

Verifying Gastric Tube Placement in the ED

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### **Abstract**

The use of nasogastric and orogastric tubes are a standard practice in Emergency Departments that require verification of placement into the stomach prior to initiating any form of treatment to minimize the risk of an adverse event. Pulmonary complications are the main risks associated with gastric tube insertion as the tube could be accidentally placed in the tracheobronchial tree. Research was conducted to assess the reliability of the bedside verification methods of pH strips and the auscultation technique. Literature that was used for this research included: systematic reviews, meta-analyses, observational studies, and clinical practice guidelines. The findings were consistent that the use of pH testing of an aspirate, compared to the auscultation technique, was the more reliable method of verification of correct placement. This research was performed in an effort to initiate the use of pH strips in the Emergency Department of Parkview Medical Center when radiographic confirmation is inaccessible or deemed unnecessary.

### **PICOT Question**

For patients who have a gastric tube inserted in the Emergency Department, when a chest x-ray is not available, how does the use of pH strip verification compare to the auscultation technique of verification to verify correct placement of the tube?

### **Introduction**

The insertion of nasogastric and orogastric tubes have become a standard practice across Emergency Departments as they are often used to decompress the stomach and remove stomach contents, to prevent aspiration and minimize nausea/vomiting, or to instill liquids or medications (Proehl et al., 2011). Tubes are inserted using the NEX (nose, ear, xyphoid process) method which indicates the nurse to measure from the patient's tip on the nose to the ear to the xyphoid

process and then insert the tube to that distance and verify placement prior to use. There is a need for reliable methods of determining if these gastric tubes are placed in the correct location. There are various methods of verification that can be used and have been compared in studies to have varying ranges of effectiveness. Some bedside methods of detection include: the auscultation technique or “whoosh” technique; the use of capnography; the testing of aspirates for biochemical markers such as pH, bilirubin, pepsin and trypsin; assessing for respiratory distress, and transillumination. Despite there being many bedside techniques, the gold standard for verifying placement is the use of an x-ray.

Reliable methods should be used to minimize the risk of an adverse event related to the placement of these gastric tubes. Patients are at a higher risk for complication if they are sedated, confused, or uncooperative during insertion, and if there is the presence of artificial airways, decreased cough-gag reflexes, a decreased level of consciousness, or craniofacial trauma (Bourgault & Halm, 2009). Adverse events related to mispositioned tubes can include pneumonia, pneumothorax, perforations, empyema, bronchopleural fistula, pulmonary hemorrhage and even death (Lin et al., 2017). Pulmonary malposition of these tubes is one of the most frequent procedural complications but can often go unnoticed without the presence of coughing, dyspnea or oxygen desaturation (Bourgault & Halm, 2009). Risk for aspiration is also increased when a feeding tube’s port ends in the esophagus. (AACN, 2016). Due to the want and need to minimize the risk of adverse events occurring related to mispositioned gastric tubes, there is a need for evidence-based practice to be followed to ensure safe patient outcomes.

This PICOT question was developed after finding that x-ray confirmation is not always used in Parkview’s Emergency Department, especially for short use gastric tubes, and the nurses on the unit are widely using the auscultation verification method. I selected the use of pH strips

for the PICOT question as there have been various studies done on the reliability and accuracy of pH strips as well as they are cost effective and timely.

### **Acquisition of Evidence**

The sources used were compiled using three different databases: CINHAL, PubMed and Google Scholar. I consulted with my preceptor as well as the nurse manager on my unit to help develop the targeted research and developed my PICOT question based on the practice observed on the unit. In the search for relevant articles, the keywords used were, “gastric tube placement,” “gastric tube verification,” “nasogastric tubes/orogastric tubes”, “verification methods,” “whoosh method/auscultation,” “pH testing,” and “emergency department.” In my search, my exclusion criteria consisted of articles that only addressed other methods of verification outside of the verification methods identified in my PICOT question and articles whose research could not be applied to the Emergency Department. The CINHAL database had limited results for the number of different searches that I attempted, so it was necessary to search in the other two databases as well. It was difficult to find articles specifically about the Emergency Department, so I had to determine if the presented information could be relevant in the Emergency Department as well in order to include it.

