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1. Introduction

Optimal provision of nutrition support and accurate assessment of energy expenditure should be an integral component of paediatric critical care (Mehta et al, 2009a). Nutritional status has a profound effect on metabolic response to injury and strongly affects patient outcome (Mitchell et al, 1994) including length of ventilated days and PICU stay (Larsen et al, 2008).

Providing nutritional care in critically ill children is challenging since fluid restrictions, digestive intolerance and interruptions in nutritional feed delivery for diagnostic and therapeutic procedures are common (Lambe et al, 2007) and result is a failure to deliver estimated energy requirements (Cohen et al 2000 and de Neef et al, 2007). With no commonly accepted guidelines for nutritional management in PICU available (Van der Kuip et al, 2004) and a lack of systemic research and clinical trials in PICU, compiling evidence based guidelines is challenging (Mehta et al, 2009b).

Elevated gastric residual volumes (GRV) are associated with sedation and catecholamine use (Mentec et al, 2001) and in paediatric patients are often attributed to gastric paresis. Although, McClave et al (2005) state that GRVs are inherently flawed, as they have yet to be validated, current paediatric evidence suggests that a GRV > 5ml/kg can be considered to be an indicator of poor feed tolerance and delayed gastric emptying (Cobb et al, 2004 and Horn et al, 2004).

A number of studies in adult patients have advocated the use of prokinetics to aid gastric motility (Cohen et al, 2000 and McClave et al 2005) however, no studies have analysed the efficacy of prokinetics in critically ill children (Lopez-Herce, 2009). It is therefore, advocated not to delay commencement of jejunal feeding in those with delayed gastric emptying in order to trial prokinetics. This is supported by a study by Gharpure et al (2001) which concluded erythromycin did not facilitate post-pyloric tube placement.

Enteral nutrition is always the preferred route for artificial feeding in critically ill children and naso-jejunal feeding offers a safe and effective alternative to parenteral nutrition for patients, in whom gastric feeding is poorly tolerated, including post-op cardiac patients (McDermott et al, 2007 and Sachez et al, 2006). Unlike gastric feeding, jejunal feeding avoids fasting times for many procedures, including endotracheal extubation thereby, ensuring energy delivery and reducing the risk of protein energy malnutrition (Jacobs et al, 1999).

Jejunal tubes have traditionally been avoided as they have been notoriously difficult to place, often requiring endoscopic or radiological guidance (Meyer et al, 2007). However, blind placement techniques have now been shown to be up to 95% successful within the PICU population (Joffe et al, 2000, Spalding et al, 2000 and Meyer et al 2007), with associated benefits to patient outcome and financial savings for health care authorities.
2. **Rationale/Purpose/Objective**
   - To provide a clear rationale for the blind insertion of jejunal tubes in critical care.
   - To provide procedural guidance on the blind bedside placement technique for jejunal feeding tubes within paediatric critical care.

   This guideline should be interpreted in conjunction with the NHS GG&C PICU Guideline on Administration of Medication via Enteral Feeding Tubes (2009) and NHS GG&C PICU Guideline for Introducing and Establishing Enteral Nutrition in PICU (2009).

3. **Scope**
   - This guideline applies to all patients in paediatric critical care (PICU/HDU) in The Royal Hospital for Sick Children in Glasgow. (Exclusion criteria are outlined in the procedure algorithm).

4. **Roles and responsibilities**
   - All healthcare professionals in paediatric critical care involved in the blind insertion of jejunal feeding tubes should be familiar with this guideline.

5. **PROCEDURE**

   **ALGORITHM FOR BLIND BESIDE JEJUNAL INSERTION [Appendix 1]**

6. **Review**

   This guideline should be reviewed within 3 years from date of approval and following results of clinical audit and future scientific evidence. The Lead Manager retains responsibility for ensuring that review takes place in partnership with the Critical Care Nutrition Forum.

