AACN PracticeAlert™

Verification of Feeding Tube Placement
(blindly inserted)

Expected Practice:

- ☑ Use a variety of bedside methods to predict tube location ***during*** the insertion procedure:
  - Observe for signs of respiratory distress.
  - Use capnography if available.
  - Measure pH of aspirate from tube if pH-strips are available.
  - Observe visual characteristics of aspirate from the tube.
  - Recognize that auscultatory (air bolus) and water bubbling methods are unreliable. [Level B]
- ☑ Obtain radiographic confirmation of correct placement of any blindly inserted tube prior to its initial use for feedings or medication administration.
  - The radiograph should visualize the entire course of the feeding tube in the gastrointestinal tract and should be read by a radiologist to avoid errors in interpretation. Mark and document the tube's exit site from the nose or mouth immediately after radiographic confirmation of correct tube placement. [Level A]
- ☑ Check tube location at 4-hour intervals after feedings are started:
  - Observe for a change in length of the external portion of the feeding tube (as determined by movement of the marked portion of the tube).
  - Review routine chest and abdominal x-ray reports to look for notations about tube location.
  - Observe changes in volume of aspirate from feeding tube.
  - If pH strips are available, measure pH of feeding tube aspirates if feedings are interrupted for more than a few hours.
  - Observe the appearance of feeding tube aspirates if feedings are interrupted for more than a few hours.
  - Obtain an x-ray to confirm tube position if there is doubt about the tube's location. [Level B]

Scope and Impact of the Problem:

Although often considered an innocuous procedure, blind placement of a feeding tube can cause serious and even fatal complications.[1;2 3] While styleted small-bore tubes are most often associated with complications, large-bore unstyleted tubes are not without risk.[1;4-6] In a review of over 2,000 feeding tube insertions, investigations found that nasogastric feeding tubes were malpositioned in 1.3 to 3.2 percent[7,8] of all insertions; further, 28 percent of the malpositions resulted in pneumonia or pneumothorax.[7] Although rare, feeding tubes may be malpositioned in the brain, especially in patients with a traumatic defect.[4;11-13] Risk for aspiration is greatly increased when a feeding tube's ports end in the esophagus.[1;9]

Supporting Evidence:

<u>Bedside Methods to Determine Placement During Blind Tube Insertion</u>

Signs of Respiratory Distress

- Symptoms such as coughing and dyspnea may occur when feeding tubes are inadvertently positioned in the airway, especially in patients with an impaired level of consciousness.[14-16] The occurrence of these signs should cause removal of the tube and a new insertion attempt.[17]

Capnography

- A carbon dioxide detector is helpful but is not sufficiently sensitive and specific to preclude the need for a confirmatory x-ray before initial use of a feeding tube.[22;23]In addition a concurrently used CO_2 sensor failed to detect 2 of the 4 malpositioned tubes.[23] Also, a carbon dioxide sensor cannot determine where a feeding tube's tip ends in the gastrointestinal tract (esophagus, stomach, or small bowel).[1]

pH and Appearance of an Aspirate

- Fasting gastric pH is usually 5 or less, even in patients receiving gastric-acid inhibitors.[24;17;25] Respiratory secretions typically have a pH greater than 6.[15;26] However, because gastric fluid occasionally has a high pH,

the pH method is not sufficiently reliable to rule out the need for an x-ray to distinguish between gastric and respiratory tube placement.[26]

- Small bowel secretions typically have higher pH values (≥6) than gastric juice; thus, observing for pH changes is useful in determining when a feeding tube has advanced from the stomach into the small bowel.[24;25;27] Using this method, it is often possible to limit the needed number of confirmatory x-rays to one.
- The pH method has no benefit in detecting placement of a feeding tube in the esophagus. Fluid withdrawn from the esophagus can be swallowed alkaline saliva or refluxed acidic gastric juice.[28]
- In summary, while the pH method is helpful, it is not sufficiently accurate to eliminate the need for a confirmatory x-ray prior to first-time use of a feeding tube.
- Aspirate appearance is not sufficient to eliminate the need for a confirmatory radiograph prior to first-time use of a feeding tube; there is confusion in differentiating between gastric and respiratory secretions.[15;37;6;16;30-36]

Listening over Epigastrium for Air Insufflated Through Tube.