### **Synthesis and Summary of Evidence**

#### **AACN, 2016**

The American Association of Critical Care Nurses have released a practice alert which acts as a clinical practice guideline regarding verification of feeding tube placement in adult patients. This guideline was created in an effort to help reduce adverse events related to the insertion and use of gastric tubes. This clinical practice guideline was created by experts in the critical care field and took into consideration meta-analyses, meta-syntheses as well as

randomized controlled trials. The AACN considered varying levels of credibility ranging from Level A to Level E, where Level A is the most credible and Level E being the least credible. Level A qualifies as the most accurate level of evidence which stems from meta-analysis of quantitative studies, and systemic reviews of randomized controlled trials. Level B evidence comes from controlled studies that consistently produce a specific outcome.

It has been found that “styleted small-bore tubes are most often associated with complications, but large-bore tubes without stylets are not without risk” (AACN, 2016). Due to these risks it is a level B recommendation that two or more bedside techniques be used to verify placement as well as radiographic confirmation prior to use for feedings or medication administration. These level B techniques include: watching for signs of respiratory distress, use of capnography, measuring pH and observing the characteristics of the aspirate. Radiographic confirmation still remains as the gold standard for placement verification at a Level A recommendation. It has also been recommended to not use the auscultatory method or the bubbling technique to determine tube location which is a Level B recommendation (AACN, 2016). It has also been recommended that each critical care unit should have written policy indicating their practice guidelines based on the recommendations provided in order to maintain correct gastric tube placement throughout the patient care.

The guidelines provided by the AACN are easy to understand and outlined by the various methods of verification. The focus of this guideline is to eliminate or reduce the chance of adverse events related to improper placement of gastric tubes and is patient health oriented. In regard to stated PICOT question, the AACN suggests that “there is no evidence that indicated that the auscultatory method is useful” as well as there being instances reported where “tubes entering the respiratory tract undetected by the auscultatory method, led to poor outcomes for

patients” (AACN, 2016). In reference to pH testing, the AACN suggests that the pH method is more reliable than the auscultatory method, but still has room for error as “gastric pH occasionally has a high pH” (AACN, 2016). One main limitation of this guideline is the fact that it is not specific to the Emergency Department; however, the indications can still be applied to the practice seen in this unit.

### **Boeykens, Steenman, & Duysburgh, 2014**

In this prospective observational study, the validity of the pH method and auscultation method were compared to the gold standard of x-ray to verify correct placement of gastric tubes in adult patients (Boeykens, Steenman, & Duysburgh, 2014). This study looked at 331 tube placements in 314 patients where 301 x-rays were performed, and a pH measurement was taken in 270 of the intubations. Factors that affected the amount of pH measurements taken were whether or not an aspirate could be obtained after the tube was placed. In 161 intubations aspirate was obtained initially after placement and in an additional 109 cases an aspirate was able to be obtained after additional measures were taken (Boeykens et al., 2014). It was found that in 98.9% of the aspirate samples that had a pH lower than 5.5 the tube was located in the stomach. Due to this, the conclusion was drawn that the pH method is a reliable bedside technique to verify gastric tube placement. This study also took into consideration the use of proton pump inhibitors and found that a pH of 5.5 was still a reliable number to use when able to test aspirates. It was also found that if the pH test came back as expected there was still a degree of uncertainty as the tube could be in the oesohagus (Boeykens et al., 2014). Overall, it is suggested that a pH below 5.5 is suggestive of correct tube placement, and an x-ray confirmation should be done in cases where an aspirate is unable to be obtained, the risk of aspiration is high and when the pH comes back greater than 5.5. The whoosh method was found to be unreliable as there

could be differing degrees of sound heard even when the tube was found to be outside of the stomach.

