Actionable Patient Safety Solutions (APSS) #15:

Nasogastric tube (NGT) placement and verification

How to use this guide

This guide gives actions and resources for creating and sustaining safe practices for NGT placement and verification. In it, you'll find:

Patient Safety MOVEMENT

Executive summary checklist

A nasogastric tube (NGT) is a tube inserted into a patient's nose and down into their stomach to drain stomach contents or to give nutrition (feeding), fluids, and medicine. The person inserting the tube uses blind placement, which means they don't know where the tube is going in the patient's body as they push it in. As a result, NGTs can be misplaced and lead to serious patient harm and death.

Use this checklist to help prioritize your actions and measure your organization's progress in each area.

Engage staff and use data to find areas for improvement

- ☐ Specifically train all staff who place NGTs in this procedure
- ☐ Train all staff who read radiographs to use a report template with the following 4 criteria:
  - ☐ Does the tube path follow the esophagus and avoid contours of the bronchi?
  - ☐ Does the tube clearly bisect the carina or the bronchi?
  - ☐ Does the tube cross the diaphragm in the midline?
  - ☐ Is the tip clearly visible below the left hemi-diaphragm?
- ☐ Create a mandatory reporting system to track NGT misplacements as a percentage of all tubes place

Ensure best patient care

- ☐ Use only NGTs that:
  - ☐ Are radio-opaque throughout their length
  - ☐ Have external centimeter (cm) markings for detection of post-insertion tube movement
- ☐ Follow best practices for NGT placement and prior to first use:
  - ☐ Before inserting the NGT, accurately measure the length of the NGT prior to using the NEMU (Nose→Earlobe→Mid- Umbilicus) method
  - ☐ Prior to first use, confirm NG placement with pH of gastric aspirate the range of 1.0 to 5.5
  - ☐ Use an abdominal radiograph if indicated (pH >5.5 or high-patient listed below)
- ☐ Follow best practices after confirmation of NGT placement:
  - ☐ Document NGT confirmation and the method of confirmation (pH or radiograph) in the EMR
  - ☐ After confirmation, secure tubes to the patient so the cm mark is visible at the nose or lips
    - ☐ If no cm marks are available mark the tube with indelible ink
    - ☐ Document this cm mark in the medical record and as part of the physical exam
    - ☐ Use this point of reference to gauge movement of the tube
  - ☐ Observe for signs of respiratory distress, gagging, or vomiting post-tube placement
    - ☐ Strongly consider removing the NGT if these signs are present as the tube may have been dislodged into the airway or further into the lungs

What we know about NGT placement and verification

NGTs are commonly used in clinical practice. Studies have shown:

- In one day at 63 institutions, 24% of hospitalized infants and children needed NGTs, including an orogastric (OG) (tube placed through the mouth), nasogastric (NG), or transpyloric (tube placed in the upper small bowel) tube (Lyman et al., 2015)
- From 2011-2016, over 3 million NG or OG tubes were used in the United Kingdom (UK) (Parker, 2016)

Addressing nasogastric tube placement and verification helps create a safety culture, which is a culture that promotes patient safety and quality of care while reducing preventable risks and harms.

The problems with NGT placement and verification

As a result of blind placement, misplaced tubes happen in the esophagus, duodenum (the first part of the small intestines), or lungs. Studies show NGT misplacement can cause serious harm to patients:

- In adult patients, NGT misplacement causes serious harm in 1 to 3% of tubes placed (Gilbertson, Rogers and Ukoumunne, 2011; Bourgault and Halm, 2009)
- In infants, 59% NGTs are misplaced, with most tubes misplaced in the esophagus (October and Hardart, 2009)
- The Pennsylvania Patient Safety Authority documented 4137NGT misplacements into the lung from 2011- 2016 with 56 were noted as causing serious patient harm. In this same report there were two deaths (Wallace, 2017). Injuries from NGT misplacement include:
    - Pneumothorax (a buildup of air in the pleural space that surrounds the lung, which causes part or all of the lung to collapse)
    - Feeding formula given into the lung
    - Esophageal perforation (hole in the esophagus)
    - Death (Gilbertson, Rogers and Ukoumunne, 2011; Bourgault and Halm, 2009)
- Injuries from NGT misplacement include:
    - Pneumothorax (a buildup of air in the pleural space that surrounds the lung, which causes part or all of the lung to collapse)
    - Feeding formula given into the lung
    - Esophageal perforation(hole in the esophagus)
    - Death (Gilbertson, Rogers and Ukoumunne, 2011; Bourgault and Halm, 2009)

Failure to detect misplaced NGTs are due to:

- Use of non-evidence-based methods to confirm initial placement (auscultation or aspiration)
- Failure to recognize when an NGT has changed position
- Failure to properly read an abdominal radiograph
- Failure to accurately interpret an electromagnetic device screen (October and Hardart, 2009; Powers et al., 2013; Metheny and Meert, 2017)

The evidence for NGT placement best practices

A recent publication from the American Society for Parenteral and Enteral Nutrition detailed best practices for NGT placement verification in children that includes a process for NGT placement verification (Irving et al., 2018). Prior to this document, pediatric organizations failed to find any guidance for NGT placement verification in infants and children. This document closely follows the National Health Service (NHS) recommendations and guidance for best practices.

Leadership plan

Show leadership's commitment to NGT placement and verification

- Identify and learn about performance gaps in their organization related to the use of evidence-based methods to verify NGT placement
- Use best practice guidelines when they exist
- Be engaged and show their own commitment to the new process change - senior leaders, directors, physicians, managers, and unit leaders have a significant role in the process improvement process by mandating practice change
- All leadership and healthcare professionals use root cause analysis of events involving NGT misplacement to identify performance gaps in their own care area and fully understand the need for change

Create the infrastructure needed to make changes

- Healthcare leadership support process changes, such as to:
  - Provide needed resources
  - Remove barriers
  - Give their time and attention
  - Encourage process improvement
- Healthcare leadership assist with the action plan, such as to:
  - Create clearly defined and measurable goals
  - Effectively communicate and collaborate
  - Encourage clinical/safety leadership and offer support during the change period

Engage staff

- Administrators recognize the impact of NGT misplacement that results in patient harm or death on the healthcare professional and provide services to the healthcare professional that help with emotional healing
- Sustain change by building acceptance and accountability - those responsible for putting the proposed changes into practice must accept them
- Use patient stories - in written and video form - to identify gaps and inspire change in your staff. For example, the story of Grant Lars Visscher, son of Deahna and Rich Visscher, is a compelling story that can be viewed and shared for free: **patient.sm/Deahna-visscher--tube**.

Action plan

Use safe equipment

- Use NGTs that are radio-opaque throughout their length and have external cm length markings to detect post-insertion tube movement
- When checking pH, use a product that is licensed for medical use

Provide staff training

- Train all staff who place NGTs. The training should include:
  - Use evidence-based procedures for guidance on NGT insertion and placement verification.
  - Knowledge of contra-indications for bedside placement, such as basilar skull fracture
  - Awareness of clinical situations that place patients at high-risk for misplacements, such as increased work of breathing or tachypnea
  - Awareness that signs and symptoms of misplacement could be:
    - Immediate, such as circumoral cyanosis, coughing, choking, and dyspnea
    - Delayed
    - Non-existent until the patient's condition worsens – staff should not take the absence of signs and symptoms as confirmation the tube is correctly placed
  - When technology is utilized demonstrated skill in the use of technology to assist with placement (see 'Technology Plan' below)
- Train all staff who read radiographs to confirm NGT placement using '4 criteria' (seek expert radiologist advice for detail of local training, but in brief):
  - Does the tube path follow the oesophagus and avoid the contours of the bronchi?
  - Does the tube clearly bisect the carina or the bronchi?
  - Does it cross the diaphragm in the midline?
  - Is the tip clearly visible below the left hemi-diaphragm rather than solely viewing the tip of the NGT?
- When product changes occur, educate staff on the new NGT and how it is different from the previous product
- For a free video to teach healthcare providers NGT placement, visit: **http://patient.sm/3bOu3b**

