

Paediatric enteral tube feeding

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Abstract

The benefits of good nutritional status on outcomes of children with chronic illness have been well established. However, many neurologically impaired or chronically ill children and young people struggle to meet their energy requirements orally. In such cases an enteral feeding device inserted directly into the stomach and/or jejunum may be necessary for temporary or long term nutritional support. The decision to recommend a child for long term tube feeding is complex and needs to be balanced against the potential risks, and should involve multi-disciplinary input. We aim to review the current evidence for gastrostomy placement in order to clarify indications for referral for tube insertion, device selection, complications and their management.

Keywords community care; enteral feeding; gastrojejunal tube; gastrostomy; jejunostomy; PEG

Introduction

The enteral tract should be used for nutritional support whenever possible due to the benefits of enteral feeding and the detrimental effects of parental nutrition (PN). Long term PN carries multiple disadvantages including higher cost, reduced availability, reduced gut stimulation, increased risk of bacteria translocation from the bowel, deranged liver function, and the risks of long term central venous catheterisation. At the long term follow-up of 36 home PN patients 82% experienced problems relating to the catheter, 50% had both mechanical problems and sepsis which caused a mean of 2.75 central lines to be inserted per patient. Where oral feeding is not possible, unsafe or inadequate

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for the metabolic demand, a variety of enteral tube feeding options is available.

The increasing prevalence of children surviving with severe chronic illness and neuro-disability and the overwhelming evidence for the benefits of good nutrition are increasing the demand for enteral tube feeding. There are a number of factors which influence the choice of route to use, mode of insertion and the long term care. These provide a challenge for health professionals and more importantly the families involved. The community nursing team who usually provides the long term care of these children should be involved with the process before and after the insertion.

Indications

Up to 40–70% of children with chronic illness are estimated to have feeding issues. Gastric feeding via a naso-gastric (NG) tube is usually the initial approach when the oral route is not suitable. However it carries significant logistical issues and risks as a long term solution. NG tube feeding is commonly used in inpatient or neonatal practice with up to 24% of neonates having one. NG tubes can be easily pulled out especially by babies. Frequent NG tube placement carries risks of misplacement, commonly into the lung or mediastinum. Oesophageal and gastric perforation in low weight babies (<750 g) are observed in up to 4% of cases. In older children a rare but life threatening complication of NG tube insertion is spasm of the cricoarytenoids causing airway compromise. Rigid tubes can cause erosions and bleeding both at the tip, but also as they pass through the nose causing epistaxis and sinusitis. The NG tube can also stimulate the naso-oro-pharynx thereby causing transient lower oesophageal sphincter relaxation (TLESR) which can increase gastro-oesophageal reflux (GOR) to a varying degree. In the short term these risks are relatively small justifying the common usage of NG tubes but in the long term and with inevitable repeated insertions these risks increase.

Gastrostomy insertion is indicated in patients with faltering growth who have oral nutritional intake that is failing to meet their metabolic need which is not expected to resolve in within months. Indications for surgically or radiologically inserted enteral tubes include:

- Physical impediment to oral nutrition
- Clinically unsafe swallow (e.g. neurological disability)
- Congenital malformations
- Foregut dysmotility (including GOR)
- Injury (e.g. head trauma or caustic oesophageal injury)
- Need for unpalatable feeds or medications
- Conditions with high metabolic demands, such as chronic renal failure, congenital heart disease, chronic lung disease including cystic fibrosis, short gut syndrome, and metabolic conditions

A multidisciplinary team (MDT) approach is useful to assess reasons for poor/unsafe oral feeding, the likely time-scale and should enteral tube feeding is required, the most suitable device and technique to be used based on other co-morbidities and psychosocial factors.

The enteral tube feeding method and procedure to be used should take into account the anatomy and existing conditions, such as scoliosis, microgastria, hepatosplenomegaly, ascites, and

previous abdominal surgery including the presence of a ventriculo-peritoneal shunt.