Descriptive statistics were used to analyze the results of this study in addition to a statistical program. The study took into consideration findings from previous studies and found that their results agreed with what was known about gastric tube verification and were able to add that a pH of up to 5.5 could still be indicative of correct placement. This study could guide change in practice as the previously accepted pH range that was found to be reliable was below 4 rather than the 5.5. Limitations of this study in regard to the stated PICOT question could be the fact that this is not specific to an Emergency Department but, rather, all placed gastric tubes in one facility, and the fact that there is still no clear way to distinguish from aspirate if the tube is in the stomach or the oesophagus. This study provides information on how the auscultation method could lead to a false positive result, through examples found during their trial as well from previous studies, which further proves that this method should be taken out of practice.

### **Bourgault & Halm, 2009**

In this clinical evidence review, 12 randomized controlled trials were looked at to review different gastric tube verification methods for their accuracy of indicating correct placement in the stomach. The objective was to identify methods to verify correct placement in blindly inserted tubes in order to reduce the chance of an adverse event. The validity of these studies were graded in relevance to the evidence provided, and whether this evidence indicated that the findings could be used in practice. The articles accepted for this review had to discuss the initial verification which is relevant in an Emergency Department setting as the tubes would be placed within this unit making them all the initial placement.

This review suggests that despite radiographic confirmation sometimes being deemed as impractical due to time and financial reasons it “remains the only reliable method to verify initial placement of blindly inserted small- or large-bore feeding tubes” (Bourgault & Halm, 2009). From this review, the authors ranked the use of pH verification as a class 2B for the evidence which means that it is supported by “fair to good evidence” and could be considered “acceptable and useful” (Bourgault & Halm, 2009). Discussion on the validity of pH verification argues that it is not useful for ruling out esophageal placement due to the chance of gastric reflux and there is room for error based on the ability to obtain aspirate, the use of proton pump inhibitors and whether or not there was recent ingestion of food. Auscultation was ranked as Class 3 which means the evidence found that this method was not an acceptable method and was not useful in verifying placement of gastric tubes. Through the studies reviewed it was found that even when audible air entry over the epigastrium could be identified there were cases when tubes were mispositioned in the esophagus and pulmonary system (Bourgault & Halm, 2009).

This article was found relevant in regard to the stated PICOT question as it discussed the validity of pH strips for verification of gastric tube placement and suggests that the auscultatory method should not be used due to its ability to have false positives. Limitations of this review include the lack of bedside techniques deemed valid for verification due to the fact that radiographic confirmation is still the only technique known to have the high accuracy of verification. Another limitation of this study was the fact that it was not specific to the Emergency Department but was still found to be relevant due to its indication of initial verification after placement rather than continued verification that would be seen in different units.



**Lin et al., 2017**

This systematic review and meta-analysis looked at 5 controlled diagnostic tests studies to review the evidence of the accuracy of ultrasonography verification of gastric tube placement compared to the radiographic verification as the reference standard (Lin et al., 2017). The main goal of this review was to look at the comparison of ultrasound to x-ray for visualization of correct placement of a gastric tube. The authors chose to exclude studies that were uncontrolled and those of which diagnostic accuracy of the ultrasound was not recorded. It was found that ultrasound could be a tool to indicate correct placement of a gastric tube but has limitations at indicating if the tube is the incorrect location. If a gastric tube is unable to be located using ultrasound it is suggested that an x-ray should be used to verify placement.

Overall, this review was well conducted as many factors were taken into consideration to include studies that had relevant and trustworthy material. One main limitation of this review is the “relatively moderate level of heterogeneity of included studies which may partially undermine the reliability and reproducibility of result” (Lin et al., 2017). Due to this, more studies would need to be performed prior to taking the information from this review and being able to put it into practice. As ultrasound technology advances it could be a possibility that in the future healthcare practice could switch to using ultrasonography as the gold standard for placement verification compared to radiology.

I included this study in my research even though the PICOT question does not address ultrasonography due to the availability of ultrasounds in an Emergency Department. Ultrasounds are much more accessible in this unit compared to x-ray and would require less time as it could be done as a bedside technique. As stated in the review, more research needs to be done to be able to confirm that this is something that can be put into practice. I believe that in the future, if

the research supports it, that ultrasonography could be a good route to go for gastric tube placement especially in an Emergency Department.

