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Outcomes of Infants with Home Tube Feeding: Comparing Nasogastric Versus Gastrostomy Tubes

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Abstract

Background—Determine the tube-related complications and feeding outcomes of infants discharged home from the NICU with nasogastric (NG) tube feeding or gastrostomy (G-tube) feeding.

Material & Methods—We performed a chart review of 335 infants discharged from our NICU with home NG tube or G-tube feeding between January 2009 – December 2013. The primary outcome was the incidence of feeding tube-related complications requiring emergency department (ED) visits, hospitalizations, or deaths. Secondary outcome was feeding status at 6 months post-discharge. Univariate and multivariate analyses were conducted.

Results—There were 322 infants discharged with home enteral tube feeding, 84 NG tube and 238 G-tube, with available out-patient data for the 6 month post-discharge period. A total of 115 ED visits, 28 hospitalizations, and 2 deaths were due to a tube-related complication. The incidence of tube-related complications requiring an ED visit was significantly higher in the G-tube group compared to the NG tube group (33.6% vs 9.5%, $p < 0.001$). Two patients died due to a G-tube related complication. By 6 months post-discharge, full oral feeding was achieved in 71.4% of infants in the NG tube group compared to 19.3% in the G-tube group ($p < 0.001$). Type of feeding tube and percentage of oral feeding at discharge were significantly associated with continued tube feeding at 6 months post-discharge.

Conclusion—Home NG tube feeding is associated with fewer ED visits for tube-related complications compared to home G-tube feeding. There may be some infants who could benefit from a trial home NG tube feeding.

Keywords

neonates; enteral feeding tube; outcomes; complications; nutrition

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Introduction

Delay in achieving full oral feeding prolongs the hospitalization of many infants in the neonatal intensive care unit (NICU). [1] The time required to develop oral feeding skills is difficult to predict and can vary from weeks to months.[1,2] Home tube feeding has been used successfully in infants discharged from the NICU to provide time to develop oral feeding skills.[3] Both home nasogastric (NG) tube and gastrostomy tube (G-tube) feeding have been shown to promote growth, reduce length of hospital stay, and decrease healthcare costs.[3–7] Furthermore, early discharge programs utilizing home tube feeding in infants may have emotional and psychological benefits for the family, including positive impact on infant development and decreased parental anxiety.[5,8]

Despite recent reports that indicate increasing numbers of premature and medically complex infants being discharged with home tube feeding,[9,10] there is no consensus regarding the optimum method of tube feeding for infants discharged home from the NICU. While NG tubes are easier to place, tube removal is common and proper positioning is essential to prevent potential respiratory complications.[11,12] Alternatively, G-tubes may be more stable but require an invasive procedure with risks for major and minor procedural and anesthetic complications, infection, and wound issues.[13–17]

For infants who require home tube feeding after NICU discharge, decisions regarding tube selection are complicated. There are no data comparing the outcomes of home NG tube and G-tube feeding in infants that may help families and care providers make informed decisions for home feeding tubes at discharge. The objective of this study was to determine the tube-related complications requiring medical attention and feeding outcomes of infants discharged home from the NICU with NG tube feeding or G-tube feeding.

Patients and Methods

Institutional Review Board approval was granted for a retrospective chart review of all infants discharged from the Children's Hospital of Wisconsin NICU with home NG tube or G-tube feedings between January 2009 through December 2013. Only infants followed by the gastroenterology (GI) service with feeding data for 6 months post-discharge were included in the analysis. Infants receiving palliative care or requiring home total parenteral nutrition (TPN) were excluded from the study. All electronic medical records within the first 6 months post-discharge were reviewed, including all emergency department (ED) visits and hospital admissions. No distinction was made between open gastrostomy tube placement and percutaneous endoscopic gastrostomy tube placement in infants discharged with home G-tube feedings. The general protocol for discharge planning of infants with home NG tube and G-tube feedings involved an inpatient GI consultation and scheduling of outpatient follow-up appointments. The inpatient GI consultation was done prior to discharge to provide education, safety precautions, anticipatory guidance, and provision of contact information for questions or concerns. The first outpatient GI clinic visit was scheduled at 2–3 weeks after discharge for infants in both groups, and subsequent follow-up was determined on an individual basis.

