# Pediatric tube feeding

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# Objectives

- Indication for tube feeding
- Type of feeding tubes
- Tube care by ED & PCP
- Tube feeding weaning

# Tube feeding (TF)

- A mode of enteral nutrition when oral feeding is not possible or not sufficient
- Through a medical device that placed into stomach or small bowel, via Nose, mouth or percutaneous route



Tube feeding in children. Pediatrics in review. 2017

# EN preferred over PN

Overview of outcomes: enteral *versus* parenteral nutrition in pancreatitis (↓= statistically significant decrease with enteral nutrition).

| Analysis | Mortality | All infections | Pancreatic infections | Need for surgery | Multi-organ failure | Length of stay |
|---|---|---|---|---|---|---|
| Petrov *et al.* [2008] | ↓ | ↓ | ↓ | ↓ | | |
| Yi *et al.* [2012] | ↓ | ↓ | | ↓ | ↓ | |
| Al-Omran *et al.* [2010] | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |

# Gastrostomy tube feeding: when to start, what to feed and how to stop

F Gottrand[1,2] and PB Sullivan[3]

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*Incapacity or limited ability to eat*

Suck–swallow dysfunction (for example, prematurity, neurological disorders, discoordinated swallowing)

Congenital abnormalities (for example, craniofacial malformations, oesophageal atresia, tracheo-oesophageal fistulae)

Acquired conditions (for example, facial trauma, coma, tumours of the face, mouth or oesophagus, oesophageal injury or obstruction)

*Inability to meet requirements by oral intake*

Anorexia (for example, reduced appetite, nausea, taste changes, anxiety)

Fatigue and muscle weakness (for example, cardiac disease, respiratory disease)

Increased metabolic needs (for example, trauma, burns, sepsis, cancer, cystic fibrosis, congenital heart disease, multiple organ failure, advanced HIV infection)

*Increased nutritional losses*

Impaired digestion (for example, pancreatic insufficiency, enzyme deficiencies)

Impaired absorption (for example, intestinal resection, mucosal damage or inflammation)

Excess gastrointestinal losses (for example, high-output fistulae, protein-losing enteropathy, chronic diarrhoea)

*Altered metabolism/primary disease management*

Inborn error of fasting adaptation (for example, hyperinsulinaemia, glycogen storage disease, defects in gluconeogenesis)

Impaired organ function (for example, renal disease, liver disease, pulmonary disease, Crohn's disease)

# Temporary tubes

| | | | | |
|---|---|---|---|---|
| Orogastric | Short-term | Bedside | • Used in preterm infants up to 34 weeks' gestation<br>• Safe with basilar skull fracture | • Feeding<br>• Medication<br>• Hydration |
| Nasogastric | Short-term | Bedside | • With or without stylet | • Feeding<br>• Medication<br>• Hydration |
| Nasointestinal (including any nasal tube that extends beyond the pylorus) | Short-term | Fluoroscopic | • Displaces easily<br>• Weighted or unweighted | • Feeding<br>• Hydration |

# Indication of permanent tube

- Long term tube feeding is anticipated
- Enteral tube feeding exceeds 4-6 weeks



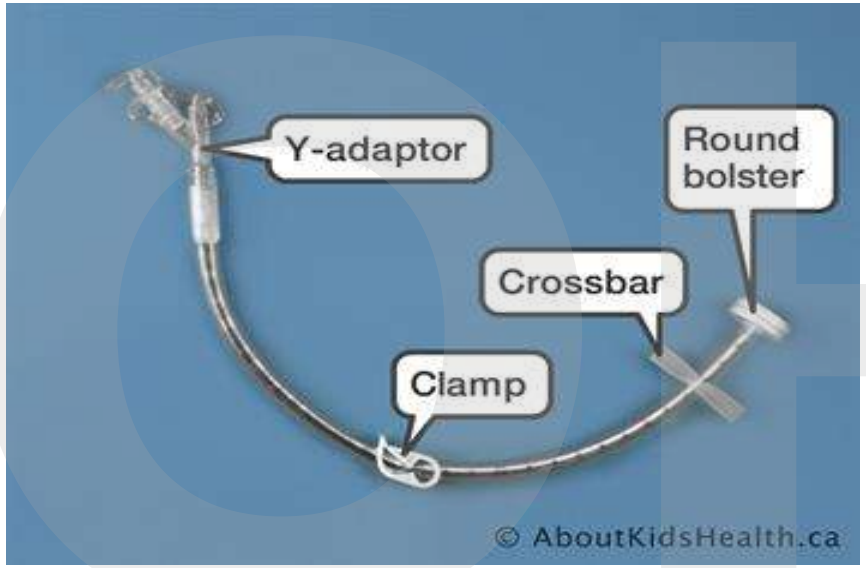
ESPGHAN Committee

# Gastrostomy tube

| Table 1 — Gastrostomy techniques by category. |
| --- |
| Fascial suture techniques |
| Open |
| Laparoscopic with fascial sutures at the stoma |
| PEG techniques |
| PEG |
| PEG with fluoroscopy |
| Push techniques |
| Endoscopic with t-fastener or full-thickness transabdominal suture |
| Laparoscopic with t-fastener or full-thickness transabdominal suture |
| Fluoroscopy only |

| | | | | |
|---|---|---|---|---|
| Gastrostomy | Long-term | Surgical | • Not ready for immediate use | • Feeding<br>• Medication<br>• Hydration |
| Percutaneous endoscopic gastrostomy (PEG) | Long-term | Endoscopic or radiologic techniques | • Can be used 4 hours from placement | • Feeding<br>• Medication<br>• Hydration |
| Low-profile device<br><br>Internal balloon or internal "mushroom" | Long-term | Initial endoscopic<br><br>Thereafter at bedside (home) | • More convenient and easier to care for than gastrostomy tube<br>• Aesthetically more pleasing | • Feeding<br>• Medication<br>• Hydration |