Insertion methods and preparation

The insertion methods commonly used are summarized in [Table 1](#). They are determined by:

- the anatomical site where the feeds are to be delivered
 - gastric or
 - post-pyloric (usually jejunal)
 - or both
- the access route
 - oral/nasal route – i.e. NG tube or nasojejunal tube
 - abdominal – which can be direct or indirect as in gastro-jejunal (transpyloric)
- the general insertion technique
 - open surgery (laparotomy)
 - laparoscopic
 - endoscopic
 - fluoroscopic

(on its own and/or combination of two or more techniques)

NG tubes are usually inserted by a nurse or a trained carer. The other more invasive techniques are carried out by a paediatric surgeon, gastroenterologist or interventional radiologist depending on the expertise and preference at the paediatric centre. The device used can be a tube or a skin level low-profile “button” device both of which may have an internal flange or a water-filled balloon to prevent dislodgement ([Figure 1](#)).

The threshold for performing anti-reflux surgery (e.g. Nissen fundoplication) for GOR symptoms at the time of gastrostomy creation varies between surgeons and centres. Many surgeons would manage expectantly unless a clear anatomical abnormality is present which is not going to resolve spontaneously, e.g. significant hiatus hernia. Indeed, for some NG tube fed patients, by removing the NG tube post-gastrostomy will reduce the oro-nasopharyngeal stimulation which in turn reduces transient lower oesophageal sphincter relaxation (TLESR), and hence the GOR may improve. On the other hand, altering the gastric anatomy (e.g. angle of His) by fixing the stomach anteriorly to the abdominal wall may worsen GOR necessitating further anti-reflux management.

We usually perform an upper gastro-intestinal contrast study to exclude malrotation, and hiatus hernia. The contrast study may also indicate the degree of delayed gastric emptying and GOR at the time of the study and can be used as a reference for future comparison. A pick up rate of 3.5–4.7% for other anatomical abnormalities, such as hiatus hernia or malrotation, have been reported and would alter the surgical management plan and counselling of the parents.

Percutaneous endoscopic gastrostomy (PEG)

The PEG insertion technique was introduced in 1980 and has remained the most commonly used method for creating a gastrostomy in children and adults. Its popularity has led to the term “PEG” being used synonymously with “enteral tube feeding” which is incorrect as “PEG” is only one of many techniques in achieving a gastrostomy, and indeed any enteral feeding tube. The internal and external components of a Corflo PEG are shown in [Figures 2 and 3](#) (below).

Standard insertion technique

A flexible fibre-optic endoscope of appropriate size is used to visualise the gastric wall internally while a site is selected for insertion externally. A trocar is placed directly through the abdominal wall into the stomach under endoscopic vision. A distinct “finger indentation” as viewed endoscopically and gastric illumination in the epigastrium need to be clearly demonstrated to minimise risk in visceral injury. A guide-wire is passed through the trocar and retrieved internally by the endoscope which is then pulled out orally thus creating a continuous wire through the abdominal wall, stomach, oesophagus and the mouth. The PEG tube device (e.g. 12Fr Corflo or 9Fr Freka) is tied to the wire and pulled antegrade through the abdominal wall such that the PEG tube flange rests internally against the gastric mucosa. The flange has a thin soft or sponge filled silicone disc which prevents the tube from being removed accidentally. An external bolster is then fitted to complete the fixation of the stomach to the anterior abdominal wall. In the standard technique, the stomach is not sutured to the anterior abdominal wall. Adhesions will then form between the surfaces and mature to establish a more permanent approximation. The gastrostomy tract is lined by granulation tissue as it matures hence removal of the tube will cause spontaneous closure within 24–48 hours.

Variation of the standard technique

PEG insertion is a quick, relatively cheap, well tolerated procedure that leads to rapid patient recovery and is the method of choice for the majority of patients requiring a gastrostomy. In adults or older teenagers, it may possibly be carried out under sedation without general anaesthesia. However, the standard technique may not be appropriate for safe insertion without intra-abdominal visualisation, e.g. abnormal torso anatomy or adhesions. Some surgeons routinely use a laparoscope to provide additional views to reduce the risk of inadvertent visceral damage. There is some evidence to support this practice though careful patient selection may be the crucial factor.

Some surgeons place sutures to fix the stomach on the abdominal wall directly to improve security especially if the device is prematurely removed in the first few weeks. This is particularly so when a balloon device is inserted, e.g. in laparoscopic primary gastrostomy button insertion. The added advantage is that it potentially avoids further general anaesthesia to tube change as a balloon can be changed at the clinic without endoscopy. However this is associated with increased theatre time as well as potential morbidity associated with laparoscopic surgery including the need for CO₂ pneumoperitoneum which is particularly relevant in patients with limited cardio-respiratory reserves.

