



# Reducing nasogastric tube misplacement through evidence-based practice

Is your practice up-to-date?

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**ON APRIL 8, 2008**, my beautiful baby boy, Grant Lars Visscher, was born.

We knew he would be born with a heart defect, so it was no surprise when he had open-heart surgery at 4 days old. As Grant was recovering, his doctors decided he would need a feeding tube to help increase his weight. With Grant just a few days old, the nurse struggled to place the feeding tube and got an X-ray to confirm placement. By the time that Grant was 11 days old, the doctors felt that he was doing so well that he would be released from the hospital in just a couple of days. But that wouldn't happen. It was on this day that the morning nurse wasn't comfortable with Grant's feeding tube, and she got approval to insert a different style. As I watched her struggle

to put it in, I let her know that the current tube placement was confirmed by x-ray. She told me that

wasn't needed and proceeded to insert the tube while explaining to me that she had years of experience. I asked her multiple questions about how she would know the feeding tube was placed correctly. She showed me the process of auscultation and aspiration to verify the placement.

After the tube was placed, Grant seemed off. His color changed, he blew milky white bubbles, and he seemed agitated. I mentioned it to the nurses throughout the day but none of them looked into what was causing his distress. By evening, when he was getting his feed, he was starting to turn blue around the mouth. I mentioned this to the nurse again, but she continued to push the feed before evaluating him. At this point, he had turned completely blue. She asked me to go into



## LEARNING OBJECTIVES

1. Describe the impact of misplaced nasogastric tubes (NGTs).
2. Identify nonevidence-based practices that can lead to complications from misplaced NGTs.
3. Discuss best practices for avoiding complications related to misplaced NGTs.

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the hall and ask for help. I ran into the hall and said, “My son is turning blue!” And I watched as 20 staff members tried to resuscitate him. My sweet baby boy was pronounced dead at 9:10 PM.

I would later learn that the nurse had incorrectly inserted the feeding tube via Grant’s trachea. This misplaced feeding tube led to filling his lungs with fluid. If the nurse had listened to me about needing the x-ray like before or listened to my concerns, Grant would be alive. We would have celebrated Grant’s 10th birthday this year; instead, we celebrated his memory.

—Deabna Visscher

Feeding and drainage tubes, including nasogastric tubes (NGTs), are routinely used in hospitals, but they carry the risk of serious and potentially lethal complications across all patient groups; elderly patients and babies are at most risk. (See *NGT facts and figures*.) Despite these risks, no universal standard of practice exists for bedside verification because each verification method has limitations. This article will discuss current research, steps for improving the verification process, and best practices for NGT placement and verification. Special attention will be paid to processes in the United Kingdom’s National Health Service (NHS).

### A troubling report

The state of Pennsylvania is one of a few in the United States that mandate hospitals to report sentinel events related to NGT misplacement. A recent report published by the Pennsylvania Patient Safety Authority illustrates how prevalent misplaced NGTs are and how this issue and its complications affect patients of all ages. The study analyzed enteral feeding tube misplacements over a 6-year period and found that more than half led to complications, includ-



## NGT facts and figures

Nasogastric tubes (NGTs) pose several risks, including mistaken placement in the lung, esophagus, or small bowel. And even experienced clinicians may have difficulty recognizing pulmonary intubation when placing a temporary NGT.

- A 2011 review in the *Journal of Pediatric Nursing* noted that NGT misplacement in pediatric patients occurs as much as 43.5% of the time.
- An estimated 500,000 NGT and percutaneous endoscopic gastrostomy tubes and suction tubes are misplaced each year, resulting in severe complications or even death.
- In a 2014 review of 15 pediatric case reports in which tubes were placed in the lung, four children died after feedings were introduced. In all cases, auscultation failed to detect the improperly positioned tubes.
- A 2015 study showed that more than 88% of nurses are currently using non-evidence-based practices to verify NGT placement, creating a serious patient safety issue.
- Complications from misplaced NGTs can range from pneumothorax, requiring chest tube placement, to profound chemical pneumonitis and respiratory distress syndrome.
- Providers are more likely to order an x-ray to verify correct NGT placement in adults than children.
- In a 2012 survey of over 2,000 critical care nurses, most believed that radiographic evidence of correct NGT placement is necessary before initial use of a feeding tube, but some of the nurses reported using auscultation when radiography wasn’t available.