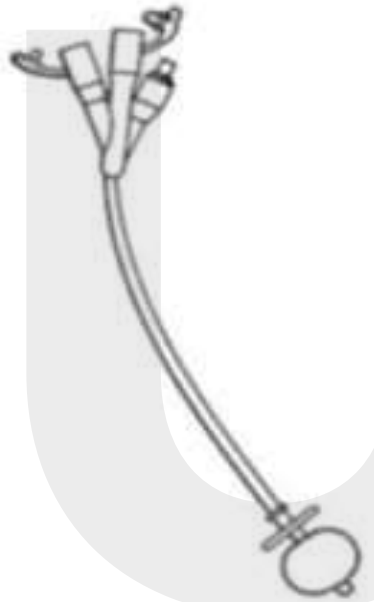
# PEG



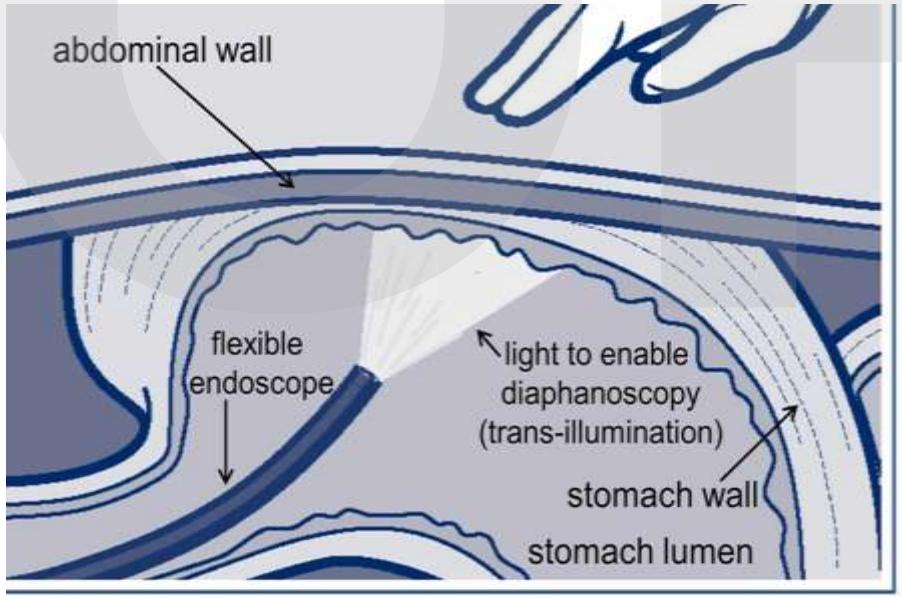

Criteria:
>3.5Kg
Normal upper GI
No previous abdominal surgery

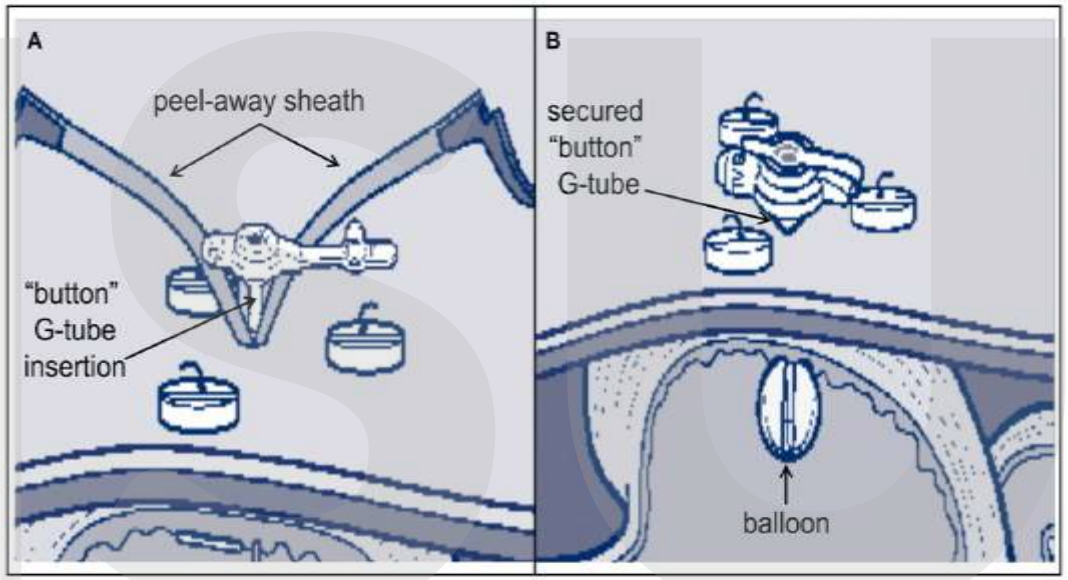
• Crossbar touches the skin, that gets rotated twice daily to Prevent irritation