- The auscultatory method is not reliable in distinguishing between respiratory and gastric placement or between gastric and small bowel placement.
- There are numerous anecdotal reports of blindly-inserted tube entering the respiratory tract undetected by the auscultatory method, causing clinicians to assume that the tubes were correctly positioned in the stomach.[6;15;16;36;38-43] In a number of these cases, feedings or medications were administered and led to poor patient outcomes.[6;16;35;36;40;42-44]

Radiographic Confirmation

- A properly obtained and interpreted radiograph is recommended to confirm correct placement of any blindly inserted tube before its initial use for feedings or medication administration.[1;9;30;45;46 47] Because radiographs may be misinterpreted,[42;44;48] it is best to have a radiologist read the film to approve use of the tube for feedings.[1]
- Marking and documenting the tube's exit site at the time of radiographic confirmation of correct placement will be helpful in subsequent monitoring of the tube's location during its use for feedings.[49]

Checking Tube Location at Regular Intervals After Feedings are started

Feeding tube dislocation during feedings is a frequent problem.[49-51] Most often, it occurs when the tube is partially pulled out during movement or by an agitated patient.

Observing for Change in External Tube Length.

- Observing for a change in length of the external portion of the feeding tube (as determined by movement of the marked portion of the tube) may be helpful in detecting tube dislocation.[49-50]

Reviewing Routine Chest and Abdominal X-ray Reports.

- Reviewing routine chest and abdominal x-ray reports to determine if the radiologist has referred to feeding tube location can be quite helpful.[49]

Observing For Changes in Volume of Feeding Tube Aspirates.

- Observing the volume of fluid withdrawn from a tube at 4-hour intervals during continuous feedings or prior to each intermittent feeding may be helpful.[49] A sharp increase in residual volume may indicate displacement of a small-bowel tube into the stomach.
- Consistent inability to withdraw more than a few drops of fluid from the feeding tube may signal upward displacement into the esophagus.[28]
- It is often difficult to withdraw fluid from small-bore feeding tubes.[52] To avoid this problem, a proven method[53] calls for injecting 20-30 ml boluses of air into the tube with a large syringe (30 ml to 60 ml) and then slowly applying negative pressure to the plunger to withdraw fluid; it may be necessary to repeat the procedure several times.

Testing pH of Feeding and Observe the Appearance of Tube Aspirate if Feedings are Off for Several Hours.

- While feedings should never be interrupted solely for the purpose of pH testing, or observing the appearance of feeding tube aspirates they are sometimes interrupted in preparation for tests or procedures. If the latter occurs, pH testing may be useful in distinguishing between gastric and small bowel tube positions.[26;54] The pH method is of minimal benefit during continuous feedings because enteral formula buffers the pH of gastric secretions.[26] Observing the appearance of feeding aspirates may be useful in distinguishing between gastric and small bowel positions.[37] As indicated above, fasting gastric juice is usually grassy-green or clear and colorless, while small bowel juice is often bile-stained.[37]

Listening Over Epigastrium for Air Insufflated Through the Tube.

- The auscultatory method cannot distinguish between esophageal, gastric, or small bowel tube placement.

Obtain an x-ray to determine tube location if in doubt.

- When multiple bedside methods suggest that tube displacement has occurred, it is prudent to consider obtaining an x-ray to determine tube location.

AACN Evidence Leveling System

Level A	Meta-analysis of quantitative studies or metasynthesis of qualitative studies with results that consistently support a specific action, intervention or treatment.
Level B	Well-designed, controlled studies with results that consistently support a specific action, intervention or treatment.
Level C	Qualitative studies, descriptive or correlational studies, integrative review, systematic reviews, or randomized controlled trials with inconsistent results.
Level D	Peer-reviewed professional organizational standards with clinical studies to support recommendations.
Level E	Multiple case reports, theory-based evidence from expert opinions, or peer-reviewed professional organizational standards without clinical studies to support recommendations.
Level M	Manufacturer's recommendations only.