The primary outcome was the incidence of feeding tube-related complications requiring medical attention, defined as any ED visits, hospitalizations, or deaths, due to an unanticipated problem with the feeding tube. The secondary outcome was feeding status at 6 months post-discharge and categorized as either attained full oral feeds or continued tube feeding. For infants who underwent NG tube to G-tube conversion or who had a G-tube that was changed to an NG tube, the timing and reason for conversion were recorded. To avoid crossover, only complications associated with the original feeding tube were considered for these infants.

Other collected data consisted of patient characteristics including gestational age, race, birth weight, sex, and indication for tube feeding. All discharge diagnoses were examined and comorbidities were noted and categorized as central nervous system (CNS), genetic/metabolic, cardiovascular, respiratory, gastrointestinal (GI), renal, prematurity (defined as birth at < 37 weeks gestation) and other. Oral feeding at the time of discharge were recorded as percentage of goal enteral feeds for the 24-hour period prior to discharge. The usual practice at our institution during the study period was to provide goal enteral feeds of 150 mL/kg per day.

Statistical Analyses

Study data were collected using the Research Electronic Data Capture (REDCap) system, a secure, web-based application used for data capture and management in clinical and translational research.[18] Unless otherwise stated, the data are expressed as medians and interquartile ranges. Data were not normally distributed and univariate analysis was carried out using Mann-Whitney test and categorical data were compared using Chi-square test. Logistic regression was performed using stepwise selection to assess the relationship between patient characteristics and feeding status at 6 months post-discharge. Variables significant at the 0.05 level in the univariate analysis were tested for inclusion into the regression model and interactions between significant variables were investigated. Stata Version 12.0 (Stata Corporation, College Station, TX, USA) and SAS Version 9.2 (SAS, Cary, NC, USA) were used for statistical analysis. All tests were conducted as two-tailed tests with a p-value < 0.05 considered statistically significant.

Results

A total of 335 infants were discharged from the NICU with home NG tube or G-tube feeding. Thirteen infants receiving palliative care were excluded from the analysis. Of the remaining 322 infants, 84 were discharged with NG tube feeding and 238 with G-tube feeding. Study population composition and assignment are shown in Figure 1.

Patient characteristics in NG tube and G-tube groups are shown in Table 1. Fifty-six percent of infants in both groups were premature. Although median gestational age was similar for both groups, infants in the NG tube group were heavier at birth. Infants with home G-tube feedings were older and more mature at the time of discharge. A higher proportion of infants with a central nervous system comorbidity were discharged with home NG tube feedings than G-tube feedings (p < 0.01). Prematurity was the most common comorbidity in both NG

tube and G-tube groups. The median number of comorbidities was similar between groups, (3 comorbidities (IQR 2 – 3 comorbidities) in each group, p = 0.60). At the time of discharge, approximately equal numbers of infants with home NG tube feeds were orally feeding ≤ 25%, 26–50%, or 51–75% of their goal enteral feeding volumes. The majority of infants with home G-tube feeds were receiving ≤ 25% of their goal enteral feeding volumes orally at discharge.

Overall, 115 ED visits, 28 hospitalizations, and 2 deaths were recorded for tube-related problems during the first 6 months after discharge. Figure 2 compares the proportion of infants with tube-related complications in each group. Significantly more infants in the G-tube group had at least one ED visit compared to the NG tube group (80 infants (33.6%) vs 8 infants (9.5%), p < 0.001). Twenty-two (9.2%) infants in the G-tube group had more than 1 ED visit, with 5 infants having three or more visits. None of the infants in the NG tube group had more than one ED visit.