### **Longo, 2011**

This review performed by the Society of Pediatric Nurses (SPN) and Anne Longo looked at previous studies to help compile the various ways to verify gastric tube placement in children and how effective the different methods are. The SPN recognized the need for accurate placement to help prevent adverse events such as aspiration, pneumonia, and pneumothorax (Longo, 2011). Based on the review of the studies collected, it is suggested that the auscultation method “when used alone cannot differentiate among respiratory, gastric and intestinal placement” and has been found to be correct “only 34.4% of the time” (Longo, 2011). Although radiological confirmation remains the gold standard for verifying placement, Longo recognizes the need to consider the cost, radiation exposure and its value for only a point in time. Due to this, the need for alternate reliable methods of verification is recognized. The use of pH strips for verification has its limitations as in regard to a patient on continuous feedings or acid-reducing medications as well differentiating between the stomach and esophagus. It is suggested to use a “multivariate approached to tube placement confirmation such as pH and color” (Longo, 2011). This goes to say that pH should be tested on the aspirate as well assessing the characteristics of the aspirate as gastric aspirates will appear as “clear, off white, grassy green, tan, or brown tinged if blood is present” compared to pulmonary aspirates that should appear as “watery straw-colored mucus” (Longo, 2011).

This article is relevant to the stated PICOT question as the pediatric population is often seen in an Emergency Department setting as well as the fact that it addresses both pH strip verification and the auscultation method. Limitations to this study include the fact that the

reviewed studies were not specific to the Emergency Department and it was unspecified if the studies included were randomized controlled trials. It was also unspecified by the author how the articles were found. The studies reviewed appeared to have similar conclusions of what is best practice regarding gastric tube verification and focused on the need to have proper verification to avoid adverse events in patients to better promote positive outcomes.

### **Peter & Gill, 2009**

This clinical audit took clinical practice guidelines (CPG) for the verification of gastric tube placements after insertion and with continued use established through review and critical analysis of literature and applied these to a metropolitan hospital. The purpose of this audit was to eliminate the use of the whoosh test and the use of litmus paper and to instate the use of pH strip testing to verify placement of gastric tubes (Peter & Gill, 2009). Despite x-ray being the gold standard for verifying placement, there is a need for a more reliable bedside technique to help reduce exposure to radiation. The CPG provided to this hospital provided guidelines on testing for pH and when to seek further information. The standard set was that aspirate should be obtained and if the pH was less than 5.5 it was assumed that tube placement was correct, and the tube could be used. If aspirate could not be obtained the patient was to be turned on their side, 1-5ml of air was to be put into the tube and attempt to reaspirate. If aspirate was still not obtained the instructions were to wait 15-30 minutes leaving the tube at a free drainage level lower than the patient and then again attempt to reaspirate. If again no aspirate was obtained, the tube could be retracted by 1-2cm and again attempt to reaspirate. If through all these steps there was still no aspirate there were instructions to seek further help, consider re-passing the tube or obtaining an x-ray for confirmation. By following these steps and through this audit an aspirate was able to be obtained 97% of the time (Peter & Gill, 2009).

There was concern that continued feedings and the use of acid-inhibiting medications would affect the results of the pH tests. Through this audit it was found that “the children receiving continuous feeds were more likely to have more than one pH fail, as were the children on acid-inhibiting medications” which serves as a limitation to pH testing (Peter & Gill, 2009). Despite this limitation, success was still seen in some patients with these factors. It is suggested that the pH strips used must have an appropriate pH range for sufficient sensitivity, and the pH strips favored in this audit had a range of ability to detect from 4-7 which allowed for more distinctive color changes which resulted in more accurate interpretation of pH values (Peter & Gill, 2009). Through the creation of the clinical practice guidelines utilized in this audit it was recommended that the whoosh test was unreliable and that the “injection of air into the tracheobronchial tree or into the pleural space can produce a sound indistinguishable from that produced by injecting air into the gastrointestinal tract” (Peter & Gill, 2009).