Actions for Nursing Practice:

- Use a variety of bedside techniques to assess tube placement during the insertion procedure; use results to determine when it is time to obtain radiographic confirmation of tube location. The number of needed confirmatory x-rays can likely be reduced to one.
- Obtain an x-ray that visualizes the entire course of a newly inserted tube to ensure that it is in the desired position (either the stomach or small bowel) before its initial use. Work with an interdisciplinary team to establish a protocol whereby a radiologist will read the film and give written permission for first-time use of the tube for feedings or medication administration.
- Ensure that your critical care unit has written practice documents such as a policy, procedure or standard of care that include when the initial x-ray should be obtained, a method of marking the feeding tube, where to document the exit site, and the frequency of the documentation.
- If documentation of tube placement is not currently a part of the routine interpretation of chest and/or abdominal x-rays, form a collaborative team including a radiologist, pulmonologist, staff nurse, and risk manager to develop strategies for implementing this practice.
- Monitor tube position at 4-hour intervals using a variety of bedside techniques; consider the need for an x-ray if multiple bedside techniques raise doubt about a tube's location.

Need More Information or Help?

- Go to (www.aacn.org/prninfo).

References:

1. Metheny NA, Meert KL, Clouse RE. Complications related to feeding tube placement. Curr Opin Gastroenterol. 2007;23:178-82.
2. Aguilar-Nascimento JE, Kudsk KA. Use of small-bore feeding tubes: successes and failures. Curr Opin Clin Nutr Metab Care. 2007;10:291-6.
3. Pillai J.B., Vegas A, Brister S. Thoracic complications of nasogastric tube: review of safe practice. Interact Cardiovasc Thorac Surg. 2005;4:429-32.
4. Metheny NA. Inadvertent intracranial nasogastric tube placement. Am J Nurs. 2002;102:25-7.
5. Harris CR, Filandrinos D. Accidental administration of activated charcoal into the lung: aspiration by proxy. Ann Emerg Med. 1993;22:1470-3.
6. el-Gamel A, Watson DC. Transbronchial intubation of the right pleural space: a rare complication of nasogastric intubation with a polyvinylchloride tube--a case study. Heart Lung. 1993;22:224-5.
7. Sorokin R, Gottlieb JE. Enhancing patient safety during feeding-tube insertion: a review of more than 2000 insertions. JPEN J Parenter Enteral Nutr. 2006;30:440-5.
8. Aguilar-Nascimento JE, Kudsk KA. Clinical costs of feeding tube placement. JPEN J Parenter Enteral Nutr. 2007;31:269-73.
9. Baskin WN. Acute complications associated with bedside placement of feeding tubes. Nutr Clin Pract. 2006;21:40-55.
10. Marderstein EL, Simmons RL, Ochoa JB. Patient safety: effect of institutional protocols on adverse events related to feeding tube placement in the critically ill. J Am Coll Surg. 2004;199:39-47.
11. Rahimi-Movaghar V, Boroojeny SB, Moghtaderi A, Keshmirian B. Intracranial placement of a nasogastric tube. A lesson to be re-learnt? Acta Neurochirurgica 2005;147:573-4.
12. Genu PR, de Oliveira DM, Vasconcellos RJ, Nogueira RV, Vasconcelos BC. Inadvertent intracranial placement of a nasogastric tube in a patient with severe craniofacial trauma: a case report. J Oral Maxillofac Surg. 2004;62:1435-8.
13. Ferreras J, Junquera LM, Garcia-Consuegra L. Intracranial placement of a nasogastric tube after severe craniofacial trauma. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2000;90:564-6.
14. Rassias A, Ball P, Corwin HL. A prospective study of tracheopulmonary complications associated with the placement of narrow-bore enteral feeding tubes. Crit Care. 1998;2.
15. Metheny N, Dettenmeier P, Hampton K, Wiersema L, Williams P. Detection of inadvertent respiratory placement of small-bore feeding tubes: a report of 10 cases. Heart Lung. 1990;19:631-8.
16. Schorlemmer GR, Battaglini JW. An unusual complication of naso-enteral feeding with small-diameter feeding tubes. Ann Surg. 1984;199:104-6.
17. Metheny NA, Titler MG. Assessing placement of feeding tubes. Am J Nurs 2001;101:36-45.
18. Burns SM, Carpenter R, Truwit JD. Report on the development of a procedure to prevent placement of feeding tubes into the lungs using end-tidal CO2 measurements. Crit Care Med. 2001;29:936-9.
19. Burns SM, Carpenter R, Blevins C, et al. Detection of inadvertent airway intubation during gastric tube insertion: capnography versus a colorimetric carbon dioxide detector. Am J Crit Care. 2006 Mar; 15:188-95.
20. Howes DW, Shelley ES, Pickett W. Colorimetric carbon dioxide detector to determine accidental tracheal feeding tube placement. Can J Anaesth. 2005;52:428-32.
21. Ellett ML, Woodruff KA, Stewart DL. The use of carbon dioxide monitoring to determine orogastric tube placement in