Sources: Metheny 2012; Relias Media 2015; Society of Pediatric Nurses Clinical Practice Committee 2011

ing death. Analysts identified 166 NGT misplacements occurring between January 2011 and December 2016. Using expanded criteria, another 16 events were found.

The study also showed the distribution of misplacements among different ages. Elderly patients between the ages of 60 and 89 years were affected the most with 68.7%

of the reported misplacements. Newborns and infants between ages 0 and 11 months accounted for 6.6% of reported misplacements.

Analysis of the data revealed that pneumothorax was the most common outcome of feeding tube misplacement for elderly patients. Other complications included coiling during placement, perforation, and



## Best practices

To confirm nasogastric tube (NGT) placement, both the New Opportunities for Verification of Enteral Tube Location (NOVEL) project and the Actionable Patient Safety Solutions (APSS) recommend a multimodal verification system that includes:

- **pH.** The existing British National Patient Safety Agency safety guideline recommends testing the pH of NGT aspirates. Use of the NGT is considered safe if pH is  $\leq 5.5$ . If you can't obtain gastric aspirate or confirm placement after testing gastric aspirate, request an order for a radiograph that follows the path of the tube from the lungs to the stomach.
- **NEMU.** Measure nose-ear-mid-umbilicus (NEMU) every time you place an NGT—from the tip of the patient's nose to the earlobe and from the earlobe to the point midway between the xiphoid process and umbilicus.
- **Critical-thinking skills.** If patients deteriorate during NGT placement or soon after, remove the tube.
- **X-ray verification.** This remains the gold standard but raises concern with repeated radiation exposure, particularly in neonates. When x-rays are done, they must be read by someone with validated competency in NGT placement verification. Accurate verification requires confirming that the x-ray is the most recent one for the patient, then checking the path of the tube at key anatomic points, rather than solely assessing the tip.

Sources: Bankhead 2009; Gilbertson 2011; Ni 2017

placement in the wrong portion of the GI tract. More than half of the events (56%) were reported as serious, including two deaths. Almost half of the misplacements were discovered with a chest x-ray, which is one of the recommended practices for verification; however, of the 81 x-rays obtained, 16 were misread.

### Practice improvement

Failure to detect misplaced NGTs is attributed to:

- failure to use evidence-based methods to confirm initial placement
- failure to recognize when an NGT has changed position
- failure to properly read a chest and abdominal radiograph for the "four criteria"
  - Does the tube path follow the esophagus/avoid the contours of the bronchi?
  - Does the tube clearly bisect the carina or the bronchi?

X-ray  
misinterpretation  
can lead to  
*misplacement.*

- Does the tube 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?
  - failure to accurately interpret an electromagnetic device screen.
- Improving NGT placement and verification requires a two-pronged approach: consistency of radiographic interpretation and reporting and eliminating nonevidence-based practices.

### Consistency of radiographic interpretation and reporting

Currently, x-rays are the gold standard for NGT placement confirmation because they can aid in visualizing its course. However, as Turgay noted, x-ray misinterpretation can lead to misplacement. The United Kingdom's National Patient Safety Agency reported that between 2005 and 2010, 45% of all cases of harm caused by a misplaced NGT were due to x-ray misinterpretation.

Providers without formal training in radiographic interpretation may rely solely on assessing the placement of the tube tip. Proper radiographic interpretation requires tracking the path of the tube past key anatomic points. Unfortunately, the lack of a mandated and protected central repository to report sentinel events related to NGT misplacements in the United States makes determining how often misinterpretation occurs impossible.

### Eliminating nonevidence-based practices

More alarming than x-ray misinterpretation is the use of nonevidence-based practices, including aspiration or auscultation, to verify NGT placement.