# Balloon devices

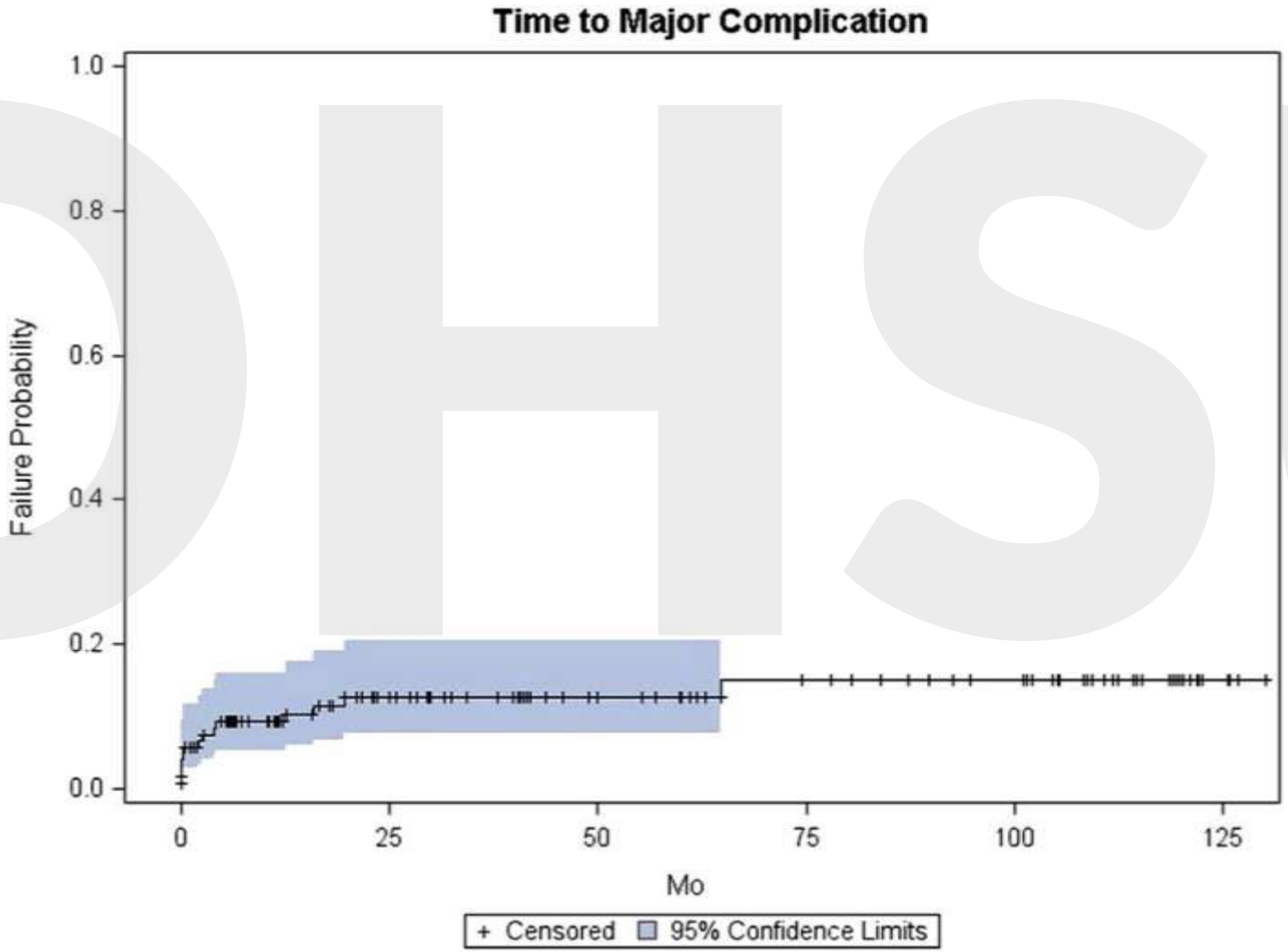



# One-step Gastrostomy button



# Risk of PEG complication




Advance in pediatric gastrostomy placement. Gastro endo cli n Am. 2016

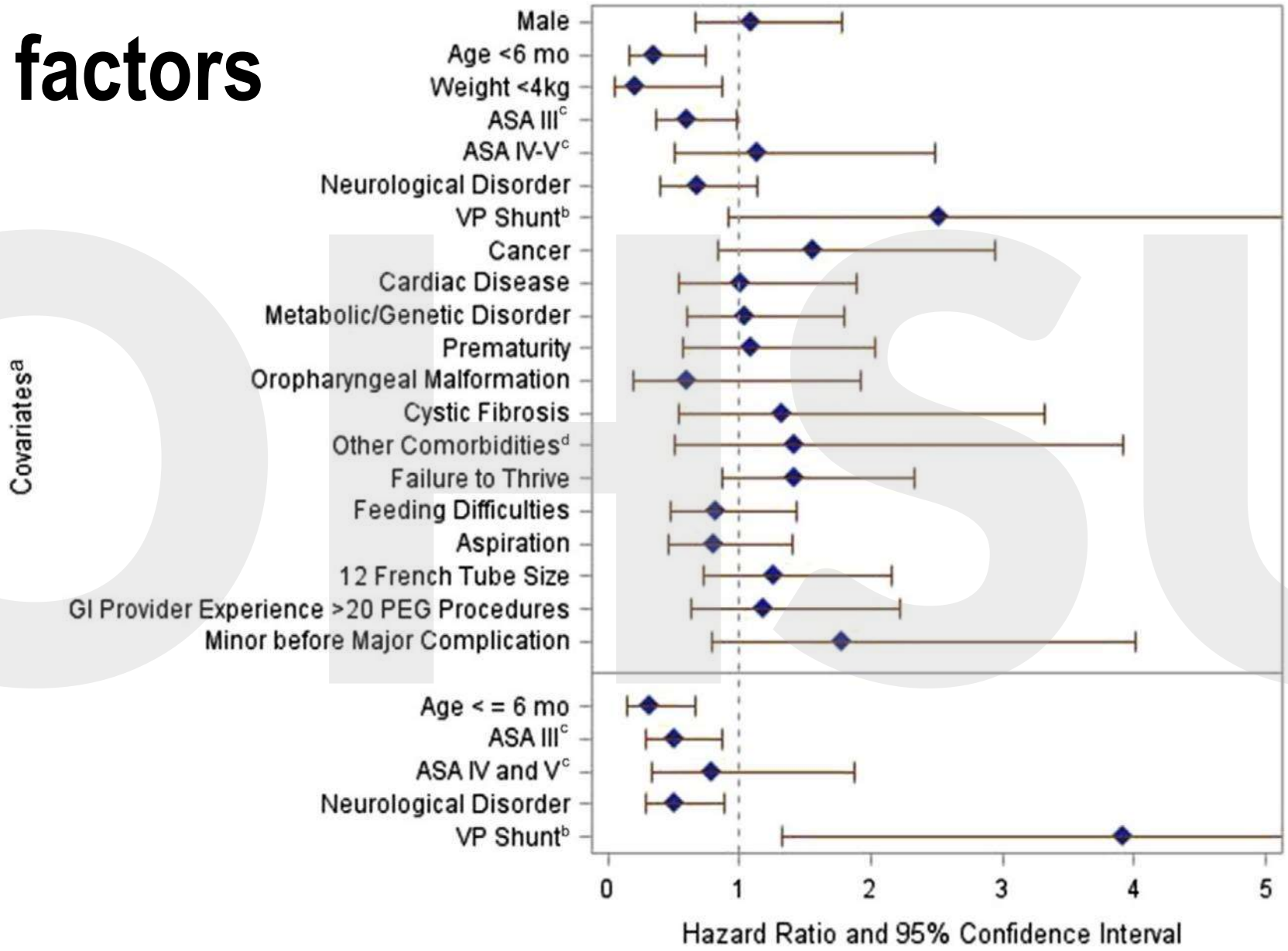
# Late onset complications

**Table 2.** Late complications of gastrostomy tube placement.

| Late Complications | |
|---|---|
| **Major** | **Minor** |
| • surgical revision 3 (3.6%)<br>• occlusion 2 (2.4%)<br>• buried bumper syndrome 2 (2.4%)<br>• dumping Syndrome 5 (5.9%) | • dislocation 10 (11.9%)<br>• granuloma or skin infection 7 (8.3%) |

Gastrostomy Placement and Management in Children: A Single-Center Experience . Nutrients. 2019