7. **References**


[Evidence Table, Appendix 2]

A Communication and Implementation Plan

Groups informed prior to implementation:
- PICU Consultant Group
- PICU Charge Nurse Group
- PICU Critical Care Nutrition Forum
- PICU Education Team
- Clinical Effectiveness Office (Yorkhill Hospital)

Implementation Plan:
- Education and training for nursing staff
- Competency for nursing staff
- Patient care plan

B Monitoring

In line with clinical governance, audit will be utilised to provide a means by which to assess the efficacy and impact of this guideline. Adverse events will be identified through the established local incident reporting infra-structure.
C   Impact Assessment

Risk assessment and EQIA were not deemed necessary for this guideline.
ALGORITHM FOR BLIND BESIDE JEJUNAL INSERTION [Appendix 1]

Paediatric Intensive Care Unit (PICU) Blind Bedside Jejunal Tube Insertion Guideline

Jejunal Tube indicated by PICU Guideline for Introducing and Establishing Enteral Nutrition in PICU due to high Gastric Residual Volumes (GRVs)

Patient unsuitable for blind jejunal tube insertion. Discuss with PICU medical staff. Consider;
- Endoscopic jejunal tube insertion
- Parenteral Nutrition

<table>
<thead>
<tr>
<th>Absolute Exclusion;</th>
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<tbody>
<tr>
<td>• Upper GI Mechanical Obstruction (incl. Duodenal &amp; Oesophageal Atresia/Stenosis)</td>
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<td>• Significant upper GI Bleeding</td>
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<tr>
<td>• Oesophageal varicies</td>
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<tr>
<td>• Pancreatitis</td>
</tr>
<tr>
<td>• Extensive Short Gut with ileostomy/jejunostomy</td>
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<tr>
<td>• Recent fundoplication (&lt;3 months ago)</td>
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</tbody>
</table>

Relative Risk – Discuss with PICU medical team
- Recent upper GI surgery
- Pre-existing fundoplication (>3months ago)
- NEC/Poor gut perfusion
- Extubated patient
- Haematological condition /coagulopathy
- Haemodynamic instability# #Patient should be stabilised before proceeding

Special Consideration – Discuss with PICU medical team, patient unsuitable for NJT but may be suitable for OJT.
- Basal Skull Fracture
- Posterior Pharyngeal Injury
- Maxillo-facial Injury
- ECLS support (ECMO & VAD)*

* Marked coagulopathy should be corrected prior to proceeding

Discuss with PICU medical staff. Is the patient suitable to proceed to blind jejunal tube placement?

Yes

Yes

Yes

Yes

Yes

Yes

No

No

No

No

No

No

No

No

Contraindications to blind placement identified

Elective decision by medical staff for OJT/NJT e.g.
- Burns
- Head Injury

Inform medical team & continue to Procedure for Blind Bedside Jejunal Tube Placement

- Ensure NGT is in-situ before proceeding
- Jejunal tubes should NOT be inserted overnight- Continue gastric feeding at tolerated volume until dayshift, then proceed to jejunal tube placement
- Pass Oral Jejunal Tube (OJT) if deemed appropriate

**** If haemodynamic instability occurs at any point during the procedure, stop procedure immediately & alert medical staff ****
1) EQUIPMENT and INITIAL PROCEDURE

Using a tape measure, measure the approximate length for both gastric and jejunal position and document – ear – nose – gastrum – right lower abdomen (see guidance notes for measuring).

Choose the appropriate NJ tube (size/length), gloves, apron, pH paper, two 20ml syringes, sterile water, gauze, tape measure, hypaflx tape and stethoscope.
Assess need for sedation.
Explain procedure to parents and child if appropriate.

Open the packaging and flush the tube with 10ml of sterile water via the purple port to ensure it is well lubricated.

Elevate bed slightly to 15-30° and position patient (if clinical condition allows) in a right lateral oblique position (left side up).

2) PROCEDURE- GASTRIC PLACEMENT

Empty and decompress stomach with nasogastric tube already insitu.

A: Lubricate the tip of the tube with water and insert preferably via the nostril with existing NG tube until in the stomach.

B: Confirm gastric placement as per hospital policy (Testing pH). Once position is confirmed flush inflate the stomach with 10ml air and proceed as 3)

C: If there are any problems passing the tube at this stage then remove the NJT and restart from A. If position is good proceed to 3).
3) PROCEDURE – JEJUNAL PLACEMENT

A: Continue to advance NJT whilst slowly rotating it close to the nostril. A small amount of resistance can be felt as you advance through the pylorus.

