Actionable Patient Safety Solution (APSS) #15:
NASOGASTRIC FEEDING AND DRAINAGE TUBE PLACEMENT AND VERIFICATION

Executive Summary Checklist

Nasogastric tubes (NGTs) are a commonly used intervention in clinical practice for decompression or for administration of enteral nutrition, fluids and medications. Misplacement of NGTs can lead to significant morbidity and even, death.

☐ Use only NGTs that are radio-opaque throughout their length with external centimeter length markings to be used to detect post-insertion tube movement.
☐ Ensure that all staff who place NGTs are specifically trained in this procedure.
☐ Accurately measure the length of the NGT prior to insertion using the NEMU method (Nose→Earlobe→Mid-Umbilicus).
☐ Confirm NG placement prior to initial use with pH of gastric aspirate which should like in the desired range of 1.0 to 5.0.
    ● If unable to obtain a gastric aspirate within the required pH range, confirm NG placement with a radiograph.
☐ Ensure all staff who read radiographs are specifically trained in reading the radiograph using the following four 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?
☐ Document the confirmation of NG tube in the EMR as well as the method of confirmation (pH or radiograph).
☐ Secure tubes to the patient after confirmation in such a way that the centimeter mark is visible at the naris.
    ● Document this mark in the medical record and used as a point of reference for other caregivers to gauge movement of the tube.
☐ Observe for signs of respiratory distress or gagging/vomiting and remove tube if these signs are present as NG tube may have been dislodged into the airway or lungs.
☐ Develop a mandatory reporting system to track nasogastric feeding tube misplacements as a percentage of all tubes placed.
The Performance Gap

Nasogastric tubes (NGTs) are a commonly used intervention in clinical practice for decompression or for administration of enteral nutrition, fluids and medications. In a neonatal and pediatric one day prevalence study of 63 institutions, 24% of hospitalized infants and children required an orogastric (OG), nasogastric (NG), or transpyloric tube (Lyman et al., 2015). Of those patients, 61% were located in a neonatal intensive care unit (NICU). A National Patient Safety Alert (NPSA) issued by the National Health Service (NHS) documented over 3 million NG or OG tubes were used from 2011-2016 in the United Kingdom (UK) (Parker, 2016). These tubes are inserted using blind placement technique, so called because the person doing the procedure cannot discern where the tube is going in the body as it is being advanced. As a consequence, complications can occur if the NG or OG is misplaced into the esophagus, duodenum or pulmonary tree. Serious patient harm and deaths have occurred when tube misplacement is not detected prior to use.

Studies of adult patients report NGT misplacement with serious harm to patients in 1.3 to 3.2% of tubes placed (Gilbertson, Rogers and Ukoumunne, 2011; Bourgault and Halm, 2009). A study of neonates documented an incidence of 59% NGT misplacements with the majority of tubes being in the esophagus (October and Hardart, 2009). The Pennsylvania Patient Safety Authority documented 44 NGT misplacements into the lung from 2011-2013 (Powers, Fischer, Ziemba-Davis, Brown and Phillips, 2013). Of these events, 24 were classified as serious patient harm. Case reports in the literature describe such injuries as pneumothorax, enteral formula administration into the lung, esophageal perforation, and even death (Gilbertson, Rogers and Ukoumunne, 2011; Bourgault and Halm, 2009). Failure to detect misplaced NGTs are attributed 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, Fischer, Ziemba-Davis, Brown and Phillips, 2013).

Leadership Plan

Successful implementation of NG tube safe practices includes the following:

- Commitment from hospital governance and senior administrative leadership to identify and maintain awareness of performance gaps within their organization.
- All leadership and healthcare professionals will fully understand the need for change by identifying performance gaps in their own care area.
- Healthcare leadership must take an active role in facilitating process changes by providing necessary resources, removing barriers, giving their time and attention, as well as encouraging process improvement.
- Goals that are clearly defined and measurable, effective communication and collaboration, encouraging clinical/safety leadership, and being supportive during the change period are ways healthcare leadership will assist with improvement initiatives.
- Hospital governance at all levels and senior administrative leadership must be engaged and demonstrate their own commitment to implementing the new process change. Senior leaders, directors, physicians, managers, and unit leaders are expected to be engaged as they have a significant role in the process improvement process.