The traditional open gastrostomy as described by Stamm in 1894 is still commonly performed. This requires a limited laparotomy and is especially useful in very small infants, the presence of extensive adhesions or significant anatomical anomaly with may preclude oesophago-gastro-duodenoscopy (e.g. oesophageal atresia). Due to the relatively large size of the standard PEG tubes, usually an open or laparoscopic approach without endoscopy is used when the patient is less than 6 kg.

In centres with expertise in paediatric interventional radiology, percutaneous fluoroscopic gastrostomy insertion may also

Variants of surgical techniques for enteral tube feeding procedures

Anatomical access	Variants of technique	Advantages	Disadvantages	Comments
A) Gastrostomy	Percutaneous endoscopic gastrostomy (PEG)	Quick procedure; allow endoscopic inspection and biopsy at the same time	Requires endoscopy; peritoneal cavity not visualised ↑ risk of visceral damage	Commonest method – by paediatric surgeon or paediatric gastroenterologist
	Radiological insertion of gastrostomy (RIG)	Quick	Risk of visceral damage	Requires interventional radiology
	Laparoscopic PEG	As above; peritoneal cavity visualised; adhesiolysis	Requires CO ₂ pneumoperitoneum; ↑ time/risks associated with laparoscopy	Useful if previous abdominal surgery/moderate amount of adhesions
	Laparoscopic 1° gastrostomy (balloon device e.g. “buttons”)	No further need for GA endoscopy for changes	Easier to come out than PEG tube; Potentially difficult or unsafe to replace	Usually with gastropexy to secure the stomach
	Balloon gastrostomy device (subsequent changes)	More convenient and easier to hide under clothes	Needs changes every 3–5 months by healthcare professionals (initially)	If too tight can cause gastric mucosa to drag outwards worsening leak
	Open “Stamm” gastrostomy	Direct visualisation of stomach; even in very small babies. Secure fixation to abdominal wall; no endoscopy	Requires laparotomy	If too tight can cause gastric mucosa to drag outwards worsening leak
B) Gastrojejunal transpyloric tube feeding	Other gastrostomy devices (without a balloon)	Useful in very small babies if balloon causing obstruction	Not commonly stocked product. Uncomfortable to remove	
	Freka GJ tube – endoscopic insertion	Can last over 2 years	Requires endoscopy; challenging in babies; may get blocked or displaced; removal requires endoscopy	Beware of buried bumper syndrome especially if too tight
	Freka GJ tube – open insertion	Can last over 2 years	Requires mini- laparotomy and opening the stomach	Useful in small babies especially if previous laparotomy
C) Surgical jejunostomy	Low-profile balloon GJ tube	Changes can be done without endoscopy (GA)	Requires fluoroscopy; Changes needed every 6–12 months	
	Loop jejunostomy	Direct access to small bowel; can use balloon gastrostomy buttons	Risk of volvulus, internal herniation; antegrade flow of milk; needs gastrostomy	Also the disadvantages of jejunal feeding
	Roux-en-Y jejunostomy	As above	Needs open procedure; two suture lines	Disadvantages of jejunal feeding lines

Table 1



Figure 1 Balloon (Right) and non-balloon (Left) button gastrostomy devices.

performed. The outcome is very operator-dependent and generally not as commonly done compared to endoscopic and laparoscopic techniques.

Post-operative care

Following insertion the patient is monitored with the gastrostomy on free drainage and regular venting of air (not immediately after oral medication is given). Enteral feed is introduced as tolerated usually with a personalised feeding plan by a dietitian. The initiation of feeding and rate of increase after gastrostomy insertion varies between clinicians. Most centres start feeds 12–24 hours post-procedure though some start feeds within 4 hours.

Children should be closely monitored for any immediate post-operative complications. The parents/carers and child are trained to use and care for the gastrostomy. In our centre the specialist nurse teaches daily cleaning with warm water and mild soap. Turning through 360° is recommended and some children may require venting to release trapped wind. The patient is discharged from hospital when full feeds are established and carers able to manage the gastrostomy in the community. This typically requires 48–72 hours of inpatient post-operative care.