Create protocols

- Create a mandatory reporting system to capture the frequency of NGT misplacement and patient outcome
- Use evidence-based procedures for guidance on NGT insertion and placement verification, including guidance on when a patient is considered high risk for misplacement – the procedure should include a comment to encourage critical thinking skills when assessing a patient during placement, immediately after, or at any time the NGT is in place and a patient's condition worsens

Place NGT

- To get an accurate measurement of insertion length, use the NEMU method (Nose→Earlobe→Mid- Umbilicus) for children and adults

- Position the patient properly. Particularly, put their head into anatomic position during the insertion

Confirm placement before first use

- Upon initial NGT insertion, check the pH is within the desired range of 1-5.5:
  - Aspirate 3-8 ml of gastric fluid to obtain specimen for pH with stylet in place (in neonates and smaller pediatrics, a stylet may not have been used for placement, and it may not be possible to obtain 3 mL)
  - To remove the stylet after confirmation, instill water
  - You may need to instill water prior to NGT insertion to allow for stylet removal due to the narrow bore of the tube. Withdraw and waste the fluid before obtaining a specimen for pH measurement. Normal saline and water have an alkaline pH.
  - Use of acid suppressing medicines is not a contra-indication to pH measurement -if the pH is > 5.5 follow the process
  - If unable to obtain an aspirate, turn the patient on their left side if possible and after 10-20 minutes, try again to obtain fluid from the NGT
- If unable to obtain an aspirate within the required range of 1-5.5, do not use the tube until a radiograph is done to confirm placement
- When a radiograph is used to confirm placement, it should:
  - Follow the tube from the chest to below the diaphragm and give a visual of the tip of the NGT
  - Include a report template that documents all the following:
    - Does the tube path follow the oesophagus and avoid the contours of the bronchi?
    - Does the tube clearly bisect the carina or the bronchi?
    - Does it cross the diaphragm in the midline?
    - Is the tip clearly visible below the left hemi-diaphragm?
  - Have a comment that the tube is appropriately placed for use
  - Include a check that the radiograph is of the correct patient and the most recent radiograph taken
- For adults and certain infants and children, consider a radiograph even if pH is in the required range when the patient:
  - Is severely obtunded (has an altered level of consciousness)
  - Has an endotracheal tube
  - Is clinically unstable after NGT re-insertion post resuscitation
  - Has clinical deterioration soon after NGT placement

Reconfirm NGT placement after initial use

- Secure the tube to the patient so the cm mark is visible at the snaries – document this mark in the medical record and use it as a point of reference for movement of the tube
- Use pH to re-confirm placement especially if the securement device has become dislodged or the tube is not at the reference cm mark
- "When in doubt, pull it out!" - when in doubt of correct placement, remove and replace the tube

Do supplementary checks on NGT placement

The AACN recommends using 2 or more bedside methods to predict tube location at these time points:

- During insertion
- Before feeding
- At 4 hour intervals after feeding has started
- When there is any interruption in feeding
- For a decompression tube, an abrupt decrease in output warrants reconfirmation of placement

Below are 3 methods for supplementary checks. **Do not use these methods to confirm correct placement:**