B: Once you have reached your approximate length undertake confirmation TEST. TEST: 2-10mls of air can be freely bolused in but resistance is met upon attempted aspiration back of the air. Auscultation can also be used over the lower abdomen. If TEST is passed NJ placement is considered ‘CONFIRMED’.

C: To ensure duodenal/proximal jejunal placement, advance an additional 5-10cm.

D: If air is not easily injected and resistance is met, the tube is likely to be either coiled or kinked.

E: If unsuccessful on the 1st attempt then leave the NJT in situ. Withdraw tube to stomach and confirm placement with pH test. Go back to A. No more than 2 attempts should be made to place the tube.

Secure the NJT in place. Remove the guidewire. Mark the tube @ the nostril.

Commence continuous NJ feed @ previous rate of NG feed. If not previously fed commence feed as follows:
- <10kg start @ 1ml/kg/hr and increase by 0.5ml/kg/hr every 4 hours
- >10kg start @ 0.5ml/kg/hr and increase by 0.5ml/kg/hr every 4 hours per NJ feeding protocol.

Aspirate the stomach to remove air from procedure 2)B. Leave NGT on free drainage. And aspirate NGT after 4 hours and 4 hourly thereafter as per NJT feeding protocol.
4) GENERAL NOTES

- NGT should remain insitu even when NJ tube in place.

- Auscultation is a useful additional guide to help with NJ placement only. It should never be used for confirmation of NG tube placement.

- Remember some oral drugs are ineffective when administered directly into the jejunum. Follow the NJ medication guidance notes.

- Prophylactic Ranitidine (NG) should be prescribed for all patients being fed via NJ tube.

- Marking the NJ tube at the nostril aids assessment of dislodgement of NJT.

- The next x-ray on the patient should include the abdomen for NJ position check.

- Follow Nursing Care for NJT Guidelines following insertion.
Guidance Notes for Measuring Naso-Jejunal Tube Length

Figure 1: Naso-Jejunal Tube Length Measurement – Infant (< 1 year)

Figure 2: Naso-Jejunal Tube Length Measurement – Child (>1 year)

Notes
- Measurement should be made using a disposable tape measure
- Measure from ear – nose – gastrum (mid-point between ziphisternum and umbilicus) – right lower abdomen (right iliac crest)
- Note measurement at gastrum and right lower abdomen
- Use a Merck Corflo NJ tube with guidewire of appropriate length. If <8kg use 6Fr, >8Kg use 8Fr, older children may require a 10Fr.
**Nursing Care Guideline**
for Naso-jejunial Feeding Tube

**CARE OUTCOMES**
1. To maintain nutrition and hydration
2. To prevent potential complications – tube blockage, tube misplacement, aspiration and accidental removal

<table>
<thead>
<tr>
<th>NURSING CARE</th>
<th>RATIONALE</th>
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<tbody>
<tr>
<td>1. Ensure procedure documentation is completed on CIS, including the insertion date, the size and internal length of the NJ tube.</td>
<td>To prevent infection</td>
</tr>
<tr>
<td>2. The NJ tube can remain insitu for 4-6 weeks.</td>
<td>To prevent displacement</td>
</tr>
<tr>
<td>3. Every 4 hours document on CIS the external length of the NJ tube and ensure tube is securely taped.</td>
<td>To prevent infection</td>
</tr>
<tr>
<td>4. Every 4 hours aspirate Naso-gastric tube and test pH as per nasogastric feeding guideline. If milk aspirated, it is probable that NJ tube has migrated back into the stomach, follow the NJ feeding guideline. If no aspirate obtained follow naso-gastric tube feeding guideline.</td>
<td>To prevent displacement, aspiration and accidental removal.</td>
</tr>
</tbody>
</table>

* If NJ tube displacement is suspected (eg. following extubation or vomiting). The following test can be used to confirm placement:
  Instill 2-10ml air into NJ tube, if unable to aspirate the air the tube is probably in the jejunum.
  a. If a high volume of air is aspirated (>15ml) NJ tube is likely to be in oesophagus or upper part of stomach.
  b. If a high volume of secretions (>15ml) NJ tube likely to be in stomach and test pH = 1-4. NB: Drugs such as Ranitidine, Omeprazole & Sucralfate will increase gastric pHi.

If the test is not conclusive seek medical advice. A check X-ray of chest/abdomen maybe required.