Specific feeding tube-related complications evaluated in ED in the first 6-months after discharge are shown in Table 2. In infants with home NG tube feeding, 3 infants were evaluated in the ED for concerns for possible aspiration and 2 infants were evaluated for apparent life-threatening event (ALTE). Inadvertent tube removal and G-tube/site related complications were the most common causes of ED visits in infants with G-tubes. For both groups, none of the infants evaluated for possible aspiration or ALTE required intubation or mechanical ventilation.

Of the 6 deaths recorded during the study period, 2 were directly attributed a complication of a G-tube. One death was secondary to duodenal perforation from the gastrostomy tube. The second patient died after having bowel obstruction from the gastrostomy tube and subsequent intestinal perforation.

By 6 months post-discharge, home tube feeding was discontinued because full oral feeding was achieved in 71.4% of infants in the NG tube group compared to 19.3% in the G-tube group (p < 0.001). Median time to achieve full oral feeds was 30 days (IQR 15 – 61 days) for infants with a NG tube versus 70 days (IQR 39 – 119 days) in those with a G-tube, (p < 0.001). Among the patient characteristics listed in Table 1, only type of feeding tube and percentage of oral feeding at discharge were significantly associated with continued tube feeding at 6 months post-discharge (Table 3). There was no interaction between type of feeding tube and percentage of oral feeding at discharge. There was a significant, inverse relationship between the amount of oral feeding at discharge and continued tube feeding at 6 months in both groups (p-values < 0.001) (Figure 3).

For those with continued tube feeding at 6 months post-discharge, 20 infants discharged with a NG tube underwent conversion to G-tube within 6 months after discharge. Median time of conversion to G-tube was 67 days (IQR 40–90 days) after discharge. Persistent poor oral intake was the most common indication (66.6%) for the conversion to G-tube, followed by concerns for aspiration (14.2%) and ALTE (9.5%). One infant discharged with a G-tube was changed to a NG tube 38 days after discharge due to recurrent cellulitis with excessive drainage due to poor stomal healing.

Discussion

This is the first study to examine post-discharge outcomes of both home NG tube and G-tube feedings in infants. We found that infants with home G-tube feeding had significantly more feeding tube-related complications requiring medical attention in the first 6 months after NICU discharge. Despite the potential for greater stability, 39.1% of G-tube related complications were due to inadvertent removal or misplacement. Many infants discharged with home NG tube feeds did not require tube feeding 6 months after discharge.

We chose to compare infants with home NG tube feeds to those with home G-tube feeds because of the clinical relevance of these groups. NG tubes and G-tubes are the most common types of feeding tubes used in infants. Once it is determined to discharge an infant with home enteral feeds, physicians and families must decide which feeding tube to choose. Prior studies have reported on only one type of feeding tube, however data regarding outcomes of both feeding tubes may help with this decision making.

We found that the majority infants discharged from the NICU with home NG or G-tube feeding have multiple comorbidities. Similar to reports in older children, our population reflects the medical complexity of infants requiring home enteral tube feeds.[9,16,19] Consistent with published guidelines for the provision of home enteral tube feeding,[20] families/caregivers of our study patients received education and training prior to discharge and had access to continuing medical support after discharge.

This study confirms that gastrostomy tube-related problems are common. Depending on the definition, complication rates associated with surgically placed G-tubes and percutaneous endoscopic gastrostomy (PEG) tubes have been reported to be as high as 83% and 44%, respectively, in children.[21] Our finding that one-third of infants with a G-tube had at least one ED visit and 9% had multiple ED visits indicates that many gastrostomy tube-related complications require increased medical attention. This finding is similar to other reports of increased healthcare utilization for gastrostomy tube-related complications. In a retrospective study of children with surgically placed G-tubes, 34.6% were evaluated in the emergency room for tube-related issues.[15] Recently, McSweeney *et al* reported that 25% of children with a PEG tube experienced either a major or minor tube-related complication requiring increased use of hospital resources or procedures mostly occurring in the first 6 months of life.[17] Our finding of 2 deaths occurring as a consequence of a G-tube complication also underscores the potential for life-threatening consequences associated with gastrostomy use.