Limitations of this article are the fact that it was not a research study but rather a clinical audit which could lead to incomplete data entry and a lack of standardized data entry. There is the chance that there were factors that were not controlled which could leave room for error in the results. The audit supports that recommendation that pH testing is a valid method for verifying the placement of gastric tubes in an effort to reduce radiation exposure through x-ray verification. This audit is applicable to the stated PICOT question as it supports the use of pH strips and does not support the use of the whoosh method for verifying placement. Although this audit was specific to the pediatric population this is still applicable to the patient population seen in an Emergency Department.

**Proehl et al., 2011**

This is a resource created by the Emergency Nurses Association aimed at answering: “In patients having gastric tubes inserted in the emergency department setting, which bedside technique is best for confirmation of accurate placement immediately after tube insertion compared to radiograph?” (Proehl et al., 2011). A thorough review and critical analysis of various research studies, meta-analyses, systematic reviews and existing guidelines were included and then analyzed based on the ENA’s classification of levels of recommendation for practice. The varying levels of recommendation include: Level A (High), Level B (Moderate), Level C (Weak) and Not recommended for practice (Proehl et al., 2011). The authors of this resource took the included articles and used standardized worksheets to help rank the various techniques into clinical recommendations for practice. This review was created in an effort to help eliminate or reduce the complications that can occur from incorrect placement of a gastric tube. They recognized the need for reliable bedside techniques as the use of radiographic verification can lead to additional costs, time delay and radiation exposure. (Proehl et al., 2011).

From this review it was found that the auscultation technique for verification is an unreliable method for verifying correct placement and is not recommended in practice as a single, stand-alone verification method. When used as a single verification method, it was found that the auscultation technique only has about a 60-80% reliability and it has been suggested in the past at abandoning this method all together (Proehl et al., 2011). When looking at the reliability of pH testing for verification it was ranked as a Level B meaning there is moderate support for this verification method. It was found that the use of pH strips had an 84-97% reliability, but there is the risk for alteration of results in patients receiving acid suppression

medication (Proehl et al., 2011). The bedside technique that has the most support is the use of a multi-mode approach that utilizes auscultation, followed by pH testing and visual inspection of the aspirate. It was found that using this approach had a probable accuracy of 97-99% (Proehl et al., 2011).

In regard to the stated PICOT question, this resource was able to answer the stated question and helped to provide additional methods for a more reliable verification process in the absence of an x-ray. This resource is applicable to the PICOT question as it addresses the techniques specific to an Emergency Department setting.

### **Stock, Gilbertson, & Babl, 2008**

In this prospective observational study, patients in a pediatric emergency department were looked at for the effectiveness of pH testing to confirm gastric tube placement (Stock, Gilbertson, & Babl, 2008). Across this study, 404 patients were enrolled and of that 393 patients were able to have aspirate obtained for testing. In 332 patient cases, gastric tube placement was able to be confirmed by pH alone. In this study, a pH of less than 4 was used to indicate correct placement. During the study, 52 patients had a pH higher than 4 and had to have confirmation by radiography where 3 tubes were found to be misplaced in the esophagus (Stock et al., 2008). This study was approved by the hospital's ethics committee and had nurses fill out a case record form (CRF) in order to keep the data collection concise. The CRF included the following information: indication for NGT insertion, patient medications, pH of obtained aspirate, method of confirmation if pH was higher than 4, size of the NGT used and any adverse events (Stock et al., 2008). The authors were also given access to patient charts for any supplemental information needed such as medical imaging if used. Based on the findings from this study, it was concluded that pH testing is a reliable method for verification of gastric tube placement and that x-ray

confirmation should be used in cases where aspirate cannot be obtained or if the pH came back higher than 4.

This study also reviewed previous literature regarding the topic and suggested that the auscultation method is “considered unreliable because injection of air into the tracheobronchial tree can produce a sound that is indistinguishable from that produced when air is injected into the stomach” (Stock et al., 2008). When looking at the validity to pH testing, the diseases status as well as vomiting status was looked at the patient enrolled in this study. It is known that the “pH due to backwash of intestinal fluid into the stomach has been measured at a pH of 7” and there was concern that if a patient was vomiting or presented with previous illness such as gastroenteritis it could cause a high pH to be found even if placement was correct (Stock et al., 2008). However, the study was able to conclude that there was no significant difference in pH regardless of disease state or vomiting status. This adds credibility to the results of the pH testing as the time was taken to consider different factors that may affect pH.