5. Strict hand washing is essential. Clean the feeding end with alcohol swabs | To prevent infection as the NJ tube bypasses the stomachs anti-infective acid. |

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**PICU Guideline on Blind Bedside Jejunal Tube Insertion**
Sr. Susan Greenock, Isobel Macleod, Dr Neil Spenceley, Dr Mark Davidson, Dr David Ellis, Jackie Bird & Emma Gentles

December 2009
6. Pre-packed feeds can be hung for 24 hours. Prepared feeds (and feeds with active ingredients) should be changed every 4 hours and all feeding sets every 24 hours using a non-touch technique. To prevent infection as the NJ tube bypasses the stomachs anti-infective acid.

7. Feeds and most drugs are given via the NJ tube. Follow the NJ feeding guideline for type of feed and build up flow rates. Continuous feeds only via NJ tube. Bolus feeds must not be given through the naso-jejunal tube because the jejunum cannot hold a bolus and it causes abdominal pain, diarrhoea and dumping syndrome.

8. Most medications should be given via the NJ tube. Follow the guideline for NJ medication, NB: flushing with sterile water. To prevent blockage. To prevent reaction with feed and between drugs.

**PROBLEM SOLVING**

**RATIONAL**

**Feed Intolerance**
- Follow NJ feeding guideline
- Check tube position as in section 4.
- Inform dietician and discuss feed type and regimen

Diarrhoea may be caused by feed rate being increased too quickly.

Vomiting may be caused by NJ tube migrating into stomach.

**Blocked Tube**
- If tube becomes stiff to flush or blocked, flush with 5-10ml warm sterile water, leave for 15-20 minutes and then flush with sterile water.
- If unsuccessful take 10,000 units of Creon capsule, dissolve granules in 10ml Sodium Bicarbonate 8.4%, ensure granules have fully dissolved (takes 3-5min) and then flush 5-10ml into tube. Leave for 15-20mins and then flush with sterile water.
- If unable to unblock arrange for NJ tube to be repassed. See guidelines for passing naso-jejunal feeding tube.

Warm water may dissolve fatty deposits on the tube.

Pancreatic enzymes (Creon) digest the build up of feed on the internal lumen of the NJ tube. Sodium Bicarbonate dissolves the coating on the granules and activates the pancreatic enzymes.

NJ tube should only be placed by a nurse trained to do so.

**Displacement of Tube**
- If the tube is pulled partially out of the nostril, gently push the NJ tube using a slow rotating movement until advanced to the correct length. Re-tape and check position as in section 4.
- If tube falls out or becomes damaged replace with the same type and size of NJ tube. See guidelines for passing naso-jejunal tube.

To reposition tube in to the correct position for use.

To replace the tube. NJ tube should only be placed by a nurse trained to do so.