In our cohort of infants, tube-related ED visits were three times higher in infants with home G-tube feeds compared to NG tube feeds. Ricciuto *et al* also found that older children with prolonged G-tube feeding were more likely to have tube-related hospital visits than those with NG tube feeding.[22] Similar to other reports,[14,15] inadvertent removal/misplacement of the tube was the most common cause of ED evaluation in those with G-tubes in our study. While NG tubes may be replaced by trained personnel in the home, replacement of a G-tube, particularly a primary G-tube that requires time to allow for the stomach to adhere to the abdominal wall, often requires a higher level of medical expertise. This may have

contributed to the higher number of ED visits in those with G-tubes in our study. A limitation of our study is that we could not differentiate between primary and non-primary G-tubes or assess whether home care nursing replacement of G-tubes was possible. It is also possible that infants with NG tubes may have sought medical attention at smaller facilities or clinics for tube replacement that we could not capture. Interestingly, even if visits for tube removal/dislodgement were excluded in our analysis, ED evaluations for other G-tube complications were still 8 times more than those in the NG tube group.

Although out-patient evaluations for possible respiratory complications, including ALTE and aspiration, were the most common reasons for ED visits in infants with home NG feeding, these complications were also seen in infants with G-tube feeding. Others have also reported respiratory complications associated with G-tube feeding in older children.[13–15] Even though aspiration is a well-recognized complication of NG tube misplacement,[11, 12] it is important to be mindful that this risk is not obviated with G-tube feeding.

We found that most infants discharged with home NG tube feeds were able to achieve full oral feeding by 6 months after discharge. Interestingly, despite the inverse relationship between oral feeding volume at discharge and continued tube feeding at 6 months, we also found that almost half of the infants with NG tubes who were orally feeding 25% or less of their goal at the time of discharge no longer needed their feeding tube at 6 months. These findings suggest that there may be a group of infants who could benefit from a trial home NG tube feeding if appropriate out-patient supports are in place; however, the potential to wean from tube feeds is influenced by factors beyond oral feeding at discharge. The retrospective nature of this study limits our ability to fully assess the impact of specific co-morbidities and the severity of comorbidities on the ability to develop oral feeding skills. Prospective studies are needed to increase our understanding of these important factors in order to better identify infants who may benefit from a trial of NG tube feeding.

A higher proportion of infants with a CNS comorbidity were discharged with home NG feeds and achieved full oral feeds in this study. This data seems to conflict with reports of prolonged need for supplemental tube feeds in older children with neurologic disorders.[23,24] We were not able to assess the severity or degree of impairment, and it is possible that infants with a CNS diagnosis were less impaired in the NG group. Alternatively, newborn neurologic function has been shown to exhibit considerable plasticity after injury,[25, 26] and our findings may reflect an inability to predict improvements in neurologic function in infants.

This study has limitations. We acknowledge that the NG tube and G-tube groups may not be entirely comparable. Although we chose these groups due to their clinical relevance, there may be other factors that influence the decision to place one type of feeding tube versus another. The retrospective nature of this study prohibits fully controlling for this potential selection bias. Next, it is a single-center study and may reflect practices unique to our institution. In addition, medical evaluations performed at other institutions or during clinic visits may not have been captured. Because our goal was to compare outcomes of infants with NG tubes versus G-tubes, we did not distinguish between different techniques for insertion or types of G-tubes. Future studies are needed to examine these factors in order to

improve the safety of gastrostomy tubes. Lastly, family perspectives and out-patient resources are important for optimizing patient-centered outcomes for those with home tube feeding.[27,28] Assessment of family preferences, access to appropriate home and out-patient support, and other themes relevant to the infant, parent, and family experience were beyond the scope of this study and need to be addressed in future research.