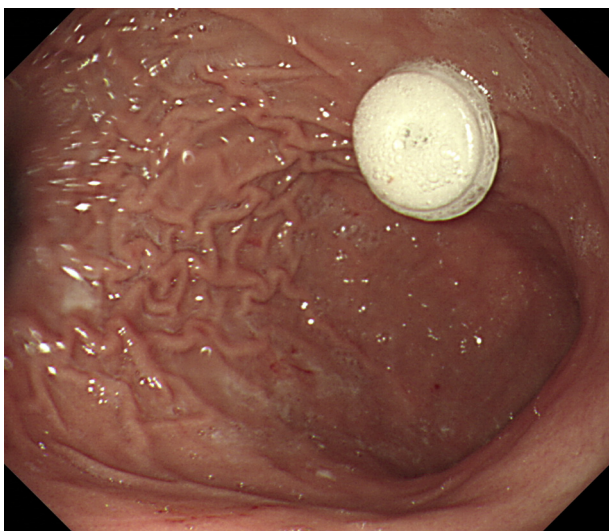


Figure 2 Internal flange of a newly inserted PEG tube.



Figure 3 CorFlo PEG with external bolster in place to prevent inward migration of tube.

Following discharge the specialist nurse acts as a liaison between the hospital team, the patient and the community team. After 1 month the tube can be advanced by loosening the external bolster to prevent buried bumper syndrome.

If there are no complications or concerns, once the tract has safely been established, the gastrostomy can be replaced with a low-profile button gastrostomy device (e.g. MINI or MIC-Key buttons) (Figure 1). The first replacement is done under general anaesthesia in theatre, but subsequent changes of button can be done in the community or under sedation as tolerated by the child.

There is some heterogeneity in practice as to when the gastrostomy is replaced by a button. The controversy centres around formation of a secure gastrostomy tract to allow safe re-insertion of a button device should it become dislodged accidentally. Animal studies have shown tract formation within a week of surgery and clinical practice ranges from one month to one year. The commonly used PEG devices in the UK are manufactured to last more than 12 months. For this reason the senior author usually changes the PEG tube to a button device about 12 months following the initial PEG insertion which also maximise the maturation of the adhesions and gastrostomy tract.

A significant number of children may be able to resume oral feeding after a period of time. Occasionally changing to a different method of feeding or device may be necessary depending on response. The MDT input in these circumstances is particularly useful.

Jejunal or post pyloric feeding

In the presence of significant foregut dysmotility including severe GOR with normal oesophagogastric junction anatomy, microgastria or other reasons for inability to tolerate gastric feeds, post pyloric feeding may be considered. It may only be required for short term as some patients may regain ability to tolerate gastric feed over time. It also avoids problems such as aspiration of oropharyngeal secretions from discoordinate swallowing exacerbated by fundoplication. Though jejunal feeding may be effective in carefully selected patients, both the risks of reinsertion and the logistical issues of continuous feeding for the care givers should be taken into account. Post pyloric feeding is

usually given as a continuous infusion over 24 hours which can be reduced to 16 hours so that there are “off pump” periods. Patients may initially experience diarrhoea and/or dumping syndrome which are usually self-resolving.

There are three common ways of providing post pyloric feeding.

- 1) Naso-jejunal tube
- 2) Transpyloric gastro-jejunal (GJ) tube
- 3) Surgical jejunostomy

Naso-jejunal tubes are inserted with or without fluoroscopic guidance. Transpyloric GJ tubes are commonly inserted via an existing gastrostomy opening under fluoroscopic or endoscopic guidance. It may also be inserted primarily percutaneously under interventional radiology or via a laparotomy. The devices commonly used are PEG tubes with an inner jejunal extension which is passed via the pylorus into the proximal jejunum, and low-profile “button” GJ tube which has specific dimensions (diameter, length to balloon and jejunal extension length). These are quite bulky and can be technically difficult to insert in small children and infants and have a higher risk of perforation in infants especially when <6 kg and/or <6 months. The need for repeat hospital admissions due to blockage and displacement is high, often less than 6 monthly for button device. This can place a heavy burden to the family and healthcare provider.