- Observe for signs of respiratory distress such as coughing, choking, desaturation, and dyspnea
    - If patient has signs of respiratory distress, remove and re-insert tube
    - However, the patient may not have signs of respiratory distress when the tube is accidentally placed in the airway, especially if the patient has an impaired level of consciousness
- Observe for a change in the marked reading of the tube at the lip/naris or change in length of external portion of the tube (e.g., the length not inserted in the patient)
    - There are many reasons that a feeding tubes may become dislocated during use
    - Check tube location at regular intervals while the tube is being used for feeding or medicine
    - Observe and record the length of the external portion of the NGT to help detect tube migration
- Observe visual characteristics of aspirate for signs the tube moved from stomach to small bowel – there may be a more marked difference in appearance
        - Do not use this method to try to distinguish between gastric and respiratory secretions – there is not always a marked difference in appearance

Do not use these practices to verify NGT placement

The following non-evidence-based practices are misleading and should never be used to verify NGT placement:

- Auscultation (listening to sounds from the stomach, heart, lungs, or other organs)
- Visual inspection of fluid from the tube
- Observation of bubbles - this method is not reliable
- Litmus paper

Technology plan

The following section highlights best practices and emerging technologies used to assist accurate NGT placement and verification.If you know of other options not listed here, please complete the form for the PSMF Technology Vetting Workgroup to consider:
http://patient.sm/7hAR0s

Best Practices	Overview	Limitations

pH testing	• Collect aspirate through NGT and analyze at bedside using an appropriate pH strip
	  • Common first-line method for confirming NGT placement
	  • Gastric placement is confirmed if reading is equal to or below 5.5
		• pH measurement can be skewed by gastric contents, including:
		  • Enteral formula
		  • Acid suppressing medicines
		• Requires accurate color perception
		• Considered Point of Care testing

Abdominal X-ray	• X-ray to confirm NGT tip is visible below the diaphragm, at least 10cm for adults or beyond the gastro-esophageal junction for infants and children
	  • Considered the gold standard for initial placement confirmation
		• X-rays can be misinterpreted
		  • 45% of harm events associated with NGT placement reported by the UK National Patient Safety Agency from 2005-2010 were caused by misinterpreted x-rays
		• Often avoided in pediatric settings to decrease the cumulative effects of radiation exposure

The following table shows methods with limited evidence or unclear benefit. These methods require further research. Some U.S. guidelines, research, and teaching methods have not kept up with advances in other parts of the world. Global studies are referenced below.

Emerging Technologies	Overview	Evidence/Limitation
Biochemical markers	• Laboratory tests for bilirubin, pepsin, and trypsin can be used to compliment pH testing to confirm placement	• Not a bedside test • Not widely validated in a variety of clinical settings • Demonstrated in a 15-patient feasibility study of gastric-fed patients receiving mechanical ventilation (Schallom et al., 2015)

Capnography/ colorimetric capnometry	• Both measure carbon dioxide (CO2)
	  • Commonly used to confirm endotracheal tube (ETT) placement
	  • Not to be used as a single method of placement confirmation
	  • Unreliable in neonates and smaller pediatric patients.
		• Will not differentiate between gastric and small bowel placement.
		• Effectively rules out pulmonary misplacement.
		  • In a 100-patient study, colorimetric capnography correctly ruled out tracheobronchial insertion (Meyer, et al., 2009)
		  • In a 40-patient study, colorimetric capnometry was consistent with x-ray in 97.5% of cases (Erzincanli, Zaybak, and Guler, 2017)
		  • In a meta-analysis of nine clinical trials involving a total of 651 insertions, gastric placement was correctly identified in 88-100% of cases. (Chau, et al., 2011)

Direct anatomical visualization (camera)	• A camera embedded in the tip of the NGT provides real-time images of anatomical landmarks in the GI or respiratory tract as the tube advances
	  • May aid in placement, early identification, and timely correction of tracheobronchial insertion
		• Can visualize both gastric and post-pyloric placement.
		  • A 45-patient study of adult ICU and step-down patients found 98% agreement between visualized anatomical landmarks and X-ray (Wischmeyer, McMoon, Waldron, and Dye, 2018)
		  • A 20-patient study of adult ICU patients showed 100% agreement between anatomical visualization and X-ray (Mizzi, et al. 2017)
		  • · Both studies reported near-miss respiratory tract insertion in 20-35% of cases, but the NGT was repositioned without patient harm. (Wischmeyer, McMoon, Waldron, and Dye, 2018;Mizzi, et al. 2017)
		• No published clinical evidence in pediatric populations