Conclusion

Short-term home NG tube feeding in infants does not appear to have any higher risk for tube-related complications requiring medical attention than home G-tube feeding. For capable families with access to proper community support and resources, home NG tube feeding may allow time for infants to improve oral feeding skills before undergoing an invasive procedure. Future prospective studies with patient- and family-centered outcomes and long-term follow-up are needed to better identify which infants may benefit from home NG tube versus home G-tube feedings.

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Abbreviations

NICU	neonatal intensive care unit
NG tube	nasogastric tube
G-tube	gastrostomy tube
ED	emergency department
GJ-tube	gastro-jejunostomy tube
TPN	total parenteral nutrition
CNS	central nervous system
GI	gastrointestinal
IQR	interquartile range
ALTE	apparent life-threatening event

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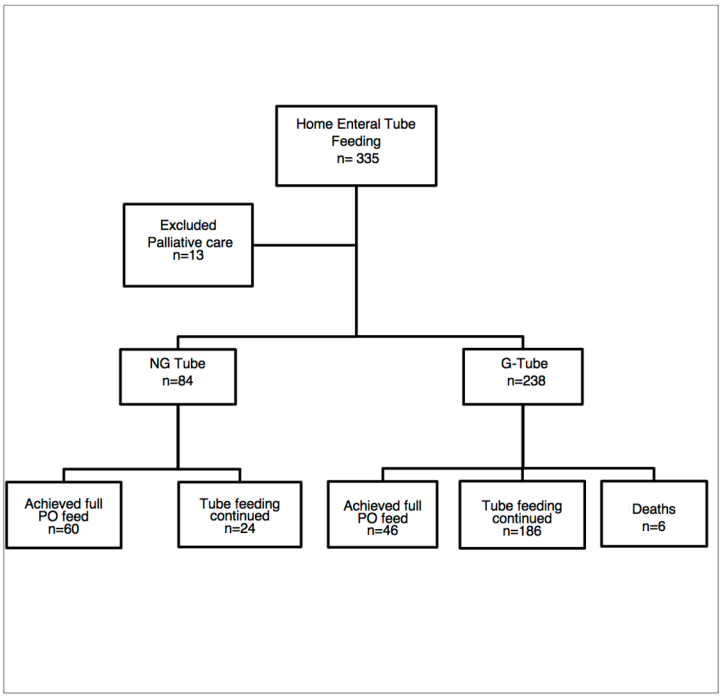

PO, per os; NG Tube, nasogastric tube; G-Tube, gastrostomy tube

Figure 1.

Flow chart of study patients with regard type of feeding tube and feeding outcome at 6 months post-discharge.