Aspiration and auscultation are commonly used to verify tube placement (The American Society for Parenteral and Enteral Nutrition [ASPEN] surveyed 63 hospitals and found that 39 were using this



Children's Hospital Colorado (CHCO) updated its nasogastric tube (NGT) verification procedures 10 years ago following a sentinel event related to a misplaced NGT. After extensive research, the updates included eliminating auscultation as a verification method and implementing organization-wide education to promote the policy change. The policy is revised annually to review the literature, provide education (in 2018, CHCO began using high-fidelity simulation to aid in training of revised procedures and also incorporated interactive case studies to support multimodal verification), and promote patient safety. CHCO is now collecting data related to verification by pH and/or x-ray confirmation.

"When we took auscultation out of the procedures, there was a lot of resistance," says clinical nurse specialist Christine Peyton, RN, who spearheaded the CHCO changes. "We had to go to our nurse managers and our home-health agencies to educate and implement the new process. Since there was resistance, we had to take a step back. We told Grant's story [see beginning of main article], and that was powerful. It was really hard for people to hear but they realized that [the change to the policy] was the right thing to do and that the literature supports it."

After the policy change, CHCO published a case study illustrating how new processes, including using pH for NGT verification before tube use, resulted in a provider saving an infant's life.

NGT placement verification. Members of the group have critically reviewed the literature, conducted research to further describe the problem, and have developed education tools for NGT placement and verification.

Most recently, the NOVEL project has been working to create an evidence-based best practice document. The Patient Safety Movement, a nonprofit that works with global leaders in healthcare to create free resources, worked with leaders from the United Kingdom's NHS, the NOVEL project, and Children's Hospital Colorado to create "Nasogastric feeding and drainage tube placement and verification." This is one of the free Actionable Patient Safety Solutions (APSS) documents spearheaded by the Patient Safety Movement to address patient safety challenges ([tinyurl.com/yc3d94oa](https://tinyurl.com/yc3d94oa)).

The APSS encourages hospitals to closely scrutinize their own NGT placement and verification methods. The document includes recommendations for safe equipment, staff training and competency, institutional policies, tube placement, confirmation of placement before first use, and reconfirmation of NGT placement after initial use. The APSS also includes practices that should *never* be used:

- auscultation
- visual inspection of fluid from the tube
- observation of bubbles
- litmus paper.

### Best practices

The APSS, based on research and best practices from the NHS and the NOVEL project, recommends evidence-based best practices to verify tube placement, including x-rays, pH testing, nose-ear-mid-umbilicus measurement, and critical-thinking skills. (See *Best practices*.) AACN's procedure manuals for critical care and pediatric acute care both recommend pH measurement as part of the procedure for verify-

method), but human error can result in undetected problems. Both the Child Health Patient Safety Organization and the American Association of Critical-Care Nurses (AACN) have issued alerts recommending that hospitals stop using this verification method. The basis of these alerts is that the lungs and stomach are both resonant organs that can transmit sounds, and the ability to discern the difference between them is negligible, yielding misleading results.

Research dating back to the 1990s has documented the unreliability of auscultation in verifying NGT placement. One study showed that 80% of healthcare professionals were unable to detect tubes placed

in the lungs. Thirteen years ago, England banned auscultation, but in some countries, including the United States, this technique is still taught to parents, nurses, and providers.

### Working toward a solution

To address concerns about lack of consistency in practice and use of unreliable verification methods, ASPEN convened a workgroup to study the issue, beginning with a focus on pediatric NGT placement verification. The New Opportunities for Verification of Enteral Tube Location (NOVEL) project is an interdisciplinary, interorganizational, and international effort to standardize care and to work with industry to develop technologies to address

## Resources

- **APSS**—The free Actionable Patient Safety Solutions (APSS) are presented in a checklist format for easy implementation. You can get more information and review the APSS and supporting documentation at [bit.ly/2D340M5](http://bit.ly/2D340M5).
- **NOVEL**—Get more information about **New Opportunities for Verification of Enteral Tube Location (NOVEL)** project, including access to videos and newsletters, at [bit.ly/2QtG0Wa](http://bit.ly/2QtG0Wa).

ing temporary NGT placement. (See *Success story*.)