Electromagnetic Placement Device	• Uses electromagnetic sensors in a stylet to provide a visual representation of the NGT tip relative to an external receiving unit placed over the patient's xiphoid process.
	• In 2018, the FDA recommended competency training for all staff using this device and a second method to verify NGT placement, such as pH or radiograph.
		• A 2018 report documented 1 adverse event (pneumothorax) in 7081 placements using this device. (Powers et al., 2018)
		• Harm events are associated with misinterpretation of the visual representations
		  • 2 patient deaths and 2 moderate harm events described in a 2013 NHS Patient Safety Alert
		  • 51 serious harm events, including 11 patient deaths were described in a Letter to Health Care Providers issued by the FDA in 2018.
		• No published clinical evidence in pediatric populations for NGT placement verification.

Ultrasound	• Imaging method that uses high-frequency sound waves to produce images of structures within the body
	  • Most useful to show progress of the tube through the esophagus
		• Requires skilled sonographers
		• Effective in adult ICU patients with large bore feeding tubes
		  • In a 56-patient study, NGT images were obtained in 92.8% of cases, but in one case failed to identify a tracheal placement. (Gok, Kilicasian, and Yosunkaya, 2015)
		  • In a 41-patient study, ultrasound correctly identified 38 proper placements. (Nedel, Jost, and Filho,2017)
		• Demonstrated in pediatric populations
		  • A study of 21 pediatric patients found 100% agreement between abdominal ultrasound and x-ray
		• Larger scale studies are needed

Measuring outcomes

Topic: NGT misplacement

Serious Safety Event (SSE) Rate: Rate of NG tube misplacements per 10,000 NG tube insertions

Outcome Measure Formula:

Numerator: Number of misplaced NG tubes

Denominator: Total number of NG tubes inserted
Rate is typically displayed as: misplaced NG tubes per 10,000 NG tube insertions

Metric recommendations:

Direct Impact:
All patients

Elimination of patient harm:
As measured by elimination of serious safety events, sentinel events, state reportable events, or hospital acquired conditions (HACs).

Lives spared harm:
Lives spared harm = (Rate of NG tube misplacement_baseline - Rate of NG tube misplacement_measurement) X NG tube insertions_measurement

Lives saved:
Lives saved = (NG tube misplacement mortality rate_baseline - NG tube misplacement mortality rate_measurement) X NG tube misplacements_measurement

Mortality SSEs are coded. If the organization codes the severity of their events, this formula could be applied to their data set.

Notes:

Data Collection:

Data may be captured from your electronic medical record if a discrete data element exists for NG tube placement and/or misplacement.

Manual chart review of events to determine if an event is a serious safety event.

Settings:
All inpatient and outpatient settings.

Mortality (will be calculated by the Patient Safety Movement Foundation): The PSMF, when available, will use the mortality rates associated with Hospital Acquired Conditions targeted in the Partnership for Patient's grant funded Hospital Engagement Networks (HEN). The program targeted 10 hospital acquired conditions to reduce medical harm and costs of care. "At the outset of the PfP initiative, HHS agencies contributed their expertise to developing a measurement strategy by which to track national progress in patient safety—both in general and specifically related to the preventable HACs being addressed by the PfP.

In conjunction with CMS's overall leadership of the PfP, AHRQ has helped coordinate development and use of the national measurement strategy. The results using this national measurement strategy have been referred to as the "AHRQ National Scorecard," which provides summary data on the national HAC rate.

Conflicts of interest disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers. Some of the APSSs recommend technologies that are offered by companies involved in the Patient Safety Movement Foundation. The workgroups have concluded, based on available evidence, that these technologies work to address APSS patient safety issues. Workgroup members are required to disclose any potential conflicts of interest.