**References:**


## Evidence Table  [Appendix 2]

<table>
<thead>
<tr>
<th>Publication</th>
<th>Sample Size/Study type</th>
<th>Aim/Objective</th>
<th>Notes</th>
<th>Blind NJ Technique</th>
<th>Outcome/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Meyer et al 2007</em></td>
<td>UK n=100</td>
<td>All patients ventilated &gt; 24 hrs Audit in 2001 and 2004.</td>
<td>Training incl 1:1 session, algorithm and supervised insertion</td>
<td>NJ inserted if GRV&gt; 4 hrs feed volume</td>
<td>NJT placed in 19% of pts in 2001 and 18% in 2004</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>- 15-30° patient tilt</td>
<td>Blind success rate ~95%</td>
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<td></td>
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<td></td>
<td></td>
<td>- Right lateral oblique (life side up)</td>
<td>Education and audit cycles key to success</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>- Guidewire tube – lubricate H2O</td>
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<td></td>
<td></td>
<td></td>
<td>- Aspirate NGT</td>
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<td></td>
<td></td>
<td>- Confirm gastric placement (pH)</td>
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<td></td>
<td></td>
<td>and flush with 3-5ml H2O</td>
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<td>- If cyanosed/coughing pull back and retry</td>
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<td></td>
<td>- Continue to advance and rotate tube at nostril, resistance flet at pylorus</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>- Once reached length, aspirate or inject air and listen, if resistance? kinked</td>
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<td></td>
<td></td>
<td>(withdraw to stomach and retry)</td>
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<td></td>
<td></td>
<td>- Remove guidewire</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>- Confirm position with BLUE DYE</td>
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<tr>
<td><em>Harrison et al 1997</em></td>
<td>USA n=75 Prospective</td>
<td>Non-radiological assessment of blindly placed feeding tubes in PICU</td>
<td>89% ventilated</td>
<td>Used blind bedside protocol</td>
<td>Median time to place 10mins UWT wired tube</td>
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<td>Used UWT wired tubes 56cm or 91cm, smaller diameter in &lt;6kg</td>
<td>- Metoclopramide iv before insertion</td>
<td>99% in SB, 13 in duodenum, 61 in jej</td>
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<td>- Supine, head midline, neck anteroflexed</td>
<td>Inability to aspirate insufflated air confirms transpyloric position of tube</td>
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<td></td>
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<td>- 15-30 degree tilt</td>
<td>without need to AXR</td>
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<td></td>
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<td></td>
<td></td>
<td>- 10ml gastric air insufflated, position checked auscultation and air withdrawn</td>
<td>BLUE DYE not accurate</td>
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<td></td>
<td>- Position confirmed if &lt;2ml air returned from 10ml instilled compared to AXR</td>
<td>Following study 10 tubes successfully placed by Drs</td>
</tr>
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</table>
**PICU Guideline on Blind Bedside Jejunal Tube Insertion**  
Sr. Susan Greenock, Isobel Macleod, Dr Neil Spenceley, Dr Mark Davidson, Dr David Ellis, Jackie Bird & Emma Gentles  
December 2009