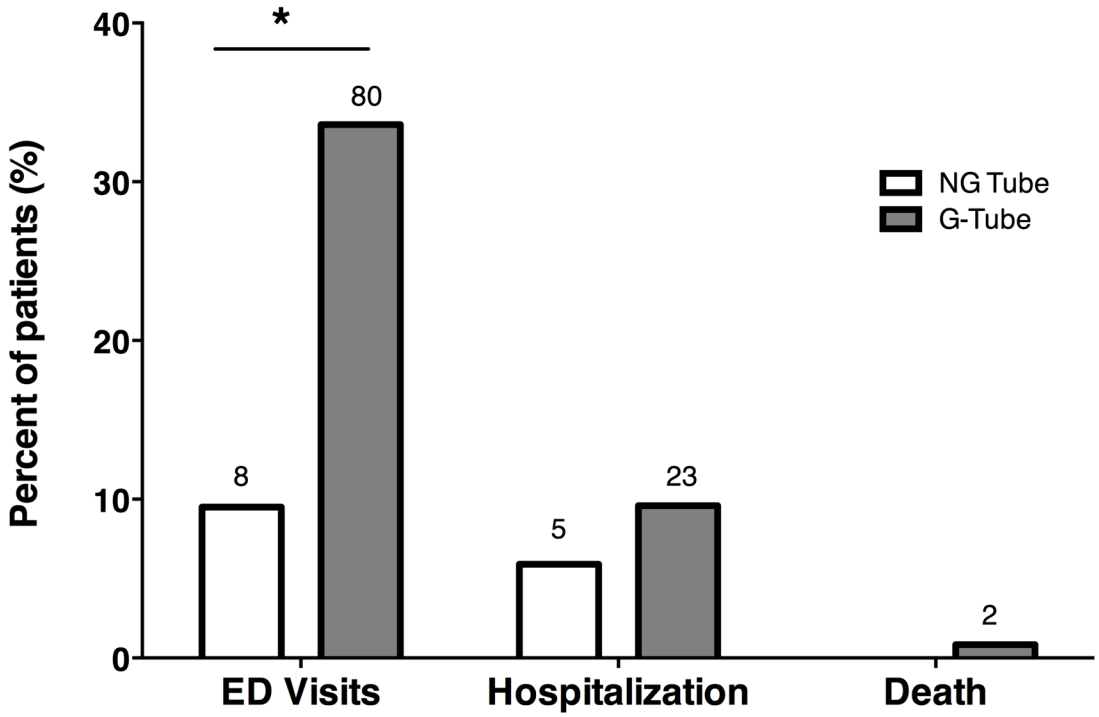

Figure 2.

Proportion of infants with tube-related complications requiring medical attention for each type of feeding tube. Numbers above the bars indicate the number of infants in the NG tube or G-tube group with tube-related emergency department (ED) visits, hospitalizations, and deaths. *P < 0.001.

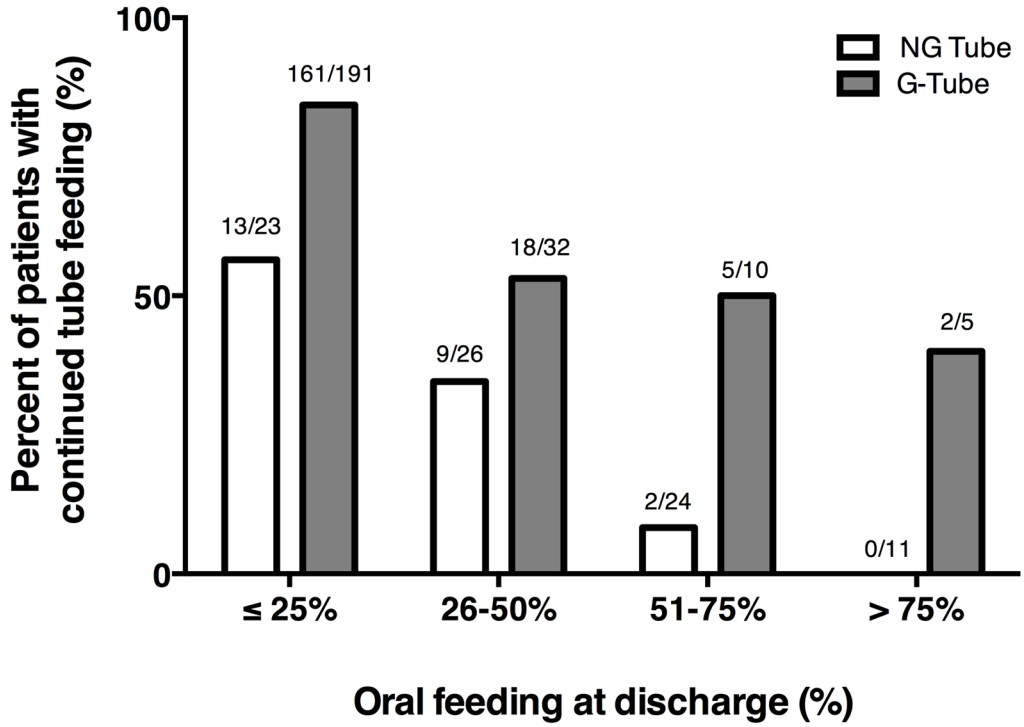

Figure 3.