premature infants: a pilot study. Gastroenterol Nurs. 2007;30:414-7.
22. Kindopp AS, Drover JW, Heyland DK. Capnography confirms correct feeding tube placement in intensive care unit patients. Can J Anaesth. 2001;48:705-10.
23. Munera-Seeley V, Ochoa JB, Brown N, et al. Use of a colorimetric carbon dioxide sensor for nasoenteric feeding tube placement in critical care patients compared with clinical methods and radiography. Nutr Clin Pract. 2008;23:318-21.
24. Phang JS, Marsh WA, Barlows TG, III, Schwartz HI. Determining feeding tube location by gastric and intestinal pH values. Nutr Clin Pract. 2004 Dec; 19:640-4.
25. Griffith DP, McNally AT, Battey CH, et al. Intravenous erythromycin facilitates bedside placement of postpyloric feeding tubes in critically ill adults: a double-blind, randomized, placebo-controlled study. Crit Care Med. 2003;31:39-44.
26. Metheny NA, Reed L, Wiersema L, McSweeney M, Wehrle MA, Clark J. Effectiveness of pH measurements in predicting feeding tube placement: An update. Nurs Res. 1993;42:324-31.
27. Gharpure V, Meert KL, Sarnaik AP, Metheny NA. Indicators of postpyloric feeding tube placement in children. Crit Care Med. 2000;28:2962-6.
28. Metheny NA, Clouse RE, Clark JM, Reed L, Wehrle MA, Wiersema L. Techniques & procedures. pH testing of feeding-tube aspirates to determine placement. Nutr Clin Pract. 1994;9:185-90.
29. Kaufman JP, Hughes WB, Kerstein MD. Pneumothorax after nasoenteral feeding tube placement. Am Surg. 2001;67:772-3.
30. Kawati R, Rubertsson S. Malpositioning of fine bore feeding tube: a serious complication. Acta Anaesthesiol Scand. 2005;49:58-61.
31. Balogh GJ, Adler SJ, VanderWoude J, et al. Pneumothorax as a complication of feeding tube placement. AJR Am J Roentgenol. 1983; 141:1275-7.
32. Nakao MA, Killam D, Wilson R. Pneumothorax secondary to inadvertent nasotracheal placement of a nasoenteric tube past a cuffed endotracheal tube. Crit Care Med. 1983;11:210-1.
33. Theodore AC, Frank JA, Ende J, Snider GL, Beer DJ. Errant placement of nasoenteric tubes. A hazard in obtunded patients. Chest. 1984;86:931-3.
34. Hand RW, Kempster M, Levy JH, Rogol PR, Spirn P. Inadvertent transbronchial insertion of narrow-bore feeding tubes into the pleural space. JAMA. 1984;251:2396-7.
35. Lipman TO, Kessler T, Arabian A. Nasopulmonary intubation with feeding tubes: case reports and review of the literature. JPEN J Parenter Enteral Nutr. 1985;9:618-20.
36. Torrington KG, Bowman MA. Fatal hydrothorax and empyema complicating a malpositioned nasogastric tube. Chest. 1981;79:240-2.
37. Metheny N, Reed L, Berglund B, Wehrle MA. Visual characteristics of aspirates from feeding tubes as a method for predicting tube location. Nurs Res. 1994 Sep-Oct; 43:282-7.
38. Metheny N, McSweeney M, Wehrle MA, Wiersema L. Effectiveness of the auscultatory method in predicting feeding tube location.[see comment]. Nurs Res. 1990;39:262-7.
39. Ng C, Wan S, Lee TW, Yim A. Transbronchial intrapleural intubation with a feeding tube under unusual circumstances. N Z Med J. 2002;115:166-7.
40. Metheny NA, Wehrle MA, Wiersema L, Clark J. Testing feeding tube placement: Auscultation vs. pH method. Am J Nurs. 1998;98:37-42.