To sustain the change, acceptance and accountability building is essential. Success and sustainability are more likely to be the outcome of the initiative when the proposed changes are accepted by those primarily responsible for the implementation.
Practice Plan

Safe Equipment

- All NGTs should be radio-opaque throughout their length with external centimeter length markings to be used to detect post-insertion tube movement
- When checking pH use a product that is licensed for medical use.

Staff Training and Competency

- All staff who place NGTs should be specifically trained in this procedure. Competency should include:
  - 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
  - Demonstrated skill in the use of any technology to assist with placement (see ‘Technology Plan’ below)
- All staff who place NGTs should be aware that signs and symptoms of misplacement could be immediate such as circumoral cyanosis or delayed or non-existent until the patient’s condition deteriorates. Therefore staff need to be constantly alert for such signs, but not take their absence as confirmation the tube is correctly sited.
- All staff who read radiographs done to confirm NGT placement should be specifically trained in reading the radiograph using the ‘four criteria’ (seek expert radiologist advice for detail of local training, but in brief:
  - Does the tube path follow the oesophagus/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.

Institutional Policies

- A mandatory reporting system should be instituted to capture the frequency of NGT misplacement, including patient outcome.
- Institutional procedures guiding NGT insertion and placement verification should be evidence based and should provide guidance to staff on when a patient is considered high risk for misplacement.
- Within that procedure, a comment should be added encouraging the use of critical thinking skills when assessing a patient during, immediately after or at any time the NGT is in place and clinical deterioration occurs.
- When product changes occur, staff need education regarding the new NGT and how it is different from the previous product.

Tube Placement

- To obtain an accurate measurement of insertion length, use the NEMU method (Nose→Earlobe→Mid-Umbilicus)
- Proper positioning of the patient, particularly of the head (into anatomic position) during the insertion procedure will make the procedure safer.

Confirmation of Placement Before First Use

- Upon initial insertion of an NGT, a pH should be checked with the desired range being 1-5.0.
- Aspiration of 3-8 ml of gastric fluid should be withdrawn to obtain specimen for pH with stylet in place. Water can then be instilled after confirmation to remove the stylet.
● If unable to obtain an aspirate, turn the patient on the left side if possible and after 10-20 minutes, re-attempt to obtain fluid from the NGT.
● If still unable to obtain an aspirate within the required range, do not use the tube until a radiograph is done to confirm placement.
● Concomitant use of acid suppressing medications is not a contra-indication to pH measurement. If the pH is > 5.0, an abdominal radiograph is necessary.
● When a radiograph is obtained:
  ○ It needs to follow the tube from the chest to below the diaphragm. The tip of the NGT needs to be visualized.
  ○ The report needs to document all ‘four criteria’ (seek expert radiologist advice for detail of local training, but in brief: Does the tube path follow the oesophagus/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?) along with a comment that the tube is appropriately placed for use.
  ○ The reader of the radiograph needs to assure the radiograph being read is the correct patient and the most recent radiograph obtained.
● For adult patients and certain neonatal/pediatric patient, consider a radiograph even if pH is in the required range when:
  ○ patient is severely obtunded
  ○ have an endotracheal tube, or are
  ○ clinically unstable after NGT re-insertion post resuscitation
  ○ clinical deterioration occurs soon after NGT placement

Reconfirmation of NGT Placement after Initial Use
● Tubes should initially be secured to the patient in such a way that the centimeter (cm) mark is visible at the nare. This mark should be documented in the medical record and used as a point of reference for other caregivers to gauge movement of the tube.
● pH can and should be used to re-confirm placement especially if:
  ○ there has been a clinical indication the tube may have migrated such as vomiting or visible enteral formula in the oral cavity from an unwitnessed event.
  ○ The securement device has become dislodged or the tube is not at the reference cm mark.