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Procedures</th>
<th>Technique Details</th>
<th>Results</th>
<th>Notes</th>
</tr>
</thead>
</table>
| *Phipps et al 2006 USA*       | n = 75   | Prospective RCT PICU 0-18 years | To compare 3 different techniques used to place NJTs in critically ill children in 12 bed PICU  
Technique 1: Standard  
Technique 2: Standard + gastric air insufflation  
Technique 2 : Standard _ pre-insertion iv erythromycin  
Position checked by AXR | Gastroparesis may develop in critical illness. Early onset of SB recovery of peristalsis compared to gastric peristalsis.  
Decision to pass NJ made by Dr.  
-Further advancement 5-10cm  
- Length of tube = Nose–ear–xiphoid process–right lateral costal margin +10cm  
- 15-30° tilt, neck anterioflexed and midline  
- NGT removed prior to NJ insertion  
- When gastric placement confirmed, turned to right lateral oblique  
- Tube advanced and position confirmed by air auscultation  
- Technique 2: Air injected 10ml/kg (max 500ml) at gastric and pylorus markers  
- Technique 3: 3mg/kg iv erythromycin over 60mins 30mins before procedure  
Some operators used ‘snap-back-test’ (<2ml of 10ml air aspirated when in SB. | 94.6% has tubes passed into SB successfully on 1st or 2nd attempt, 88% 1st attempt.  
No statistical difference in methods.  
Greater the experience of operator higher success rate.  
Gastric insufflation – smaller volumes need studied |
| *McDermott et al 2007 UK*     | n = 21 patients and 27 NJTs inserted under blind protocol in 21 PICU patients | Audit of 27 NJTs only 1/22 PICUs (St. Marys) had guidelines  
Blue food dye ? mitochondrial toxicity | Absence of clinical guidelines for NJT insertion makes procedure haphazard, often unsuccessful, delays procedure and necessitates XR  
-Confirm gastric position with pH, advance tube  
-Confirmation confirmed by higher pH or snap-back-test  
-XR if child not ventilated | Mean time to pass tube 16 mins  
Common indications for passing NJTs were feed intolerance and large GRV  
58% of patients would probably have required PN if NJT unsuccessful  
26/27 staff found guideline easy to follow |
<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Age</th>
<th>Weight</th>
<th>NJT</th>
<th>OJT</th>
<th>Placement Success</th>
<th>Insertion Time</th>
<th>Confirmation</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joffe et al 2000 Canada</td>
<td>n = 38 patients, 71 NJTs</td>
<td>Mean age 56/12</td>
<td>Mean weight 17.8Kg</td>
<td>NJT 94.4%</td>
<td>OJT 5.6%</td>
<td>36/38 95% of patients had successful placement</td>
<td>Average time to insert 7.43mins, median 5mins, range &lt;1-45mins</td>
<td>Day 1 XR 15.9% in jej. Day 2: 33.3% in jej. Day 3-5 51% in jej</td>
<td>Bedside placement simple, rapid, well tolerated highly successful with little training</td>
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<tr>
<td></td>
<td>&lt;17 years</td>
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<td>Feeling of give at pylorus (26%), change in auscultation pitch (reported in 75% but only accurate in 40%) and ability to aspirate fluid (21% and accurate in 100%) not sensitive enough confirmation tests.</td>
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<tr>
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<td>15 patients post-op cardiac</td>
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<td></td>
<td>Inability of aspirate insufflated air predicted correct placement in</td>
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<td>69% ventilated</td>
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<tr>
<td></td>
<td>Prospective interventional study</td>
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<td>NG feeds poorly tolerated in PICU due to gastricparesis. Transpyloric feeding limited by difficulty in tube placement.</td>
<td>Intensivist requested NJ (without fundoplication, pharyngeal trauma or gastric ulceration) Passed by either 1 intensivist or 1 of 3 PICU nurses. UWT polyurethane guidewire tube 6Fr, 56cm &lt;6kg, 91cm &gt;6kg Tube marked – gastric position and pyloric (right lateral costal margin) 15-30(^\circ) tilt, right lateral position, head midline and anteroflexed Sedation given and metoclopramide 0.1mg/kg iv Tube advance 1cm at a time and 2-5mls air, once at pyloric marker 5-10ml air insufflated and tested for &lt; 2ml return. Once in this was positive tube advanced a further 5-10cm Higher pitch on auscultation over right midline, RUQ Bile coloured fluid, pH &gt;=5 XR confirmation Standard technique + metoclopramide, right lateral position and air insufflation until&lt;2ml air aspirated from 5-10ml instilled</td>
<td>Mean age 56/12</td>
<td>Mean weight 17.8Kg</td>
<td>NJT 94.4%</td>
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<td>Feeling of give at pylorus (26%), change in auscultation pitch (reported in 75% but only accurate in 40%) and ability to aspirate fluid (21% and accurate in 100%) not sensitive enough confirmation tests.</td>
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<td>Inability of aspirate insufflated air predicted correct placement in</td>
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| *Sergio et al 2002 Brasil* | **n = 78** (incl. 40 controls) RCT in PICU in 2 tertiary hospitals | **To test air insufflation to place enteral feeding tubes and the effectiveness of using smaller insufflation volumes in paediatrics** | **Indication for TEN Dr’s decision**  
Dr carried out procedure  
Exclusion criteria: facial trauma, gastrostomy, use of prokinetics  
UWT Polyurethane tube (6, 8, 10fr) and guide wire | **Modified procedure based on air sufflation as described by Spalding et al An additional air bolus (10ml/kg) was not utilised.**  
**Standard Insertion (control Gp):**  
- NGT insitu  
- 2 marks – gastric and pyloric (right lateral margin)  
- Elevated decubitus position at 45°, neck anteroflexion  
- Gastric position confirmed auscultation over epigastric region  
- Pt into right lateral decubitus position and tube advanced to second mark  
Pt return to supine  
**Gastric Insufflation (study Gp):**  
- Same as standard plus  
- Air insufflation of 10ml/kg into stomach (max 500ml) at first marking  
- Pt kept in right lateral decubitus position and tube advanced to mark 2.  
XR confirmed position in both groups | **Study Gp = 33/38 (86.8%) tubes successfully placed in 1st attempt**  
Control Gp = 18/40 (45%)  
(p<0.00026)  
Time to insert < 10mins in both groups.  
No complications  
Gastric insufflation:  
- has proved a useful tool.  
- Simple and feasible  
- Higher success rate than standard technique  
Rationale being that gastric distention opens pyloric outlet and stimulates gastric contraction (motility)  
10ml/kg air may significantly improve success rate without increasing risks |

