective clinical datasets alone may not contain sufficiently discriminatory signals for accurate prediction.

Clinical Relevance

This paper provides an important counterbalance to enthusiasm surrounding AI in critical care.

The findings highlight:
• limitations of retrospective datasets
• risk of overfitting
• poor external validity of prediction models
• importance of prospective validation

The authors appropriately avoid overstating the role of machine learning and instead advocate for:
• prospective data collection
• physiological biomarkers
• imaging integration
• clinically meaningful validation

Strengths

• Large clinical dataset
• Honest negative findings
• External validation focus
• Comparison of multiple ML approaches

Limitations

• Retrospective single-centre data
• Low event rates
• Potential missing confounders
• Limited physiological granularity

Future Directions

Future AI-related tracheostomy research should prioritise:
• prospective multicentre data
• explainable models
• clinically interpretable features

• integration with physiology and imaging
• robust external validation

OVERALL REFLECTIONS – MARCH 2026

Several important themes emerge across this month's papers:
• procedural safety
• technological innovation
• human factors
• diagnostic uncertainty
• appropriate adoption of emerging technologies

The studies collectively highlight that while innovation in tracheostomy care continues rapidly — including robotics, molecular diagnostics and machine learning — successful implementation depends on careful validation, multidisciplinary collaboration and real-world clinical integration.

Importantly, several papers also remind us that technological sophistication alone does not automatically improve outcomes.

Whether considering bronchoscopy guidance, AI prediction tools or robotic PDT devices, these studies consistently reinforce the need for:
• pragmatic clinical evaluation
• human factors understanding
• prospective validation
• balanced interpretation of innovation claims

Together, the papers provide a thoughtful overview of how tracheostomy practice continues to evolve across engineering, diagnostics, procedural safety and multidisciplinary care.