# Risk factors



# PEG Prognosis

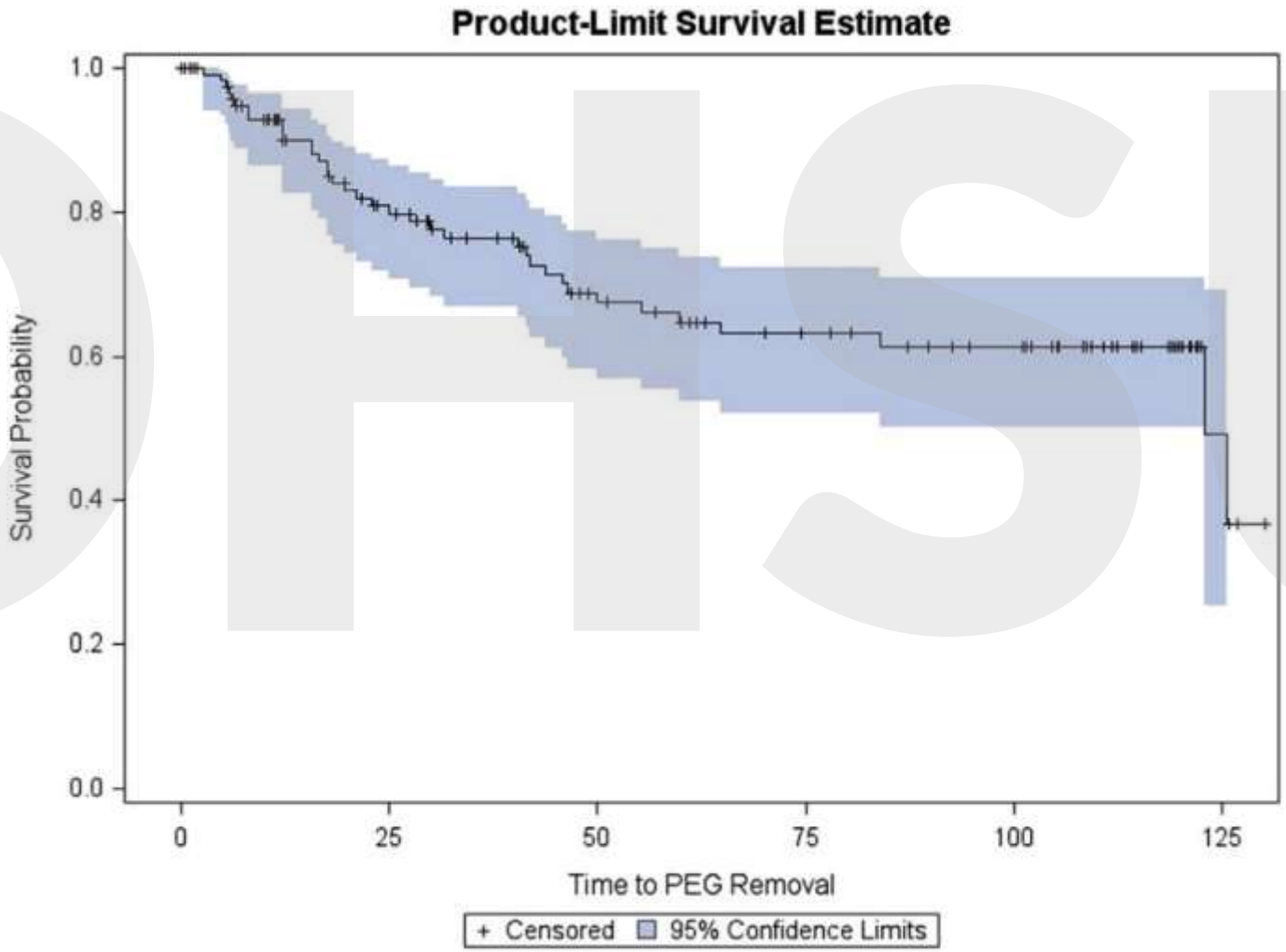


**Table 4 — Clinical burden by technique.**

| Technique | PEG, n (%) | Push, n (%) | Fascial, n (%) | Total, n (%) | P value |
|---|---|---|---|---|---|
| ED visits | 17 (16) | 38 (36) | 51 (48) | 106 (100) | 0.28 |
| Admissions | 12 (36) | 5 (15) | 16 (49) | 33 (100) | 0.06 |
| Calls for granulation | 14 (12) | 22 (19) | 82 (69) | 118 (100) | 0.12 |
| Calls for leakage | 18 (15) | 17 (14) | 83* (71) | 118 (100) | 0.05 |
| Clinic visits | 85 (15) | 125 (21) | 370* (64) | 580 (100) | 0.005 |

# GT care in the ED

(within 8 weeks)

- Dislodged, or Broken
  - Replace with same or smaller size of Corflo, or Foley; consult GI
  - If unsuccessful, consult GI & IR
- Infection (per ED care)
- Clogged
  - Flush -> replace → consult GI & IR

(after 8 weeks)

- Troubleshooting by caregiver & PCP; if unsuccessful, seen by GI or ED

# Use of Point-of-Care Ultrasound to Guide Pediatric Gastrostomy Tube Replacement in the Emergency Department

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Pediatric Emergency Care: February 2018 - Volume 34 - Issue 2 - p 145-148
doi: 10.1097/PEC.0000000000001400