*This Workgroup member has reported a financial interest in an organization that provides a medical product or technology recommended in the Technology Plan for this APSS.

Workgroup

Co-Chairs

Beth Lyman	Children's Mercy Hospital
Deahna Visscher	Advocate

Members

This list represents all contributors to this document since inception of the Actionable Patient Safety Solutions.

Steven J. Barker	Patient Safety Movement Foundation; Masimo
Michel Bennett	Patient Safety Movement Foundation (formerly)
Robin Betts	Kaiser Permanente
Haylie Coffey	Carolinas HealthCare System Blue Ridge
Mitchell Goldstein	Loma Linda University
Kim Gorsuch	Cancer Treatment Centers of America
Frances Healey	NHS Improvement
Larissa Kozloff Naves	Centro Universitário Unimonte
Ariana Longley	Patient Safety Movement Foundation
Jacob Lopez	Patient Safety Movement Foundation (formerly)
Olivia Lounsbury	Patient Safety Movement Foundation
Carol McGinnis	Sanford Health Systems
Renae Moomjian	Acacia Consultant
Bill Nadeau	Cardinal Health
William Peruzzi	Henry Ford Health System
Christine Peyton	Children's Hospital Colorado
Donna Prosser	Patient Safety Movement Foundation
Sundary Sankaran	Kaiser Permanente
Caroline Stade	University Children's Hospital Babel
Jennifer Tatro	UCHealth Southern Colorado
***Stephen Thorpe**	CME Medical

Deahna Visscher	Patient Advocate
Johannes Wacker	Klinik Hirslanden

*This Workgroup member has reported a financial interest in an organization that provides a medical product or technology recommended in the Technology Table for this APSS.

References

Bourgault, A. M. and Halm, M. A. (2009). Feeding Tube Placement in Adults: Safe Verification Method For Blindly Inserted Tubes. American Journal of Critical Care, 18(1), 73–76. doi:10.4037/ajcc2009911

Chau J.P., Lo S.H., Thompson D.R., et al. (2011). Use of End-tidal Carbon Dioxide Detection to Determine Correct Placement of Nasogastric Tube: a Meta-analysis. International Journal Nurs Stud, 48(4): 513-521. doi: 10.1016/jinurstu.2010.12.004.

Erzincanli S., Zaybak A., Guler A. Investigation of the Efficacy of Colorimetric Capnometry Method Used to Verify the Correct Placement of the Nasogastric Tube. (2017). Intensive Crit Care Nurs, 38: 46-52. Doi: 10.1016/jiccn.2016.08.005.

FDA. (2018). Feeding Tube Placement Systems - Letter to Health Care Providers. Retrieved from http://patient.sm/Feeding-tube-letter-providers

Gilbertson, H. R., Rogers, E. J. and Ukoumunne, O. C. (2011). Determination of a Practical pH Cutoff Level for Reliable Confirmation of Nasogastric Tube Placement. Journal of Parenteral and Enteral Nutrition, 35(4), 540–544. doi:10.1177/0148607110383285

Gok F., Kilicasian A., Yosunkaya A. (2015). Ultrasound-guided Nasogastric Feeding Tube Placement in Critical Care Patients. Nutrition in Clinical Practice, 30(2), 2560260. doi.10.1177/0884533614567714.

Irving S., Rempel G., Lyman B., Sevilla W., Northington L., Guenter P. (2018). Pediatric Nasogastric Tube Placement and Verification: Best Practice Recommendations from the NOVEL project. Nutrition in Clinical Practice. Epub. Doi: 10.1002/ncp.10189.