The APSS mirrors the United Kingdom's approach, and according to the NHS, out of about 1 million naso- and orogastric tubes inserted in England in 2017 and 2018 (based on purchase data), only 21 were misplaced in the lungs or pleura. In other words, one in 50,000 tubes was misplaced. Many experts believe that those misplacements could have been prevented using the steps outlined in the APSS.

### Take action

Don't wait for a tragic event like Grant's to take action. If you're a nurse leader, review the new evidence, download the recommendations, and work with others to develop and implement a plan to change current practices in your organization. If you're not in a leadership role, share this information with the decision makers and ensure policies and procedures align with best practices. Use Grant's story to propel this program forward and ensure that similar events don't happen again. ★

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**Please mark the correct answer online.****1. Which statement about the risks of nasogastric tube (NGT) misplacement is correct?**

- The incidence of NGT misplacement is 2% in pediatric patients.
- The incidence of NGT misplacement is 43% in adults.
- Providers are more likely to order an x-ray to verify correct NGT placement in adult patients.
- Providers are more likely to order an x-ray to verify correct NGT placement in teenagers.

**2. Which statement about nurses checking NGT placement is correct?**

- More than 28% of nurses are currently using nonevidence-based practices to verify NGT placement.
- More than 48% of nurses are currently using nonevidence-based practices to verify NGT placement.
- More than 68% of nurses are currently using nonevidence-based practices to verify NGT placement.
- More than 88% of nurses are currently using nonevidence-based practices to verify NGT placement.

**3. According to a report from the Pennsylvania Patient Safety Authority, the most common outcome of feeding tube misplacement in elderly patients is**

- pulmonary perforation.
- pneumothorax.
- gastric perforation.
- tube coiling.

**4. Which statement about age and complications from NGT misplacement is correct, based on data from the Pennsylvania Patient Safety Authority?**

- Children between the ages of 8 and 12 years account for 10% of reported misplacements.
- Newborns and infants between the ages of 1 and 9 months account for 10% of reported misplacements.
- Patients between the ages of 60 and 89 are least affected.
- Patients between the ages of 60 and 89 are most affected.

**5. One of the four criteria for checking NGT placement on a radiograph is asking**

- Does the tube not bisect the carina?
- Does the tube follow the trachea?
- Is the tip clearly visible below the left hemi-diaphragm?
- Does the tube cross the diaphragm on the right side?

**6. Which statement about verification of NGT placement is correct?**

- Inspecting NGT drainage is sufficient for NGT placement confirmation.
- Radiographs are the gold standard for NGT placement confirmation.
- Auscultation is an evidence-based method for verifying NGT placement.
- Aspiration is the gold standard for verifying NGT placement.

**7. The New Opportunities for Verification of Enteral Tube Location (NOVEL) project**

- is an interdisciplinary, interorganizational, and international effort.
- is an initiative of nurses based in the United States.
- was convened by the American Association of Critical-Care Nurses.
- was convened by the Patient Safety Movement Foundation.

**8. How should you measure before placing an NGT?**

- From the base of the patient's nose to the earlobe and from the earlobe to the point right below the xiphoid process
- From the tip of the patient's nose to the base of the neck and from the base of the neck to the point midway between the xiphoid process and umbilicus
- From the tip of the patient's nose to the earlobe and from the earlobe to the point midway between the xiphoid process and umbilicus
- From the base of the patient's nose to the earlobe and from the earlobe to the point right above the umbilicus

**9. Which statement about pH testing for NGT placement is correct?**

- The pH of the aspirate should be  $\leq 6.5$  before the NGT is used.
- The pH of the aspirate should be  $\geq 7.5$  before the NGT is used.
- If aspirate can't be obtained for pH testing, radiographic testing should be done.
- If aspirate can't be obtained for pH testing, auscultation should be done.

**10. Which of the following is not a strategy for improving NGT placement and verification?**

- Providing education about evidence-based practices
- Adding auscultation for checking placement
- Eliminating auscultation for checking placement
- Ensuring consistent radiographic interpretation