## Abstract

The presentation of a pediatric patient to the emergency department for a malfunctioning or dislodged gastrostomy tube (G-tube) is not uncommon. As such, these tubes are often replaced at the bedside. Improper placement can result in a number of complications, including perforation, fistula tract formation, peritonitis, and sepsis. The current criterion standard method to confirm proper G-tube placement is contrast-enhanced radiography. However, point-of-care ultrasound may be an alternative method to guide and confirm pediatric G-tube replacement in the emergency department. We report a series of cases on this novel point-of-care ultrasound application.

# Indication of NJ/GJ / JT

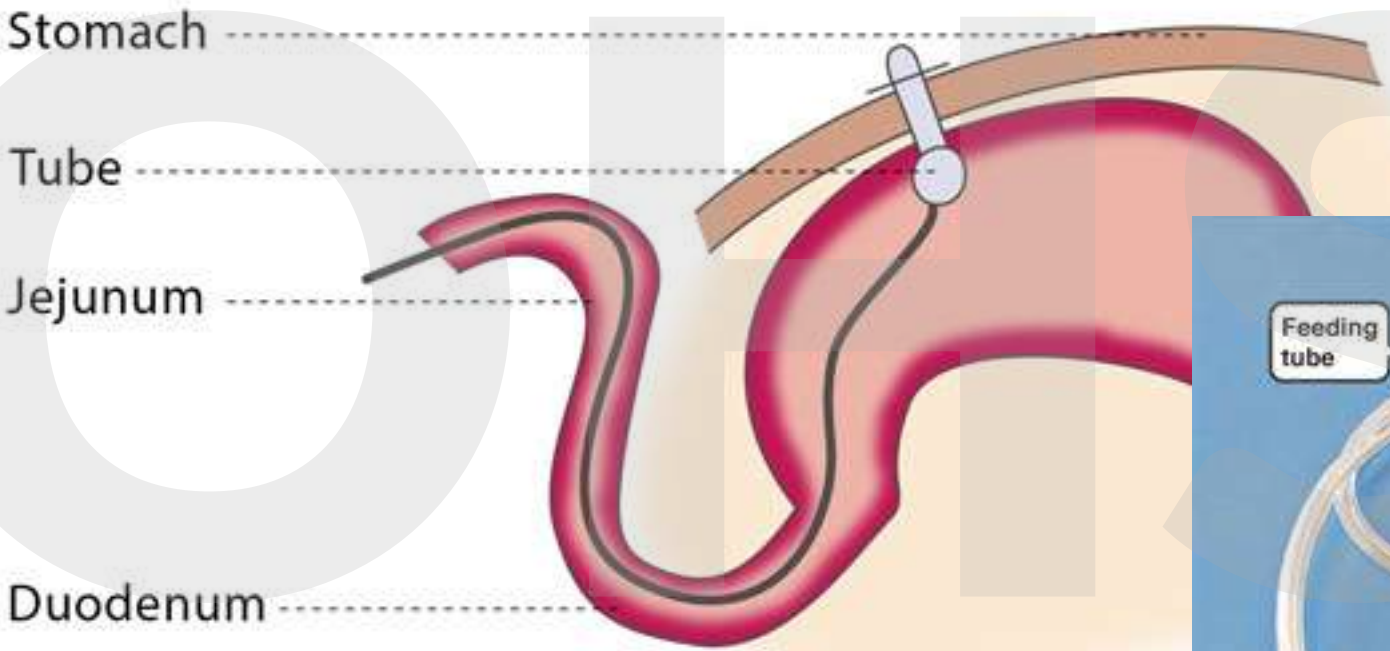
- Postpyloric feeding when gastric feeding is not tolerated or associated with unacceptable complications or insufficient to achieve caloric needs
- Conditions:
  - Failure of oral and intragastric feeds or gastric outlet obstruction
  - Failure of gastric feeding in critically ill children
  - Intestinal pseudo-obstruction
  - Risk of aspiration
  - Acute pancreatitis if Not tolerating oral or gastric feeding