41. Kolbitsch C, Pomaroli A, Lorenz I, Gassner M, Luger TJ. Pneumothorax following nasogastric feeding tube insertion in a tracheostomized patient after bilateral lung transplantation. Intensive Care Med. 1997;23:440-2.
42. Hendry PJ, Akyurekli Y, McIntyre R, Quarrington A, Keon WJ. Bronchopleural complications of nasogastric feeding tubes. Crit Care Med. 1986;14:892-4.
43. Miller KS, Tomlinson JR, Sahn SA. Pleuropulmonary complications of enteral tube feedings. Two reports, review of the literature, and recommendations. Chest. 1985;88:230-3.
44. Lo JO, Wu V, Reh D, Nadig S, Wax MK. Diagnosis and management of a misplaced nasogastric tube into the pulmonary pleura. Arch Otolaryngol Head Neck Surg. 2008;134:547-50.
45. Swain FR, Martinez F, Gripp M, Razdan R, Gagliardi J. Traumatic complications from placement of thoracic catheters and tubes. Emerg Radiol. 2005;12:11-8.
46. Gavi S, Hensley J, Cervo F, Nicastri Z, Fields S. Management of feeding tube complications in the long-term care resident. Ann Long Term Care. 2008 Apr; 16:28-32.
47. Seguin P, Le B, V, Aguillon D, et al. [Testing nasogastric tube placement: evaluation of three different methods in intensive care unit]. Ann Fr Anesth Reanim. 2005;24:594-9. French.
48. Scheiner JD, Noto RB, McCarten KM. Importance of radiology clerkships in teaching medical students life-threatening abnormalities on conventional chest radiographs. Acad Radiol. 2002;9:217-20.
49. Metheny NA, Schnelker R, McGinnis J et al. Indicators of tubesite during feedings. J Neurosc Nurs.2005;37:320-5.
50. Metheny NA, Spies M, Eisenberg P. Frequency of nasoenteral tube displacement and associated risk factors. Res Nurs Health. 1986;9:241-7.
51. Ellett MLC, Maahs J, Forsee S. Prevalence of feeding tube placement errors & associated risk factors in children. MCN Am J Matern Child Nurs. 1998 Sep-Oct; 23:234-9.
52. Conner TM, Carver D. The role of gastric pH testing with small-bore feeding tubes: in the intensive care unit. Dimens Crit Care Nurs. 2005 Sep-Oct; 24:210-4.
53. Metheny N, Reed L, Worseck M, Clark J. How to aspirate fluid from small-bore feeding tubes. Am J Nurs 1993;93:86-8.
54. Metheny NA, Williams P, Wiersema L, Wehrle MA, Eisenberg P, McSweeney M. Effectiveness of pH measurements in predicting feeding tube placement. Nurs Res. 1989;38:280-5.
55. Kearns PJ, Chin D, Mueller L, Wallace K, Jensen WA, Kirsch CM. The incidence of ventilator-associated pneumonia and success in nutrient delivery with gastric versus small intestinal feeding: A randomized clinical trial. Crit Care Med. 2000;28:1742-6.
56. Neumann DA, DeLegge MH. Gastric versus small-bowel tube feeding in the intensive care unit: a prospective comparison of efficacy. Crit Care Med. 2002;30:1436-8.

Additional reading

1. JPEN J Parenter Enteral Nutr OnlineFirst, published on January 27, 2009 as doi:10.1177/0148607108330314 ASPEN Enteral Nutrition Practice Recommendations

2. Martindale, RG. MD, PhD; McClave, SA MD; et al; American College of Critical Care Medicine; the A.S.P.E.N. Board of Directors Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine and American Society for Parenteral and Enteral Nutrition. Crit Care Med. 2009: 35; 1-30