<p>| <strong>PPV=88.7%</strong> |</p>
<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Setting</th>
<th>Design</th>
<th>Methodology</th>
<th>Findings</th>
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</table>
| *Spalding et al 2000 USA*            | n = 50 PICU  | Prospective RCT | To test effectiveness of gastric insufflation as an adjunct to placement of feeding tubes in small bowel | UWT 10ml/kg air insufflation and tube advanced proximal to pylorus, additional 10ml/kg injected and tube advanced to 4th part of duodenum. No air injected in control group. | - 23/25 successful in gastric insufflation Gp in 1st attempt  
- 11/25 successful in control Gp in 1st attempt (p= 0.001)  
- 2nd attempt 25/25 gastric insufflation and 18/25 in control gp.  
Gastric insufflation allows rapid placement with fewer attempts |
| Sanchez et al 2006 Spain             | n = 212      | Prospective observational study | 3days – 17 years old receiving transpyloric (TEN) feeding in post-op cardiac period from 1994-2002. Compared with those receiving TEN for other diagnosis | GRV > 50% feed volume x2 indicated TEN. Tubes inserted by blind or by placing patient in lateral decubitus position with air insufflation and iv metoclopramide. If failed by endoscopic guidance. Weighted tube then guidewire tube used. Position confirmed by pH> 6 and AXR. | - 350, 10.3% PICU admissions received TEN  
- 212, 60% post-op cardiac (177 post pump)  
- TEN longer to initiate in cardiacs  
- No association with TEN and hepatic/GI complications  
- Non-cardiac received pneumothorax following TEN insertion  
- Only 2 NEC patients |
| Babbit 2007 USA                      | n = 190 patients, 228 NJTs | Retrospective review | 4 year review of transpyloric feeding in a 20 bed PICU | 6Fr or 8Fr UWT Corflo tube used  
- Physician inserted NJT following protocol.  
- Pre-measurement of tube and metoclopramide | LOS 12days in PICU for those with NJTs  
NJT in place 9 days (3-104)  
Feeds held for 2.8hrs for extubation  
29% feeds not stopped for extubation, 5/43 reintubated with no episodes of |
administered prior to tube insertion
- Tube placed nasogastrically
- Advanced through pylorus whilst slowly injecting air
- XR confirmation

- 96% reached full energy requirements, average time to reach this was 44 hours, when those requiring trophic feeds excluded due to systemic illness, average time 34 hours

- Most common complication 22.6% inadvertent removal, malposition or malfunction
- Diarrhoea 6.8%
- NEC 2.1% (4 patients, 3 with cyanotic CHD)
- This equates to 43% (3/7) of cyanotic CHD patients developing NEC
- 1 patient died (CoA) due to intestinal perforation + intra-abdominal sepsis, 1 day after NJT passed.

<p>| De Lucas et al 2000 Spain | n = 240 (14.6% of PICU admissions) | 90% ventilated | Retrospective | Compare transpyloric enteral nutrition (TEN) and parenteral nutrition in PICU | Analyse effect of TEN programme on use of PN, complications and cost. | 1993 PN to all patients unable to tolerate gastric feeding, 1994 TEN programme introduced | WT 6Fr-10Fr, position confirmed by pH &gt; 6 and XR | 240 patients (14.6% PICU admissions) received PN and/or TEN | PN 168 | TEN 21 | 51 TEN + PN | PN usage reduced 16% to |</p>
<table>
<thead>
<tr>
<th>Description</th>
<th>Comparative Study</th>
<th>Hospital Acquired Infection (HAI)</th>
<th>TEN Incidence (3.2% - 10.5%) and Duration Increased.</th>
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<tr>
<td>Descriptive Comparative Study over 4 Years (1993-1996)</td>
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<td>Hospital acquired infection (50.4%) PN 45.8%, TEN 47.6% and PN + TEN 76%</td>
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<td>76% HAI related to increased LOS in PICU and ventilated time</td>
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<td>Cholestasis PN 39.2% TEN 4.7%, PN + TEN 50.9%</td>
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<td>Hyperglycaemia and Hypertrigs &gt; in PN than TEN</td>
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<td>Mortality PN 19.6%, TEN 9.5%</td>
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<td>Diarrhoea – no difference between PN &amp; TEN</td>
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<td>Conclusion:</td>
<td>TEN simple and less complications than PN and saves £.</td>
<td>TEN should be 1st method if unable to tolerate gastric, using PN if TEN contraindicated or poorly tolerated.</td>
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<tr>
<td>Study</td>
<td>Country</td>
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<td>Design Type</td>
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