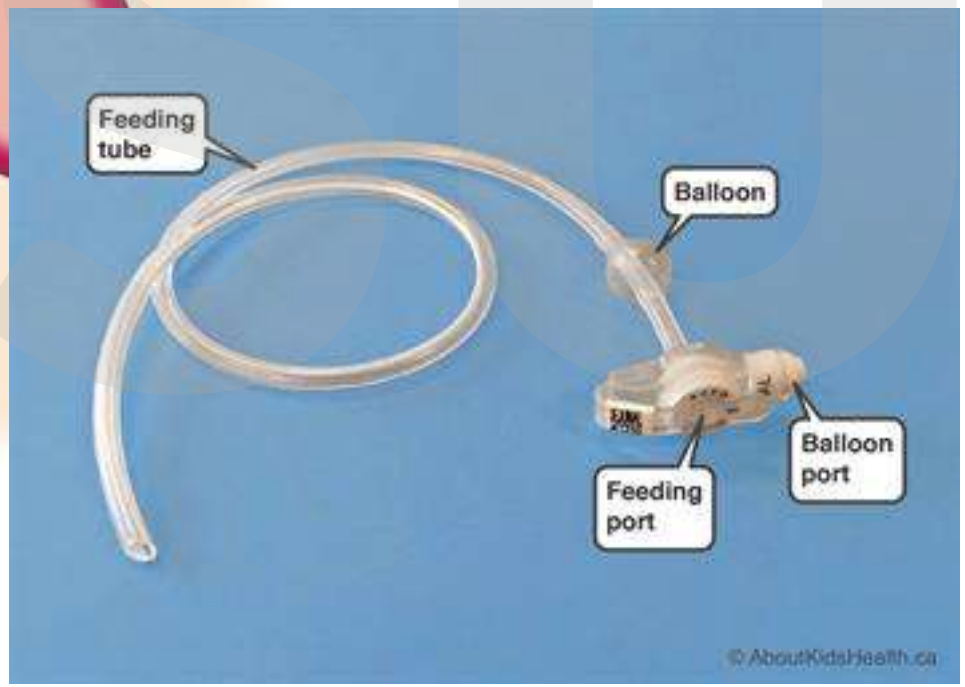
The use of jejunal tube feeding in children. JPGN. 2019

# Jejunostomy tube

| | | | | |
|---|---|---|---|---|
| Gastrointestinal (including any gastric tube that extends beyond the pylorus) gastrojejunostomy or percutaneous endoscopic jejunostomy | Long-term | Endoscopic, radiologic, or both | • Possible to access both stomach and small bowel<br>• Easily dislodged | • Limits reflux and aspiration<br>• Feeding<br>• Hydration |
| Jejunostomy | Long-term | Surgical or endoscopic | • No access to stomach | • Feeding<br>• Hydration<br>• Limits reflux and aspiration |
| Low-profile jejunal device Internal mushroom bolster or fluid-filled balloon | Long-term | Endoscopic | • More convenient<br>• Aesthetically more pleasing<br>• No access to stomach | • Feeding<br>• Hydration<br>• Some medications |

# Gastrojejunostomy



# GJ

- Complications:
  - Continuous feeding
  - Frequent needs for tube maintenance and replacement
  - Increased morbidity

- Recommendations
  - Involve multidisciplinary team before initiating GJ
  - Adequate planning, and future strategies

# Alternatives can be tried prior

- Continuous gastric feeding with hydrolyzed or elemental formula

- At least 1 prokinetic drug to promote oral or gastric feeding
  - Erythromycin
  - Metoclopramide
  - Domperidone
  - Cyproheptadine *

# Contraindications

- Absolute
  - Paralytic or mechanical ileus
  - Intestinal obstruction
  - Peritonitis
  - NEC
- Relative
  - Recommend not to use in <37 wk gestation
  - Recommend caution in intestinal dystmotility, toxic magcolon, GI bleeding, high-output enteric fistula, intractable diarrhea, immunocompromised

# Placement techniques

- NJ
  - Fluoroscopy or endoscopy guided
  - pH-guided jejunal tube placement
- GJ
  - Endoscopic
  - Interventional radiology
- JT
  - Surgical
  - Endoscopic