Lyman, B., Kemper, C., Northington, L. D., Yaworski, J. A., Wilder, K., Moore, C., … Irving, S. (2015). Use of Temporary Enteral Access Devices in Hospitalized Neonatal and Pediatric Patients in the United States. Journal of Parenteral and Enteral Nutrition, 40(4), 574–580. doi:10.1177/0148607114567712

Metheny NA, Krieger MM, Healey F, Meert KL.(2019) A review of guidelines to distinguish between gastric and pulmonary placement of nasogastric tubes. Heart & Lung, 48:226-235.

Metheny NA, Meert KL. (2017)Update on effectiveness of an electromagnetic feeding tube-placement device in detecting respiratory placements. AJCC,6(2): 157-161

Meyer P., Henry M., Maury E., et al. Colorimetric Capnograpy to Ensure Correct Nasogastric Tube Position. Journal of Critical Care.(2009), 24(2): 2310235. doi: 10.1016/jcrc.2008.06.003.

Mizzi A., Cozzi S., Beretta L., Greco M., Braga M. (2017). Real-time Image-guided Nasogastric Feeding Tube Placement: a Case Series Using Kangaroo with IRIS technology in an ICU. Nutrition. 37:48-52. Doi: 10.1016/jnut.2016.09.002. Accessed September 7, 2018.

National Health ServiceHS England. (2013). Placement Devices for Nasogastric Tube Placement Do Not Replace Initial Placement Checks. https://www.england.nhs.uk/patientsafety. Accessed August 24, 2018

Nedel W.L., Jost M.N.F., Filho J.W.F. (2017). A Simple and Fast Ultrasonographic Method of Detecting Enteral Feeding Tube Placement in Mechanically Ventilated, Critically Ill Patients. Journal of Intensive Care, 55(5); 1-3. doi: 10.1186/s405660-017-0249-5.

Nice. (2016). Cortrak 2 Enteral Access System for Placing Nasoenteral Feeding Tubes.

October, T. W. and Hardart, G. E. (2009). Successful Placement of Postpyloric Enteral Tubes using Electromagnetic Guidance in Critically Ill Children. *Pediatric Critical Care Medicine, 10*(2), 196–200. doi:10.1097/pcc.0b013e31819a3668

Oktay Y., Aydin R., Ertugrul O., et al. (2016). Does Bedside Sonography Effectively Identify Nasogastric Tube Placements in Pediatric Critical Care Patients? *Nutrition in Clinical Practice, 31*(6):805-809.

Parker, E. (2016). Response to Patient Safety Alert NHS/PSA/RE/2016/006 Nasogastric Tube Misplacement: Continuing Risk of Death and Severe Harm.

Powers, J., Fischer, M. H., Ziemba-Davis, M., Brown, J. and Phillips, D. M. (2013). Elimination of Radiographic Confirmation for Small-Bowel Feeding Tubes in Critical Care. *American Journal of Critical Care, 22*(6), 521–527. doi:10.4037/ajcc2013755

Powers J, Luebbehusen M, Aguirre L, Cluff J, David MA, et al. (2018). Improved safety and efficacy of small-bore feeding tube confirmation using an electromagnetic placement device. Nutrition in Clinical Practice, 33(2):268-273.

Schallom M., Dykeman B., Metheney N., et al. Head-of-bed Elevation and Early Outcomes of Gastric Reflux, Aspiration and Pressure Ulcers: a Feasibility Study. (2015), *American Journal Crit Care, 24*(1):57-66. Doi: 10.4037/ajcc2015781.

Wallace SC.(2017) Data Snapshot: complications linked to iatrogenic enteral feeding tube misplacements. PA Patient Saf Adivs, 14(4):1.5. https://patientsafety.pa.gov/ADVISORIES/Pages/201712_feedingtubes.aspx. Accessed August 15, 2019.

Wischmeyer P.E., McMoon M.M., Waldron N.H., Dye E.J. (2018). Successful Identification of Anatomical Markers and Placement of Feeding Tubes in Critically Ill Patients Via Camera-assisted Technology with Real-time Video Camera. *JPEN*, Epub. Doi: 10.1002/jpen.1313