Limitations to this study include the fact that correct tube position was assumed with a lack of respiratory aspiration, whereas radiography in all cases would have been a more accurate way to compare the validity of the pH verification. It is understandable that the use of radiology was not always feasible due to time constraints, a delay in starting care, financial reasons and the want to minimize radiation exposure. Despite these limitations, the study is applicable to the stated PICOT question and provides support for the validity of pH testing and provides literature review to the unreliability of the auscultation technique. This study was also specific to the Emergency Department setting. Even though the study only focused on the pediatric population this is still applicable to the patients that can be seen in any Emergency Department.

### **Clinical Practice Recommendations**

Based on the findings in these articles, it can be concluded that the auscultation technique for verifying gastric tube placement as a stand-alone method should be taken out of practice. The technique has been found to be unreliable and puts the patient at a higher risk for an adverse event related to improper tube placement. Hearing the “whoosh” does not enable a nurse to distinguish between the gastric area or the tracheobronchial area. It is recommended that pH testing should be used as a reliable bedside technique for verifying gastric tube placement. Through the studies it has been found that a pH of up to 5.5 can be indicative of correct placement even for patients who are on acid inhibiting medications. A lower pH number can be used to ensure correct placement, such that less than 4 has also been accepted as placement within the gastric area. For Parkview’s Emergency Department, I would like to recommend the use of the multi-mode approach which includes the auscultation technique followed by obtaining an aspirate. Once the aspirate is obtained the nurse should assess the appearance of the aspirate as well as use a pH strip to test the acidity of the aspirate. If an aspirate is unable to be obtained or if the pH comes back higher than 5.5 it would be recommended to order radiographic confirmation to be able to verify placement prior to initiating treatment. Education should be provided to the nurses on how to correctly assess the appearance of the aspirate as well as how to use the pH strips.

Currently, the Emergency Department at Parkview does not have access to pH strips, so it would be a process to order these strips and put them into practice. Based on the study by Peter and Gill, pH strips with an appropriate pH range for sufficient sensitivity could be favored by the nurses as it would allow for more accurate readings. Due to this, it would be recommended to find strips that are user friendly and have the different color indications of pH based on 0.5



intervals for a more accurate measurement. The process of checking gastric tube placement in Parkview's Emergency Department has room for improvement by adding in the extra steps of assessing the aspirate and checking the pH to put into practice a more reliable method of verification.

Something to keep in mind for the future would be the possible implementation of a bedside ultrasound to look for correct placement of a gastric tube as suggested by the article by Lin et al. At this time, there is limited research on the technique, but the research that has been done is in favor of the possibility of using this method developing. More research would need to be done prior to putting this method to practice but is something to look for in the future.

### **Conclusion**

The Emergency Department at Parkview is currently not utilizing a reliable and accepted bedside method for assessing gastric tube placement in patients. It is known that x-ray confirmation is the gold standard for confirmation, but this technique is not always feasible in the Emergency Department setting due to time restraints, the want to minimize delay of care, financial reasons and/or the want to minimize radiation exposure for patients. For these reasons, there is a need to utilize an evidence-based bedside technique for gastric tube placement verification. Based on the reviewed literature, the use of pH strips could serve as a reliable method for checking tube placement in patients as it is an accepted method of confirmation that is also cost effective and relatively quick, which fits the needs of an Emergency Department.

The findings of this research and the recommendation were presented to the unit as well as the nurse manager and is something that they found could be a feasible transition for their department. They agreed that their current use of the auscultation method should not be used as a single method of verification due its lack of evidence-based support and reliability. The

management team wants to look into accessing pH strips for the unit and being able to implement this method into their practice on the unit. It is my hope that the multi-mode method will be put into practice in order to reduce the risks of adverse events related to improper gastric tube placement.

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