# Utilization

- Feeding primarily
- No medications unless exceptions
- Adequate flushing

# TF pattern

| TYPE | PATIENT AGE | INITIAL INFUSION RATE | ADVANCEMENT | GOAL |
|---|---|---|---|---|
| Continuous | 0-12 months | 1-2 mL/kg/h | 1-2 mL/kg every 8 hours | 5-6 mL/kg/h |
| | 1-3 years | 1 mL/kg/h | 1 mL/kg every 8 hours | 4-5 mL/kg/h |
| | 4-10 years | 20-30 mL/h | 20-30 mL every 8 hours | 3-4 mL/kg/h |
| | 11-18 years | 30-60 mL/h | 30 mL/h every 8 hours | 100-150 mL/h |
| Bolus | 0-12 months | 30-60 mL every 2-3 hours | 15-60 mL/feeding | 150 mL every 4-5 hours |
| | 1-3 years | 30-90 mL every 2-3 hours | 60 mL/feeding | 180 mL every 4-5 hours |
| | 4-10 years | 75-90 mL every 3 hours | 60 mL/feeding | 210 mL every 4-5 hours |
| | 11-18 years | 90-120 mL every 3 hours | 60 mL/feeding | 240 mL every 4-5 hours |
| Cyclic | 0-12 months | 1-2 mL/kg/h | 1-2 mL/kg/2 h | 75 mL/h x 12-18 h per day |
| | 1-3 years | 1 mL/kg/h | 1 mL/kg/2 h | 90 mL/h x 8-16 h per day |
| | 4-10 years | 25 mL/h | 25 mL every 2 hours | 120 mL/h x 8-16 h per day |
| | 11-18 years | 30 mL/h | 30 mL every 2 hours | 150 mL/h x 12 h per day |

# TF regimen

- BM
- Commercial standard & specialized formula
- Commercial organic or plant based formula, and others
- Home blenderized diet

# Blenderized diet

**Table 1. Pros and cons of a home-blended tube feeding regimen**

| Pros | Cons |
|---|---|
| • Delivery of diverse whole foods to promote a healthy microbiome (24) | • Time-consuming and costly, requiring motivation for preparation |
| • Reduction in total added sugar, artificial flavors, and additives compared to commercial formulas (16) | • Need for increased nutrition monitoring (18) |
| • Reduced instances of gagging/retching (8) | • Experienced registered dietitian involvement with access to nutrient analysis database |
| • Reduced symptoms of diarrhea or constipation (6) | • Increased risk of feeding tube obstruction |
| • Reported increased interest in food and decreased oral aversion (7) | • Infection risk |
| • Potential for increased fiber and protein content | • May be unavailable inpatient |
| • Perception of a normalized eating behavior (25) | |
| • Improved emotional connection between caregiver and patient | |

Home Blenderized Tube Feeding: A Practical Guide for Clinical Practice. Cli translational gastro

| | | | | |
|---|---|---|---|---|
| Human Milk | Preferred nutrition source for virtually all infants* when mother's milk and/or donor milk is available | | **PRO:** whey-predominant, whey:casein ratio varies<br>**FAT**: human milk<br>**CHO**: lactose | • Nonhomogenized<br>• Special care and technique needed when feeding via tube<br>• 20 kcal/oz, crematocrit can be performed to measure kcal concentration |
| Postdischarge Formulas for Prematurity | Posthospital discharge formulas for former preterm infants | Enfacare® Lipil,[a] Similac® NeoSure®[b] | **PRO**: whey, casein, cow milk protein<br>**FAT**: high-oleic, soy, coconut oils, MCT, DHA, ARA<br>**CHO:** corn syrup solids, lactose, maltodextrin | • Standard concentration is 22 kcal/oz<br>• High in protein, vitamin D, calcium, and phosphorus<br>• 250-310 mOsm/kg water |
| Standard Infant Formulas | Normal gastrointestinal tract | Enfamil® Premium,[a] Enfamil® Gentlease,[a] Gerber® Good Start® Gentle,[c] Similac® Advance®[b] | **PRO**: cow milk protein, whey protein concentrate (Gentlease and Good Start contain partially hydrolyzed protein)<br>**FAT**: palm olein, soy, coconut, high-oleic sunflower, DHA, ARA<br>**CHO**: lactose, galactooligosaccharides, polydextrose, corn syrup solids | • Standard concentration is 20 kcal/oz<br>• Similac concentration is 19 kcal/oz<br>• 230-310 mOsm/kg water |

| | | | | |
|---|---|---|---|---|
| Soy-based Infant Formulas | Galactosemia, primary or secondary lactose intolerance, families preferring vegan formula option | Enfamil® Prosobee,[a] Gerber® Good Start® Soy,[c] Similac Soy Isomil® | **PRO:** soy protein isolate and L-methionine<br>**FAT:** palm olein, soy, coconut, high-oleic safflower/sunflower, DHA, ARA<br>**CHO:** corn syrup solids, sucrose | • Lactose-free<br>• 20 kcal/oz standard concentration<br>• Similac concentration is 19 kcal/oz<br>• 180-200 mOsm/kg water |
| Extensively Hydrolyzed Infant Formulas | Food protein intolerance, malabsorption, steatorrhea, intractable diarrhea | Similac® Alimentum,®[b] Nutramigen® Lipil,[a] Pregestimil®[a] | **PRO**: cow milk protein hydrolysate<br>**FAT**: long-chain fat, variable MCT (0%-55% of fat), DHA, ARA<br>**CHO:** corn syrup solids, modified corn starch, dextrose, sucrose | • Hypoallergenic<br>• Lactose-free<br>• 20 kcal/oz standard concentration<br>• 320-370 mOsm/kg water |
| Elemental/Free Amino Acid Infant Formulas | Severe protein allergy, eosinophilic gastrointestinal disorders, malabsorptive conditions, short bowel syndrome | Alfamino® Infant,[d] Elecare® Infant,[b] Neocate® Infant,[e] PurAmino™[a] | **PRO:** free amino acids<br>**FAT:** high-oleic safflower oil, soy, coconut, sunflower oil, variable MCT (33%-43% of fat), DHA, ARA<br>**CHO:** corn syrup solids | • Hypoallergenic<br>• No cow milk protein, soy, fructose, galactose, or lactose<br>• 330-350 mOsm/kg water |