There are three surgical jejunostomy techniques, as a loop jejunostomy, a tunnelled jejunostomy and Roux-en-Y jejunostomy. Loop jejunostomy can be done open, endoscopically with or without laparoscopy. However significant complications are frequent including volvulus of the loop. In paediatric practice, the small bowel is usually too small to allow tunnelled jejunostomy. Roux-en-Y jejunostomy via a limited laparotomy with a low profile button used as the jejunostomy entry portal is the senior author’s preference. The existing gastrostomy is usually retained for gas venting, and may be used for progression to gastric feeding later. Though there are limited cases described, laparoscopic assisted jejunostomy insertion has been shown to be safe with good recovery.

A recent systematic review and meta-analysis looking at 555 patients across three studies found similar outcomes for aspiration rates but more major complications with gastrostomy and fundoplication when compared to GJ feeding alone. Minor complications including need for tube change is more common with GJ tube. Large studies have also shown success in the management of severe reflux for patients in whom fundoplication has failed to improve their symptoms.

Complications

The benefits of enteral tube feeding do not necessarily outweigh the risks in all patients. Two Cochrane reviews found a paucity of evidence (no randomised control studies) for the benefits of gastrostomy feeding in those with cerebral palsy vs oral feeding alone. Though studies included showed sustained weight gain, significant morbidities were also described. An overall complication rate for PEG insertion up to 50% were described in various studies most of which were minor issues such as granulation tissue formation. Morbidity as defined by hospital admission or re-operation was 3–15%. Mortality rates ranged from 0 to 1.2%.

Gastro-colo-cutaneous fistula

The most significant or common major complications include visceral injury and gastro-colo-cutaneous fistula (Figure 4). This is a rare complication where the transverse colon, which lies between the stomach and abdominal wall, is punctured when the wide bore needle is inserted. This can also occur later following erosion of tube through the stomach wall.

Typical features of the fistula include undigested food in the stool (“diarrhoea right after feeding”), faeculent vomiting or faecal discharge from the gastrostomy tube. However, if the end of the tube still lies securely within the stomach then this may not present until first change of tube. A colonic perforation rate of 1–2% has been reported in the paediatric literature.

Other complications include small bowel obstruction, peristomal leak, tube migration, buried bumper syndrome and peristomal infection and granulation.

Small bowel obstruction

Cases of small bowel obstruction from perforation by the wide bore introducer or from volvulus around the PEG have been described but are very rare. These are normally associated with children who have anatomical abnormalities or previous surgeries with adhesions tethering the small bowel over the stomach. Migration of the internal flange into the pylorus can mimic bowel obstruction as the flange block the pylorus or duodenum. This is easily corrected by pulling it back and reattached to the external bolster.

Peristomal leakage and buried bumper syndrome

A common minor complication is peristomal leaking. As the tube moves around it can widen the skin opening and create a slight gap for gastric contents to leak externally. Frequently the bolster is mistakenly tightened in order pull the internal flange tight to the mucosal surface. This can lead to ‘buried bumper syndrome’ which has an estimated incidence of 1% in adults and <0.5% in



Figure 4 Contrast studying showing a colonic fistula.

children. The internal flange migrates into the mucosa and in our experience is most often seen in patients with gastro-jejunal tubes (Figure 5). Patients present with pain on feeding, the care givers can no longer turn or push the tube in, or at time of tube change endoscopically when the flange can no longer be seen internally. If untreated, the tube can migrate through the stomach wall with the potential for causing peritonitis.

Peristomal infection and granulation tissue

Peristomal infections are relatively common. Pre-operative prophylactic antibiotics have been shown to reduce the absolute risk of peristomal infections by 15% and relative risk by 60%. Severe infection requiring admission or tube removal occurs at a rate of 10–15%. The irritation and repeated infections can cause granulation tissue to build up around the tube as a result of recurrent attempts to heal over. This is normally a minor issue and can be managed with the application of topical treatments or chemical cauterisation (e.g. silver nitrate sticks) in the community. This rarely requires surgical management though may be excised at the time of a concomitant procedure under general anaesthesia.

Community care

The majority of the enteral tube related care is community based. Knowledge and experience amongst medical professionals and community care providers are variable. Both quantitative and qualitative studies looking at the care of feeding tubes in general practice found that 91% of GPs had received no training in looking after these devices but 53% had had to deal with issues relating to them. Generally the communication between secondary and primary care over these patients was poor.