Practices that should NEVER be used
The following non-evidence based practices are misleading and should never been used as methods to verify NGT placement:
● Auscultation
● Visual inspection of fluid from the tube
● Observation of bubbles - this method is NOT reliable and should no longer be used
● Litmus paper - should NOT be used to determine NGT placement

Technology Plan

Suggested practices and technologies are limited to those proven to show benefit or are the only known technologies with a particular capability. As other options may exist, please send information on any additional technologies, along with appropriate evidence, to info@patientsafetymovement.org.

Methods of NGT placement confirmation reported in a recently published literature review are listed below. New literature and/or options may exist, please send information on any additional technologies, along with appropriate evidence, to
**The Gold Standard** - X-ray is regarded as the gold standard for initial NGT placement however it is infeasible, unsafe and costly to perform X-ray before every NGT use. It is also not fool-proof. Between 2005 to 2010, 45% of all cases of harm caused by a misplaced NGT reported by the UK National Patient Safety Agency were due to misinterpreted X-rays, although it should be noted none of these cases involved use of the ‘four criteria’ but had relied on viewing tip placement.

**First-line bedside method** - pH testing should be regarded as the first-line method for bedside checking of NGT placement as studies show it has the highest sensitivity and specificity of all bedside tests when using a cut-off point of less than or equal to pH5.0

The AACN recommends using 2 or more bedside methods to predict tube location during insertion, before feeding, at four hourly intervals after feeding has started or if there is any interruption in feeding.

**Supplementary Checks on NGT Placement (NOT to be used as confirmation of correct placement):**

- Observe for signs of respiratory distress (e.g. coughing, choking, dyspnea etc) – remove and re-insert tube if observed however its important to note that that the signs of respiratory distress may be absent when tubes are inadvertently positioned in the airway especially if the patient has an impaired level of consciousness.
- Observe for change in length of external portion of the tube – feeding tubes may become dislocated during use due a number of factors. For this reason it is necessary to monitor tube location at regular intervals while the tube is being used for feeding and/or medication. Observing and recording the length of the external portion of the NGT may be helpful in detecting tube migration.
- Observe visual characteristics of aspirate ONLY for indications of migration from stomach to small bowel where the difference in appearance would be more marked. DO NOT try to distinguish between gastric and respiratory secretions as this can be visually confusing.

**Methods with limited indication or unclear benefit requiring further research:**

- Biochemical markers – currently no bedside tests available but laboratory tests for bilirubin, pepsin and trypsin levels have been used together with pH to confirm placement.
- Capnography/colorimetric capnometry – promising method however current evidence is on initial placement only so its reliability in recurrent testing is unclear. The presence of feed, gastric contents and some drinks/medications may interfere with the results.
- Ultrasound – may be useful but with some reported difficulties. Useful to show progress of the tube through the oesophagus but issues reported verifying that the tip is in the stomach.
- Electromagnetic tracing – EM trace only indicates NGT placement during insertion and cannot make subsequent confirmation. Deaths have been reported through reliance on EM devices to confirm placement (NHS England, 2013). No studies of EM use to guide nasogastric tube placement in children have been published to date and only one study of its use to guide in adults (NICE, 2016).
- Visualisation technology – limited data exists although it may be useful for initial placement in sedated patients but less useful for subsequent checking of NGT placement.
- Manometer technique – may be a promising method of NGT placement confirmation among intubated, critically ill and mechanically ventilated patients.

**Workgroup**

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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 APSS recommend technologies offered by companies involved in the Patient Safety Movement Foundation that the workgroups have concluded, based on available evidence, are beneficial in addressing the patient safety issues addressed in the APSS. 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.

References