| | | | | |
|---|---|---|---|---|
| Standard Pediatric Enteral Formulas | Normal GI tract requiring a complete or supplemental source of energy from tube feeding | Boost® Kid Essentials™,[a] Compleat® Pediatric,[a] Nutren Junior,®[a] PediaSure® Enteral 1.0 Cal, PediaSure®[b] Adolescents >13 years: Jevity® 1 Cal,[b] Nutren® 1.0,[a] Osmolite® 1.0[b] | **PRO**: cow milk protein concentrate (Compleat contains food ingredients: chicken, peas, carrots, tomatoes, and cranberry juice)<br>**FAT**: high-oleic sunflower oil, soybean, safflower, canola oil, variable MCT (0%-20% of fat)<br>**CHO**: maltodextrin, sucrose, corn syrup | • 1 kcal/mL, 30 cal/oz<br>• Lactose-free<br>• Meets/exceeds 100% of the DRIs for protein, vitamins/minerals for children 1-8 years, 9-13 years in 1,000 mL and 1,500 mL, respectively<br>• For oral or tube feeding use<br>• Fiber content varies<br>• 300-550 mOsm/kg water |
| Calorie-dense Pediatric Formulas | Normal GI tract requiring increased energy needs, shortened feeding schedules, fluid restriction, or have volume intolerance | Children 1-13 years: Boost® Kid Essentials™ 1.5,[a] PediaSure® 1.5[b] Adolescents >13 years: Isosource 1.5, Jevity® 1.2,[b] Jevity® 1.5 Cal,[b] Nutren® 1.5,[a] Nutren® 2.0,[a] Osmolite® 1.2,[b] Osmolite® 1.5[b] | **PRO:** cow milk and whey protein concentrate, sodium and calcium caseinate, soy protein isolate<br>**FAT**: high-oleic sunflower/safflower, soy oil, canola oil, variable MCT (0%-20% of fat)<br>**CHO**: sucrose, corn syrup solids, maltodextrin | • 1.2-2.0 kcal/mL<br>• Lactose-free<br>• Nutritionally complete in varying volumes/patient age-dependent<br>• 370-780 mOsm/kg water<br>• 69%-81% free water; while using these, be sure adequate free water flushes are provided to meet hydration needs of patient |
| Reduced-calorie Pediatric Enteral Formulas | Age 1-13 years with decreased energy needs requiring a lower-energy complete feeding | Compleat® Pediatric Reduced Calorie,[a] PediaSure® SideKicks 0.63 kal/mL[a] | **PRO**: cow milk and whey protein concentrate, soy protein isolate, sodium caseinate, chicken, pea protein isolate<br>**FAT:** canola oil, soy oil, variable MCT (0%-20% of fat)<br>**CHO**: corn syrup, sucrose | • 0.6-0.63 kcal/mL<br>• Lactose-free<br>• Beneficial to address disproportionate weight gain often associated with developmental disabilities<br>• Fiber content varies<br>• 300-420 mOsm/kg water |

| | | | | |
|---|---|---|---|---|
| Hydrolyzed Pediatric Formulas | Impaired GI tract function requiring peptide-based complete nutrition formula; may be beneficial for use in malabsorption, short bowel syndrome, chronic diarrhea, delayed gastric emptying, or for previous intolerance issues with intact protein formulas | PediaSure® Peptide 1.0,[b] PediaSure® Peptide 1.5,[b] Peptamen® Junior 1.0,[a] Peptamen® Junior 1.5[a] | **PRO**: enzymatically hydrolyzed whey protein, hydrolyzed sodium caseinate<br>**FAT:** canola oil, soy oil, variable MCT (50%-60% of fat)<br>**CHO**: maltodextrin, sucrose, cornstarch | • 1.0-1.5 kcal/mL<br>• Flavored and unflavored<br>• Lactose-free<br>• Fiber content varies<br>• 260-450 mOsm/kg water |
| Free Amino Acid Pediatric Formulas | For children with impaired GI tract function requiring a hypoallergenic, amino acid-based formula; may be beneficial for use in patients with multiple food allergies, eosinophilic GI disorders, malabsorptive conditions, short bowel syndrome, and other GI tract impairments | Alfamino® Junior,[c] Elecare® Junior,[b] Neocate® Junior,[d] Neocate® Splash,[d] Vivonex® Pediatric[a] | **PRO**: free amino acids<br>**FAT**: high-oleic safflower oil, soy oil, variable MCT (33%-70% of fat)<br>**CHO:** corn syrup solids, potato starch, modified corn starch | • 0.8-1.0 kcal/mL<br>• Flavored and unflavored<br>• Lactose-free<br>• Available in powder or ready to feed (Neocate® Splash manufactured as ready to feed)<br>• 360-590 mOsm/kg water |

# TF weaning

- GT
  - Improved nutritional status
  - Home oral stimulation;
  - feeding therapy; occupational therapy; SLP; psychology
  - MBSS
  - Medications
- JT
  - Inpatient or outpatient conversion
  - Consensus between medical professionals and caregivers

# Thank you