Almost a third of carers acting as first point of contact for these patients had not been trained and, although all problems encountered were resolved, many patients found this a very negative experience. Patients are frequently transferred to a tertiary centre emergency department for minor gastrostomy related issues. Though multiple review articles exist on this topic these focus on best practice in the pre-operative phase and do not describe on-going care in the community.

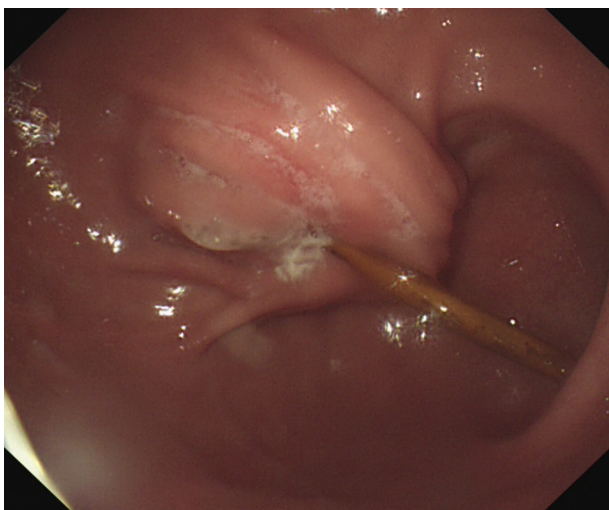


Figure 5 Transpyloric gastro-jejunal tube with the jejunal extension entering the pylorus. However the gastric flange is not seen due to buried bumper syndrome.

Maintenance of enteral tube feeding is a considerable work load for community healthcare practitioners. A prospective observational study in Sheffield found that in the course of 1 year there were 2237 separate interventions and 1019 domiciliary visits were carried out by a gastrostomy service, saving 227 hospital admissions. Multiple studies have emphasised the importance of a fully multi-disciplinary approach with communication between team members being paramount. A guideline produced in 2010 recommended the use of surgeon, paediatrician, gastroenterologist, dietician, nurse, specialist nurse practitioner, General Practice, school nurse, community paediatricians as well as the parents. Currently, in reality, few of these team members are trained in gastrostomy care which often leaves the parents and surgical team as the main support service.

We have a paediatric surgical gastroenterology nurse who works as an excellent contact point for the community teams and parents. A regional network has also been set up with MDT input to address the potential patient safety issues in paediatric enteral tube feeding. Community team and specialist nurses offer regular advice and review. They play an important role to detect complications and to manage or escalate concerns to the paediatric surgical team as appropriate.

Common problems and their solutions

1. Blockages

If the child has a blocked PEG tube the parents or care givers should flush it with warm water. If they are still unable to unblock it then they should seek advice from their Community/Complex Needs Nurse. If they are also unable to unblock the tube, an urgent referral back to the surgeons will be necessary and may require endoscopic replacement general anaesthesia.

2. Accidental removal

It is vital that an equivalent sized replacement tube is replaced in the gastrostomy immediately. Most centres will commonly stock one or two sizes of tubes (usually 12Fr or 14Fr) as the gastrostomy site can start to close within hours. This can make replacement later very difficult and may require another surgical procedure.

If no replacement is readily available the child should go to the nearest emergency department with the tube that has come out. This way the staff there can insert the same size Foley catheter as a temporising measure. This has two key benefits: 1) Foley catheters have a tapered end which allows easier insertion into a tight orifice when compared to the blunt end of an NG tube or gastrostomy tube; and 2) has a balloon so that it can be secured to allow feeding while a replacement is organised. Some patients are given a “stoma stopper” in their emergency package which also serves the same purpose as a temporising device to keep the tract open.

Conclusions

Oral feeding is not possible for all children. When oral feeding fails or is no longer considered safe then enteral tube feeding is an important option for the child, their carers and the family. Understanding the options, risks and benefits is important core knowledge for healthcare professionals. Simple troubleshooting tips for common problems can significantly reduce the burden on families. ◆

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Practice Points

- Enteral tube feeding has a beneficial effect on nutritional status of children with chronic illness, neurodevelopmental issues or impairment of oral feeding
- Often leads to improved quality of life for the child/young person and their family
- Insertion of enteral feeding tubes is relatively low risk procedure in the majority of patients but has recognised complications some of which causes significant morbidities and even mortality
- Decision for insertion should include multidisciplinary input
- Increasing demand means greater awareness and training for the healthcare providers is required to cope with the service demands