Proportion of infants with continued tube feeding at 6 months within each category of oral feeding at the time of NICU discharge. Numbers above the bars indicate the number of infants in each group with continued tube feedings at 6 months divided by the number of infants in each group who were in each oral feeding category at discharge.

Table 1

Characteristics of Patients in NG tube and G-tube groups

Characteristic	NG tube n=84	G-tube n=238	P value
Gestational age (weeks)	36.0 (31.9 – 38.8)	35.9 (29 – 38.4)	0.37 [a]
Gender			0.01 [b]
Male	39 (46.4)	149 (62.6)	
Race			0.14 [b]
White	51 (60.7)	137 (57.5)	
Black	6 (7.1)	40 (16.8)	
Other	4 (4.7)	12 (5.04)	
Unknown	23 (27.3)	49 (20.5)	
Birth weight (kg)	2.7 (1.6 – 3.3)	2.3 (1.3 – 3.0)	0.02 [a]
Age at discharge (days)	47 (27 – 84)	75 (45 – 133)	< 0.001 [a]
Corrected age at discharge (weeks)	42.6 (40.5 – 45.7)	45.8 (43.5 – 49.7)	< 0.001 [a]
Co-morbidities [*]			
Prematurity	47 (55.9)	133 (55.8)	0.99 [b]
Central nervous system	32 (38.1)	54 (22.7)	0.01 [b]
Cardiovascular system	21 (25.0)	80 (33.6)	0.14 [b]
Respiratory system	37 (44.0)	122 (51.3)	0.26 [b]
Gastrointestinal system	34 (40.5)	91 (38.2)	0.72 [b]
Genetics/Metabolic	14 (16.7)	65 (27.3)	0.05 [b]
Renal	7 (8.3)	10 (4.2)	0.15 [b]
Other [†]	29 (34.5)	93 (39.1)	0.46 [c]
Oral feeding at discharge			< 0.001 [b]
≤ 25%	23 (27.4)	191 (80.3)	
26–50%	26 (31.0)	32 (13.4)	
51–75%	24 (28.6)	10 (4.2)	
> 75%	11 (13.1)	5 (2.1)	

NG tube, nasogastric tube; G-tube, gastrostomy tube

[a] Wilcoxon rank-sum test

[b] Chi-square test

[*] Some patients had more than one co-morbidity

[†] Includes all other diagnosis not covered in the above 7 categories

Table 2

Tube-Related Complications Evaluated in the Emergency Department

Enteral tube & complications	Frequency
NG tube	
Concerns for aspiration	3
ALTE	2
Inadvertent removal	1
Tube misplacement	1
Constant fussiness	1
G-tube	
Inadvertent removal/misplacement	45
Broken/malfunctioning tube	17
G-tube site issues	
Leakage of around G-tube	7
Site bleeding	5
Skin irritation	4
Granulation	1
Enlarge stoma site	1
Infection	
Cellulitis	9
Purulent discharge	2
Peri-stomal abscess	1
ALTE	6
Aspiration pneumonia	3
Constant fussiness	1
Vomiting	1
Gastroesophageal reflux	1
Gastric outlet obstruction	1
Visceral perforation	1
Enterocutaneous fistula	1

ALTE, apparent life-threatening event; NG tube, nasogastric tube; G-tube, gastrostomy tube

Table 3

Logistic regression for the outcome of continued tube feeding at 6 months post-discharge

Variable	Adjusted Odds Ratio	95% Confidence Interval	P-value
G-tube	4.18	2.21 – 7.89	< 0.001
Oral feeding volume at discharge	0.34	0.24 – 0.50	< 0.001

G-tube, gastrostomy tube